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Foreward

The African Journal of Computing & ICT remains at the nexus of providing a platform for contributions to discourses, developments, growth and implementation of Computing and ICT initiatives by providing an avenue for scholars from the developing countries and other nations across the world to contribute to the solution paradigm through timely dissemination of research findings as well as new insights into how to identify and mitigate possible unintended consequences of ICTs. Published papers presented in this volume provide distinctive perspective on practical issues, opportunities and dimensions to the possibilities that ICTs offer the African Society and humanity at large. Of note are the increasing multi-disciplinary flavours now being demonstrated by authors collaborating to publish papers that reflect the beauty of synergistic academic and purpose-driven research. Obviously, these developments will drive growth and development in ICTs in Africa.

The January 2014 Volume of the African Journal of Computing & ICTs contains journal articles with a variety of perspective on theoretical and practical research conducted by well-grounded scholars within the sphere of computer science, information systems, computer engineering, electronic and communication, information technology and allied fields across the globe. While welcoming you to peruse this volume of the African Journal of Computing and ICTs, we encourage you to submit your manuscript for consideration in future issues of the Journal.

Wishing you a productive reading

Thank you

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Mobile Ad-Hoc Network Performance in a Disaster Management Scenario

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ABSTRACT
A post disaster situation demands an efficient communication and coordination among rescue teams. Exchange of real time information among responders and emergency management centers is crucial for saving lives. In such scenario, MANETs are suitable for providing communication mechanism, as they are easy to deploy and do not require elaborate infrastructure. In this paper, we have considered that the relief and rescue operations in a post disaster situation are managed at three stages, viz: Disaster core location (incident-location), first aid treatment area and hospital area, with a relief ambulance as a link between them. The communication between the stages is considered to be provided by a MANET based network setup. Mobility of MANET nodes between the three stages has been modeled with Reference point group mobility (RPGM) based on attraction level. Performance of ad hoc network is analyzed for reactive (AODV [1, 2]), proactive (OLSR [3]) and hybrid (ZRP [4]) protocols. Our simulation studies conducted on Qualnet indicates that both the mobility model and routing protocols affect the communication between the stages.

Keywords: Post disaster mitigation, MANET, Mobility model, AODV, OLSR, ZRP, RPGM.

African Journal of Computing & ICT Reference Format:

1. INTRODUCTION
Disaster situations have been seen to be transitive and the mitigation process constitutes an important phase. Mitigation involves handling of casualties that arise from disaster. In post disaster mitigation management, relief teams cannot rely on existing infrastructure because there is high probability of bursting of whole communication backbone. With the advent of MANETs, a rapid deployment of infrastructure is possible. A mobile ad hoc network (MANET) consists of wireless mobile nodes that are mobile and self-organized.

Performance of a MANET system depends on mobility modeling [5, 6, 7]. In the past post disaster management scenarios have been analyzed under different framework and mobility models. In most of these works random waypoint mobility model has been used to analyze MANET performance. In this paper, we have proposed a three layered framework to model post disaster management scenario. A better depiction of nodes movement can be obtained through RPGM, which has been used in our simulation.

The organization of the paper is as follows. In the next section we describe the current scenario and background of the topic. In the subsequent section we propose a three layered framework for disaster mitigation scenario to figure out architectural and performance characteristics.

These performance characteristics are measured and modeled for catastrophic situations like disaster. The next section describes the features of the proposed framework, followed by logical setup of framework in the next section. In the subsequent section performance evaluation of the routing protocols and mobility models is provided. The proposed mobility-model pattern by rescue teams is also evaluated. We also examine the performances delivered by proposed framework to comply with the use of standard routing protocols on our defined set of metrics with predefined cases. Finally we conclude the work with future prospect.

2. CURRENT SCENARIO
In general, a disaster can be classified into two major types - natural disasters, such as an earthquakes, tsunamis, and floods, and Anthropogenic (Human-Induced Disasters) such as war and terrorism. Effects of these disasters could be extremely damaging to the infrastructures, causing environmental degradation, disease, hunger and death. Here, we mainly focus on impulsive natural disasters, such as an earthquake. In post disaster situations, our intention is to provide quick disaster response and recovery. It’s a complex process requiring a wide range of resources to ensure the safety of the population and the recovery of the affected area. Many disasters took place in recent past.
The Gujarat Earthquake in India caused 20,000 casualties and 166,000 thousand injuries (according to NIDM, India). The disaster response and recovery effort required approximately 2 thousands Crore rupees in disaster response and recovery funds. Over 25,000 emergency personnel were deployed throughout the region (according to PIB, Govt. Of India) [8]. The Tsunami of 2004 was triggered by an earthquake on the ocean floor. It badly affected Indonesia, Sri Lanka, India, Thailand, Maldives, Somalia, Myanmar and Malaysia. The number of casualties exceeded 162,500 with major brunt taken by Indonesina (CRS Report for Congress) [9]. It required approximately 6,000 military support personnel, 10000 contractors and 6000 volunteers for the relief operations.

The magnitude of these disasters in terms of government resources and lives affected, demonstrates the need for fast, efficient response and recovery.

2.1 State of the art
A concise inspection of past few years’ works on emergency Ad-hoc network covers mobility, performance metrics and routing. A considerable amount of work has been done on the area of emergency mobility framework. The researchers have chosen random way point mobility model [10] and analyzed the general performance characteristics.

Meissner et.al [11] developed requirements and technology for integrated disaster management communication and information system. In particular they addressed network configuration, scheduling and data management issues during the response and recovery phases. The design issues and architectural concepts for an integrated disaster management system are identified. An infrastructure is provided that allows for horizontal and vertical information flow from the officer or fireman on the scene up to the central operations staff by means of a multi-level wireless voice and data communication infrastructure. The network hardware includes terrestrial trunked radio or satellite technology for wide area communication, wireless LAN ad hoc networks for disaster site hot spots, and personal or body area networks for frontline personnel, allowing them to act as data sources and sinks by means of smart connected devices, e.g. robust mobile terminals and sensors.

A Graph based approach was used by Stepanov et.al [12]. The instantiation of the Graph Walk Mobility Model is similar to the Random waypoint mobility model but the model uses a graph representing the spatial environment in the Spatial Model. The model relies on the Spatial Model to reflect spatial constraints of user movement imposed by the environment. The Model provides a map of the area containing its topological elements. To offer a standard interface for data access and to reuse existing data sources, the spatial model is built on top of existing standards for describing environments in digital form.

A pixel oriented approach for mobility modeling was used by Kraaier et.al [13]. In this model mobility parameters namely transition probabilities is calculated to reach the predefined stationary user distribution. The simulation area is divided into small parts and performance is evaluated. Kim et.al [14] uses a trace based approach. Here a foundation is provided for real user movements by exploring mobility characteristics in traces of mobile users. A method is presented to estimate the physical location of users from a large trace of mobile devices associating with access points in a wireless network. Based on the extracted mobility characteristics, a mobility model is developed, focusing on movements among popular regions.

In 2006 an innovative software infrastructure (software, models, services etc.) was built and developed by Mecella et.al [15] for supporting collaborative work of human operators in emergency/disaster scenarios. Here the whole team is considered to carry on a macro process and the different teams (of the different organizations) collaborate through the interleaving of all the different processes. The idea is to investigate a 2-level framework for such scenarios: a back-end peer-to-peer community, providing advanced services requiring high computational power, data-knowledge-content integration, and a set of front-end peer-to-peer communities, that provide services to human workers, mainly by adaptively enacting processes on mobile ad-hoc networks.

A work pad architecture consisting of two layers (front and back end) was developed by Catarci et.al [16] in 2008. The back end is a P2P network that lets front end teams collaborate through information exchange and coordination. Work pad employs user-centered techniques from human–computer interaction paradigms. User centered design relies on continuous interaction with end users to understand how organizations are arranged during disasters, what information is critical, and how teams exchange this information among themselves and with their operational centers.

The causes that paralyzed the entire communication systems in Taiwan earthquake was analyzed by Jang et.al [17]. In this paper a MANET based communication platform was proposed. It included a Rescue Information System for Earthquake Disasters to support a large number of rescue volunteers under catastrophic natural disasters. The platform is designed and implemented using MANET. Rescue people, voluntary or mission-specific professional could use their own notebook PCs to construct a multi-hop ad-hoc network to form a basic wireless intranet first. On top of this MANET based emergency network platform, a Rescue Information System for Earthquake Disasters (RISED) is implemented to support rescue operations for catastrophic earthquake disasters. The system consists of Disaster Assessment Subsystem, Fastest Rescue Route Generation Subsystem, Health Care and Relief Resources Integration Subsystem, and Wounded Victim Arrangement Subsystem.
Mobility patterns play an important role for performance evaluations of mobile networks. To simulate user movement, existing simulation tools provide only a few simple mobility models (e.g., random movement) suitable for particular scenarios. There is no environmental heterogeneity available in any form in these models. In reality, these models do not fit for disaster areas due to their mobility specific assumptions. Our proposed post disaster mitigation model framework features attraction point group mobility [16] (group movement based upon the attraction point). The group of nodes movement orientation is basically through group leader with the same attraction features. Nodes are only allowed to move along the predefined paths. Each node searches for the possible attraction points to visit. Each attraction point has its own attractivity value. Attractivity value is a uniform random number between 0 and 1. We have designed three cases to test out the mobility framework performance in terms of packet transfer under the standard Ad-hoc routing protocols namely AODV, OLSR and ZRP.

3. PROPOSED LAYERED FRAME WORK

In post disaster situations, effective management depends upon communication amongst affected public, protection forces, rescue teams including some out-sided teams (NGO’s) and fire brigades. In such situation teams cannot move around random fashion. There is one head or a group of best trained personnel (tactical operational command). They are responsible for where and how to move because moves are determined by well-defined strategy. These strategies are mostly based on the layered framework or architecture which we have designed in figure 2.

It is a three layer architecture which includes DCL (disaster core location) as layer-1, FTL (first treatment location) as layer-2, HL (hospital location) as layer-3. Disaster effective area and its neighborhood are divided into special areas as disaster core location, first treatment location, hospital location etc. The second layer has some sub layers like transport units & TOC (Tactical operational command) unit. Layer 1 is the core disaster area location which also has some out-side teams (Govt. /NGO teams). Layer 2 is the first treatment location/casualties handling, here teams provide first-aid treatment for injured & sufferer and layer3 is the hospital location. In figure 2 bi-directional bold arrows shows the path of the vehicle or transport units which carry affected and injured people & bring them to the second layer. The second layer area has two places: waiting for treatment area and the casualties handling, where first aid treatment is provided. Finally they are moved to hospital location. In the case of layer1 & layer2 most of the support is provided by push to talk & push to speedy move by common pedestrians who are present in above layers after the disaster. There can be delay in transports units to handle everyone on time. This delay is significant and meaningful for saving life at the time of disaster. In general terms teams take up sufferer and transport them on direct way to 3rd layer (hospital location). Here we have taken ad-hoc network supportable entities (nodes). Mobility of nodes shall be in group. In our framework we explore this model and routing of nodes based on attraction point and level of severity, layer to layer. We have taken transport nodes (ambulance) to each and every layer because at the time of emergency there might be the possibility of availability of ambulance near to the incident core location. At the time of moving, there is the possibility of ad-hoc communication sink, due to obstacles. Due to the complexity of the framework, we have left it for future work.

4. FEATURES OF FRAMEWORK

The desired features or characteristics for post Disaster mitigation scenario includes:

(i) Group/Team mobility

(ii) Heterogeneity

(iii) Routing algorithms for entities and their performance.
4.1 Group mobility

In disaster scenario, the rescue task is always performed as an integration of various teams or groups. Group mobility model stands for the team or group movement in the real scenario, where either a function creates group behavior or the nodes are somehow arranged with a group leader [16]. In our framework, we have considered attraction/reference point group mobility model [18, 19].

**ATTRACTION/REFERENCE POINT GROUP MOBILITY MODEL:** It is spatial dependent [20, 21] and the movement of a node is influenced by the node around it. In disaster mitigation operation, team collaboration has to exist and the users are likely to follow the team leader. Therefore, the mobility of mobile node can be influenced by other neighboring nodes too. Since the velocities of different nodes are correlated in space, thus we call this characteristic as the Spatial Dependency of velocity. In this, each group has a center, which is a logical center or a group leader node. The movement of the group leader determines the mobility behavior of the entire group. The logical function of group leaders and group members are described below:

In Figure 3 $\mathbf{V}_{\text{group}}^t$ is the motion vector for the group leader and the whole group. $\mathbf{R} \mathbf{M}_i^t$ is the random deviation vector for group member $i$, and the final motion vector of group member $i$ is represented by vector $\mathbf{V}_i^t$. With appropriate selection of predefined paths for group leader and other parameters, the RPGM model is able to emulate a variety of mobility behaviors, according to mobility scenario [16].

Figure: 4 group mobility view

All nodes belonging to the same group tend to have same movement tracks. However, inside the group, members also have relative mobility. This mobility makes two vectors

1. Group mobility vector, which is shared by all members of the same group.
2. Internal mobility vector, which represents the relative mobility of a node inside the group.

The vector sum of the two mobility vectors decides the mobility of the node. In figure 4 we have presented the 180° view for movement of groups in disaster scenario. Four green corners show the safe zone, as layer2 of our mobility model. Red center point shows disaster core location as layer1 of our mobility model. Small covered area on the path which includes 4-5 nodes show groups/teams and the simple black point show normal pedestrians movement to and from disaster core location.

4.2 Heterogeneity

In this paper we consider heterogeneity in terms of 3 environment values.

1. Movement of nodes: Normally we consider movement on a plane, but in hilly areas it will be more suitable to consider the movements in height also.
2. Path followed/Routing: There can be situations when the link which was followed recently, is not available now.
3. Density of nodes. The number of peoples at the disaster location may also vary depending on the geographical location of the site.
4.3 Routing procedure
The protocol selection for routing is based on the scenario support. Here we have taken few assumptions like entities or group of entities tend to move towards a specific destination area (inter or intra layer movement) & follow a defined path used for movement and pause time of the nodes is taken as a monotonic function. To test the mobility frameworks performance we have considered AODV, OLSR and ZRP. This selection has been done choosing one from each group: Proactive Routing Protocol, Reactive Routing Protocol and Hybrid Routing Protocol.

5. LOGICAL SETUP OF FRAMEWORK
In section 3 we proposed a three layer architecture which includes DCL (disaster core location) as layer- one, FTL (first treatment location) as layer 2, HL (hospital location) as layer 3. It means whole simulative area is sub divided into three sub layers. Logically simulative area Adis has three sub layer areas “a”, each of which is represented as a tuple mentioned in the figure 5.

Each tactical area “a” has dual entry-point En and an exit-point Ex. Transport nodes move from one layer to another layer following cycle path Ztr choosing one velocity of the interval Vtr for the whole cycle. The cycle depends on the layer the node is assigned. For example in figure 6 the cycle for the transport nodes of first and second layer area is: Ztr = rand-Ex, rand-En, FTL, rand-Ex, rand-En. For rand and FTL the node waits for a uniformly distributed pause time chosen from Ttr. This models the first aid and the handing over of a patient. Here rand represent the randomly selection of any one path for movement from layer to layer.
6. PERFORMANCE EVALUATION OF PROPOSED FRAMEWORK

The Post disaster mitigation mobility scenario may consist of high speed, low speed nodes or a mix of both. Speed for slow nodes (pedestrians) ranges between 1-1.5 m/s and fast nodes (vehicles/transport) ranges between 5-15 m/s. In the proposed model there are two important aspects: Attraction points for nodes from layer to layer and grouping behavior [22] (people influence each other’s mobility, clustering in groups, avoid colliding with each other). Due to the complexity of the collision-avoidance parameter, it is not considered in the simulation model. It can be taken up as a future work.

6.1 Simulator

Various N/W- simulators such as NS2 [23], Qualnet[24] and OPNET [25] are surveyed and Qualnet 5.0 is chosen due to the fact that it allows simulation of complex networks and includes all advanced wireless model library with other supportive Ad-hoc networks library. Qualnet supports the random waypoint, reference point group mobility model along with user defined trajectories.

6.2 Simulation Model

In this paper we have considered a model based on attraction which is built on the concept of reference point. Two cases have been studied viz: nodes taken as a single group and nodes taken as multiple groups. The first case is the normal motion of nodes, considering the whole network as a single group. Here a common motion policy applies to whole group. The second case is considered by dividing the whole network in groups of average size 4. It is based on group mobility. Here, we have considered groups of mixed pedestrians and vehicles based on speed. The parameter “MIX” indicates a mixture of 25% vehicles group (5-15 m/s) and 75% pedestrians group (1-1.5 m/s). For these models, we set group parameter (specified by velocity-matching, and expressed in the fraction of nodes that exhibit the specified group behavior) [26] indicating that every node acts in confirmation to group behavior.

For both these cases 3 sub case has been considered based on attraction. The attraction/reference points of the model provide proper predefined reference paths to the nodes or group of nodes for moving from one layer to another. In order to take the advantages of Reference point group mobility (RPGM) [13, 14] in our framework, we have included it in our simulation. The target of this simulation is to point out the ways in which attraction points change routing algorithm behavior. Here node speed has been chosen to be uniform between 1 and 15m/sec. The three sub cases are as follows:

Case a: It represents the movement of nodes to a fix flagged single attraction point, and back to their original position. It is a cyclic movement which mainly covers vehicle node movement from incident location to hospital location for carrying sufferer and then moving back to original position for remaining sufferers.

Case b: It represents the movement of nodes, by arbitrarily opting one, among the three attraction points and back to their original position.

Case c: It represents the movement of nodes, by arbitrarily opting one among three attraction points and then move to another randomly chosen attraction point. It is a transitive movement.

For these two models we have evaluated the influence of framework on the performance of MANET routing protocols. The simulation model includes 50 mobile nodes movement in an area of 1500m x 1500m. The whole setup is divided into three layered areas. In the initial position the nodes are distributed as 20 for DCL, 12 for FTL and 8 for HL (among these 4-5 nodes behave as an ambulance or speedy vehicle in each layer). Remaining nodes are treated as external input for the DCL with pedestrian speed. We have used two ray ground propagation models. Each node in the simulation has a radio transmission range of 180m with MAC protocol as IEEE 802.11b Wireless LAN (10 MBit per second). The data traffic with transport protocol UDP has been considered. The parameters for traffic pattern and framework scenario are given in Table 1.

<table>
<thead>
<tr>
<th>Traffic pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packet Size</td>
</tr>
<tr>
<td>Packet Rate</td>
</tr>
<tr>
<td>Data traffic</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameters for the framework scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
</tr>
<tr>
<td>No. of nodes</td>
</tr>
<tr>
<td>Min. speed</td>
</tr>
<tr>
<td>Max. speed</td>
</tr>
<tr>
<td>Average number of nodes in a group</td>
</tr>
<tr>
<td>radio transmission range</td>
</tr>
<tr>
<td>pause times</td>
</tr>
<tr>
<td>Simulation time</td>
</tr>
<tr>
<td>Antenna Model</td>
</tr>
<tr>
<td>propagation model</td>
</tr>
</tbody>
</table>

6.3 Performance metrics
Here we evaluate two parameters for performance evaluation of the proposed framework namely packet delivery fraction (PDF) and normalized packet delivery fraction (N-PDF). PDF gives an estimate of efficiency of communication network in terms of Packets sent and received. Since in our model, we have considered group movement for disaster core location, first aid treatment area and hospital area hence it is important to study the group behavior in terms of packet delivery fraction. The parameters evaluated are

- **Packet Delivery Fraction (PDF):** PDF is the ratio of the number of packets originated by the application layer sources and the number of packets received by the destinations. It describes the loss rate.

\[
\text{Packet delivery fraction} = \frac{\text{Data packets received}}{\text{Data packets sent}}
\]

- **Normalized Packet Delivery Fraction (N-PDF):** packet delivery ratio normalized to the non-group variant of each scenario.

\[
\text{Normalized packet delivery fraction} = \frac{\text{PDF for group movement}}{\text{PDF for non-group movement}}.
\]

### 7. RESULTS

#### 7.1 Effect of nodes considered as a single group.

The attraction/reference points of the model provide proper predefined reference paths to the nodes or group of nodes for moving layer to layer. In order to take the advantages of Reference point group mobility (RPGM) [18, 19] in our framework, we have included the same. The target of this simulation is to point out the ways in which attraction points change routing algorithm behavior. Here node speed has been chosen to be uniform between 1 and 15m/sec.

Figure: 7-a

Figure: 7-b

Figure: 7-c

Figure: [7-a, 7-b, 7-c] shows the packet delivery ratios for AODV, OLSR & ZRP for the defined cases.

#### 7.2 Effect of nodes considered as multiple groups.

For the mobility cases discussed above, results have been plotted in figure 8. We have plotted the PDR (packet delivery ratio), normalized to the non-group variant of each scenario. The normalization is done with respect to the previous scenarios with nodes having maximum speed 15m/s. Here “Case ’x’ MIX_GM” stands group mobility variants of mixed pedestrians / vehicle scenarios for particular case ‘X’. We observe that group settings have impact on routing protocols, particularly for AODV.

“Case a MIX_GM”, corresponds to group mobility for case ‘a’. “Case b MIX_GM”, corresponds to group mobility for case ‘b’. “Case c MIX_GM”, corresponds to group mobility for case ‘c’.
This is due to the fact that as the pause time increases, the network topology becomes relatively stable and hence the number of stale routes in the routing tables decreases. Thus route discovery and maintenance takes less time. In the case of group movement the performance increases. Hence it can be said that AODV supports RPGM in defined ways.

**OLSR:** It works proactively (i.e. the routes are established before packet transmission). The group motion does have a profound effect on OLSR, as can be observed through results. With the increase in pause time the mobility of the nodes decreases resulting in decreased congestion, and hence PDR decreases. Since some of the cases are highly dynamic, the performance of OLSR degrades in these cases. In general its performance is better than AODV. The performance is average in almost all the cases but the Packet delivery ratio is higher than AODV and ZRP for group motion.

**ZRP:** ZRP being a hybrid protocol behaves differently. It works proactively in the starting but gradually changes to reactive mode, and the effect of this shift can be observed in the results. With group mobility the performance increases showing that it supports group motion. In certain cases (e.g. case c), performance is not good because the nodes are highly dynamic in this case.

**8. CONCLUSION & FUTURE WORKS**

This paper demonstrates and evaluates the framework for post disaster mitigation mobility at rescue operation by rescue teams. We have simulated framework of mobility with three MANET routing algorithms ZRP, AODV and OLSR. Here we have used the concept of attraction points for the model. Using these points the mobility scenarios are designed. We have taken reference or attraction point’s concept to make the advantage of reference point group mobility inside our post disaster mitigation mobility model.

Our simulation shows that Manet routing algorithms behaves significantly different under the mobility scenarios designed on the same platform. For analyzing the performance of routing protocols in practice, such a scenario-based approach is vital. In future works, the level of severity of the disaster can be increased by addition of real temptation effect (e.g. obstacle avoidance in mobility and layer to layer movement through shortest path) on mobility in post disaster scenario as well as trying to add environmental effect like temperature and pressure with the use of sensors network.
REFERENCE


Nomenclature

1. **RPGM**: Reference Point Group Mobility model.
2. **DCL**: It is the Disaster Core Location i.e. the site at which disaster has occurred.
3. **FTL**: It is the First Treatment Location i.e. the place where the victims are given first aid.
4. **HL**: It is the Hospital Location for providing health services to the victims.
5. **TOC**: Tactical Operational Command.
6. **V**<sub>group</sub>: It is the motion vector for the group leader and the whole group.
7. **RM**<sub>i</sub>: It is the random deviation vector for group member i.
8. **V**<sub>i</sub>: It is the final motion vector of group member i.
9. **A**<sub>dis</sub>: It is the logically simulative area.
10. **a**: It is the sub layer of logically simulative area **A**<sub>dis</sub> and there is three such sub layers.
11. **Lr** ∈ **{DCL, FTL, HL}**: It is the tactical classification of the sub-area **a**.
12. **Pr**: It is a part of the simulative area **A**<sub>dis</sub>.
13. **En**: It is the entry point for the layer.
14. **Ex**: It is the exit point for the layer.
15. **Ntr**: It is the set of transport nodes.
16. **Vir**: It is the velocity interval {Vmin; Vmax} for the set of nodes **Ntr**.
17. **Ttr**: It is the time interval {tmin; tmax} for pause time of **Ntr** nodes.
18. **Gtr**: It is the size of groups.
19. **Ztr**: It is a sequence of points of the transport nodes.

Authors' Briefs

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A Scalable Online Crime Reporting System

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ABSTRACT
Crime is part of human activities and needs to be managed. No human society has ever been totally free of deviants and it is unlikely that society will ever be. The more populated and complex a society becomes the wider the range of anti-social conducts that must be controlled by the government through the armed forces and other agencies especially the Police Force. The incident-based system reports on a much broader range of crimes and includes data on the circumstances of the crime, the victim, and the defendant. The current crime reporting system is faced with several difficulties as there is no instant means of reporting crime other than telephone calls, messaging or perhaps face-to-face which is usually cumbersome especially where the reporter wishes to keep anonymity. The proposed crime reporting system aims to assist the Nigerian Police in their bid to solve crimes in a manner that will be useful to the Nigerian Police Force (NPF). Crime is geographical. It occurs at a specific place, specific time and for a specific reason. It can affect everyone and anyone at any time [3].

Both Information Technology (IT) and crime are complex and constantly changing. Social and technological changes introduce new targets, tools and motives for crime. E-crime targets include confidential information, technical infrastructure and denial of service. Improved and faster technology and worldwide communications make it easier to both organise and conceal crime. Software to help criminals is available, even as commercial products: criminals have used attack-testing software to probe the security of target systems. Motivations now include terrorism and revenge as well as traditional desires for financial gain.

1.1 Problem Statement
Crime is part of human activities and needs to be managed. No human society has ever been totally free of deviants and it is unlikely that society will ever be. The more populated and complex a society becomes the wider the range of anti-social conduct that must be controlled by government using police power. The incident-based system reports on a much broader range of crimes and includes data on the circumstances of the crime, the victim, and the defendant [3]. The current crime reporting system is faced with several difficulties as there is no instant means of reporting crime rather than telephone calls, messaging or perhaps face-to-face which is always cumbersome in a case the reporter might want to keep anonymity. To strengthen crime reporting system, an online based system will report on the:

- type of loss (e.g., stolen, vandalized);
- type and description of the article;
- its value;
- type of crime (e.g., theft, burglary, assault).

Terrorists might not be rational in their motivation; casual opportunists look for an open door; organised crime will evaluate potential gains against investment – which might be massive if the potential rewards are attractive enough [4].

Keywords: Crime reporting, incident-based, victims, criminals.

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The Nigerian Police Force is a security outfit of the Nigerian State established to combat crime and ensure security of lives and property of the citizenry.

2.1 Crime Management

The occurrence of crime is not random. It is spatially distributed in patterns some patterns are discovered while others are not. Factors such as social class, income level and environment play parts in the types of crime that are committed. Resources and/or a lack of resources can influence the probability of crimes committed in any given area [5]. Because of the complexity of crime, crime has to be managed. Crime as various definitions depending on which perspective one is looking at it from. For this research crime is defined as “violation of law, or an instance of this, punishable by the state,” [6]. Management on the other hand is the process of directing and controlling the resources of an organization such as its personnel, materials, and equipment to achieve the goals of the organization. Crime management is therefore defined as controlling, directing, and coordinating police resources (money, equipment, and personnel) to prevent the violation of law and where it has been violated, to apprehend the criminals and take them to court.

2.2 Blueprint for Citizen Patrols

Citizen patrols are volunteers who survey an area to report incidents and problems to the police and provide a visible presence that deters criminal activity. Some use bicycles, motorcycles, vans or cars to cover large areas. They generally have no policing powers, carry no weapons, are non-confrontational, and always coordinate with law enforcement. Citizen patrols can cover a village, a neighborhood, an apartment complex, a business district, or a park. They contact the police dispatcher or crime desk through two-way radios or cellular phones donated by a local business. Cameras or video equipment may be used to record suspicious activity. Many are based in a Neighborhood Watch group.

The citizen patrol should:

- Undergo training by law enforcements
- Work in teams
- wear identifying clothing or ID
- Never carry weapons such as guns or knives
- Always carry a pad and pencil, and a flash light if it is dark
- Be courteous and helpful to residents of the area being patrolled
- Keep logs and file reports

Citizen patrols can take on extra duties, such as escort services, traffic control, and crowd control at community events, identifying neighborhood nuisance concerns, checking on homebound residents, and identifying and reporting abandoned vehicles.

2. RELATED WORKS

The review of literature is a critical crossroad in any research effort, it presents new windows of opportunities to re-assess the knowledge base for the purpose of expanding the frontiers of intellectual horizon. Knowledge cannot and does not exist in an intellectual vacuum, a vigorous blend of knowledge through the review of other scholarly works add a touch of value to the research activity by giving it a crucial underlay of thoroughness thereby providing an escape route from merely restarting knowledge. It provides the researcher an opportunity to add to the existing stock of knowledge with subsequent sustenance of the upward trend of the knowledge base and thus opens a wholly new vista for knowledge accumulation.
2.3 Crime Education
According to [3] in a crime summit, he lays much emphasis was on Crime Education. To start or strengthen a crime reporting system, you need:
- Committed people
- A system for both anonymous and face-to-face reporting
- Education for those who run the system, handle reports and respond helpfully to victims
- Education for the school or neighborhood on what to report, how to report, and why to report

Education for those who run the system includes teaching those who might receive crime reports in how to take a useful report, how to treat reports confidentially, how to help victims, and how to teach others to use the system. Operational details of the system, such as how often reports are collected, what information is vital for a report to be useful, and what happens to a report once it's received are important for this group.

Education for those who use the system on what should be reported - specific kinds of crimes or crimes-in-the-making, tips about who committed particular crimes, and so on; information that the report should contain; how to report crime when time is critical, what will happen to reports, and how reporting helps prevent crime and build a sense of security.

Education can happen in many ways - fliers and brochures advertising the system, presentations at assemblies or in classes or meetings, videos that can be shown at meetings or in classes, posters throughout the area, bookmarks, and articles in the local paper are few examples.

2.4 Crime Reporting

The previous findings are enough to convince readers of the relevance that reporting behaviour has for the criminal justice system and the community. Citizens, through the reporting of their crime experiences, start the criminal justice machinery which in turn enables investigation of crimes by police, the prosecution and trial of offenders, and their punishment. The deterrent effect of criminal justice is potentiated as well. On the other hand, non-reporting precludes access to compensation schemes, offenders not being arrested, and the goal of a more equitable criminal justice system being achieved [7].

However, not all the victimization incidents are crimes in a technical sense, and of those which are, some are very minor indeed. The police will complete criminal offence reports in only a small number of these incidents. Increased willingness to report what people perceive as crimes would result in increased police efforts in dealing with minor incidents, not all of which may result in satisfactory outcomes to the victims; an issue with potentially negative consequences for the reporting of perhaps more serious future incidents. Crime victimisation is an expression of social conflict [8].

Reporting of perceived victimization experiences to the police depends upon a complex set of factors ranging from seriousness of incidents to confidence in the criminal justice system. A more complete understanding of non-reporting, its distribution and its correlates will help us assess the performance of our criminal justice agencies [9].

Reporting Methods
Effective methods of anonymous reporting include [7]:
- The tip box
- The telephone coupled with an answering machine or voice mail
- E-mail to a central address
- A web site that directs reports to a central address
- Oral reports

The tip box usually consists of several locked boxes at key points around the school or neighborhood. Each box has a slot for inserting written reports. Boxes need to be located in places that are reasonably populated - not deserted and not in the middle of heavy traffic. The box (and education about using it) should remind students and citizens of what's needed for a good report - a dated, legible note describing as much as possible what happened where, when, how and by whom.

Advantages of the tip box include low cost, low reliance of technology, and written records. Disadvantages include unreadable reports and limited access. Tip boxes also require that someone physically visit and collect reports from each of the boxes.

Telephone reporting systems offer a number of variations. Some include a toll-free line directed to a cell phone. Some reporting lines are partnered with a hotline. Calls left on a voicemail or answering machine can be retrieved from anywhere. The report taker doesn't have to visit boxes. The telephone approach allows students to call from school, from home, from a friend's or from a pay phone. People tend to be comfortable talking on the phone, so this approach leaves no lasting record of the report, unless messages taped or transcribed and checked for accuracy. It also requires resources - funds or in-kind donations for the equipment, the telephone service, and a secure area in which to house the equipment.

E-mail and web sites have proved successful in reaching out to those who are electronically literate. Some systems have both an e-mail box and a web site for crime reports. Both e-mail and web approaches can provide printed reports to send to appropriate authorities. There are drawbacks - setting up the web page or e-mail properly (though a youth can probably provide help). The fact that many Nigerians still may not have convenient access to computers and the need to ensure security of the system to protect reporters' anonymity is required at all cost.

Written and oral reports have the advantage that many people trust the human link more than the plastic box or the electronics of phones and e-mails.
Education about crime reporting is an ongoing process. New participants come in every year; the system acquires new features; or reporting methods change. Education should target adults in the community as well as young people. It should emphasize the preventive power of reporting, not just the need to report crimes that happened or information on criminal suspects.

2.4 New Technology of Crime Prevention

Crime prevention is a concept that has been applied in a number of ways to the problem of crime: it has been used to refer to both activities (e.g. crime prevention programs and/or strategies) and outcomes (e.g. lower levels of crime in communities and/or lower levels of offending/re-offending by individuals). In the name of crime prevention, researchers have examined the influence/role of formal social control mechanisms (e.g. the deterrent effects of police, courts, and corrections) and informal social control mechanisms, with a focus on the influence (through mechanisms such as attachment, commitment, and involvement) of family, peers, school, work, community and the role of shame and belief systems/religion). In addition, crime prevention strategies have been targeted on different levels of prevention (primary, secondary, tertiary) and on the need for individual (i.e. private actions), parochial (group actions by neighborhood residents), and public actions (i.e. decisions to call the police) to prevent crime. Understanding crime prevention requires studying intentions, as well as consequences.

A broad array of measures needs consideration beyond the traditional number of criminal events or offenders. Additional factors include the amount of harm prevented or the number of victims harmed or harmed repeatedly [10],[11],[12]. An even broader definition of crime prevention can be seen in the concern with newer factors such as reduction of risk factors for crime (e.g., gang membership or failure to complete high school). While crime prevention currently is used as a ubiquitous, catch-all phrase that can be applied to both criminal justice-based and non-criminal justice-based initiatives, our focus is on strategies that utilize new technological innovations to either prevent crime (in particular places) or prevent re-offending by targeted groups of offenders (e.g. sex offenders, mentally ill offenders,) that do not rely exclusively on traditional actions by the police (arrest), courts (prosecution), and/or corrections (punishment, control, reform).

2.5 New Technology of Policing

Changes in both the hard and soft technology of policing appear to be transforming local, state, and federal policing departments in a number of fundamental ways; but some scholars have raised questions about how much has really changed [12]. Two recent reviews [10], [11] of technology and the police describe this transformation process, review the evidence of its impact on police practices and outcomes, and discuss the implications of technological changes in policing for the public. The following conclusions were arrived at: police technology has not been found to significantly improve police performance [10], [12].

Similar assessments of the limited measurable impact of police technology on police performance have been reached by others who have reviewed the available research on the impact of recent technological innovations on police performance [12].

3. REQUIREMENTS DESIGN AND SYSTEM DEVELOPMENT METHODOLOGIES

The existing system in which a victim has to visit the nearest police station makes crime reporting a very strenuous action as a result of difficulties involved before information on a particular crime is lodged. Most victims prefer to report directly to court as to maintain law and order in a bid to seek justice. The police approach as regards FIR (FIRST INVESTIGATION REPORT) encumbers rigid investigation and analysis of crime thereby render innocent sometime culprit.

The same difficulties are faced by volunteers who wish to report crime occurrence within their vicinities. This is a quite critical process by which the victim has to undergo before lodging his/her FIR (FIRST INVESTIGATION REPORT). At times, the criminal parties gave the bribe to the police officers for not to lodge the FIR. As a result, the victim was not being able to lodge his/her FIR and he/she has to visit the court. It is also possible that when the victim is going to police station the criminal party attacks on him/her. In this case, the victim was not be able to visit the police station and may be killed by the criminal party.

The existing system is fully manual i.e. a lot of paper work has to be done by the authorities as well as by the victim. With the current trend in Information Technology, most of our daily activities are encapsulated by the standardization and advent of innovation, therefore the era of constituting police services and operation in a confused systemic approach needs to end and a total embracement of Information Technologies should be a concern. On the other hand, maintaining the paper based records and duplicating them when required is another tedious process. For instance if a police officer is asked for a separate file of any criminal record/file it may take few hours or days to locate it depending on the size of the record. If the same case arises with the computerized system, it will take only few seconds for duplicating the records/files. We can also print the hardcopy of these records.

Also, protecting the files of important records from the reach of criminal parties/pesticides/ rodents etc. is another cumbersome task. Huge amount of monies are expended for the physical safety of the important files/records. Thus there are various challenges for manually maintaining the records instead of the modern computer systems. As earlier discussed, the existing problem is associated with potential problems as a result of epileptic operation with the use of manual approach.
The following are the problems gathered from existing system:

- **Accuracy** – The present system cannot be ascertained as containing accurate information as regards any information on a crime gathered by the police. The system is corrupt and porous to accommodate any manipulation by corrupt officer(s) in charge. Due to bulkiness files, cases might be thrown aboard and new ones formulated which will suit their (corrupt officers) whims and caprices.

- **Waste of Time** – It leads to waste of time as there is much paper work involved which requires flipping through loads/stocks of file before information is fetched.

- **Lack of integrity**

- **Efficiency**

### 3.1 System Capabilities

The portal has the following few sections, which are discussed below:

**Administrator**

- An Administrator page is provided through which handles the site, databases and allow detectives, citizens and Defense Officials access to the site. A FIR (FIRST INVESTIGATION REPORT) form is provided through which citizens can enter details of the crime reported. This data once entered can be edited/deleted as required.

- There are sections provided for Defense Officials, Detectives and citizens.

**Citizens**

In Citizens sections, user can enter the details of FIR (FIRST INVESTIGATION REPORT) through the help of portal. The portal has forms that will ask for the details of victim(s), crime id/name/location/address/city/country/contact person/contact number/contact, Email-Id. After entering the details the data will be saved by clicking save button and the details will be stored in the FIR database. Each FIR will be given a unique ID.

**Administrator(s)**

In Administrator section, various data is available for searching details of criminals, FIRs, judicial results, case hearings and other. Administrator can update databases for the required fields.

- **Proofing** - Crime Reporting forms, progress tracking, and proof attachments.

- **Search** - In Search section, authorized detectives and Defense Officials will search for matching records of criminals, FIR details, missing people etc.

- **Alert Services** - An alert can be sent to the citizen regarding the FIR ID and an alert can be sent to a concerned person of the area regarding the CRIME.

### 3.2 System Functionalities

Crime reporting forms, progress tracking, proof attachments.

- On form submission an e-mail goes to regional police officer in case if it’s serious category crime where quick attention is required.

- Facilitate crime and criminals search – region, crime-type, gender, age group wise etc.

- Missing citizen or valuables reporting and search

- Secure registration and profile management facilities for detectives and security agencies

- Facilitate communication between all stakeholders – Discussion forum/chat/mail/polls

- Help book & time-to-time instructions to users through mail

### 3.3 Requirements Specification

This proposed software runs effectively on a computer system which has the minimum requirements. The requirements are split into two categories, namely:

**Software Requirements**

The minimum software requirements to run the program are listed below

1. Microsoft Windows XP (Home and Professional Editions), Windows 7
2. MySQL
3. JavaScript, PHP/HTML, CSS, jQuery
4. Browser e.g. Mozilla Firefox, Safari, chrome, Flock e.t.c.
5. Local Server e.g. WAMP Server, XXAMP or EasyPHP Server

**Hardware Requirements**

The minimum hardware required to run the program are listed below

1. Hard disk of 20 Giga bytes
2. System memory (RAM) of 512 Mega bytes
3. Dot Matrix, Laser jet Printer
4. Compatible flash drive or external Hard disk
4. SOFTWARE DEVELOPMENT METHODOLOGY

4.1 Architecture of the Proposed System
The proposed system is aimed at providing a flexible platform that enhances user friendliness.

4.2 Description of Architectural Design
In this context diagram, the information provided to and received from the ‘Online Crime Reporting System’ is identified. The arrows represent the information received or generated by the application. The closed boxes represent the set of sources and sinks of information. In the system, we can observe that the user interacts with the application through a graphical user interface (GUI). The inputs to the system are the FIRs, profile, police detail etc criteria provided by the user and a new review written by the user to some certain entries unlike FIRs. Also, the output is in the form of repeater and grid views which present the users (Police) with the list of FIR available. The users (police) can view complete FIRs or complaints; view Images and reviews by other users (public).

4.3 Object-oriented System Analysis and Design

System Description
- Victim/Volunteer reports officially or lodges FIR
- FIR ID number is generated to assist easy referencing rather than a muddle up
- Victim/Volunteer performs a follow-up as a confirmation if the report is being taken care
- Police examines the report for further analysis and identification
- Police marks a particular area as notorious (this is not system requirement)

4.4 Identifying the Actors
The actors in the system are the victim/volunteer, the police and the reporting system consisting of form processing, record documentation, Analysis and report generation. The victim/volunteer is a passive user–actor who initiates the process and lodges FIR, a goal of measurable value. The police are an active user–actor, who triggers the system and has the role of performing investigation with the responsibility of collecting the correct information from the victim/volunteer, which is a measurable value. Predesigned and deployed crime reporting system at the back end is a system actor–user to ensure that crime report/investigation processing is done correctly and different system statuses are updated on handling the FIR. This actor has an active role and responsibility at the back end.

4.5 Process Model – Crime Reporting System
Based on the system observation by the analyst, a high-level activity diagram is drawn modeling the process of crime report lodged by the victim/volunteer.

The activity diagram brings everybody concerned with the system on the ground to a common understanding of the system as it functions.
Figure 2: The Activity Diagram of Crime Reporting System

- Victim/volunteer visit the online Application
- Fills FIR Form and Submit
  - Form modified
  - Not Ok
  - Ok

- Generate FIR ID Number
- Send Email Alert to both the Police and Victim/volunteer
- Prompt the User login to be able perform other function
  - Not Ok
  - Ok

- Police Officer in Charge fetches the report based on reference ID (FIR ID Number)
- Validate the entry and file it for immediate action i.e. set a priority
- Trigger the update process
- Attend to next report
4.6 Use Cases
In the Crime Reporting systems, users are the victims/volunteer, the Police and Crime Reporting System (CRS). Take each user and identify the roles played, which would lead us to identify the roles played, an identification of use case. Table 3.1 shows the result of the process of identifying the use cases. The system has three users, eight roles and eleven use cases. To illustrate the process of identifying the use cases, let us take the victim/volunteer (a user of the system). A victim/volunteer as a user may play one or more of three roles.

The roles are
1. Lodging FIR/Complaints about a crime.
2. Assist the police with adequate and necessary information required for swift investigation.
3. Follow-up to ascertain that the report is treated or considered by the police.

As explained in the case of victim/volunteer, the roles are use cases. Similarly, one can probe into the roles and use cases for police and crime reporting system.

Table 1: Roles in use case

<table>
<thead>
<tr>
<th>Users</th>
<th>Roles</th>
<th>Use Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Victim/volunteer</td>
<td>Lodging FIR/Complaint</td>
<td>Crime Reporting Process</td>
</tr>
<tr>
<td></td>
<td>Provide necessary Information</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Follow-up</td>
<td></td>
</tr>
<tr>
<td>Police</td>
<td>Perform validation and verification of the information</td>
<td>Data Manager</td>
</tr>
<tr>
<td>Data Manager</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crime Reporting System</td>
<td>Server System</td>
<td>Structures the report, process FIR and prepare documentation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Updates the record, enforce data integrity and back-up</td>
</tr>
</tbody>
</table>

4.7 Interaction Diagrams
Interaction diagrams are used to show the interactions between user/actor and the system. Use case is a scenario that develops through interaction. Let us model different scenarios through interaction diagrams:

Use Case: Crime reporting process
1. Victim/volunteer fills form to lodge FIR
2. Police checks for validity and verifies the information source.
3. If OK, the police proceed with the investigation.
4. If not OK, the police ignore and file the report as counterfeit.
6. Steps 2 to 4 are repeated.

Figure 3 shows the steps in the activity diagrams of use case crime reporting process.
5. APPLICATION SOFTWARE MODULES

- **Password Module**
  In this module, user enters a password and the portal checks its validity. If the password is valid then he is allowed to enter, otherwise “Invalid User/Password” message is displayed. This is done to avoid unauthorized access.

- **Search**
  In the Search section, authorized detectives and Defense Officials will search for matching records of criminals, FIR details, missing people etc.

- **Contact of Concerned Authority**
  Contact details of the area official who is solving the case.

- **Progress**
  Case study and progress of the case entered by the FIR can be found in this section. All the progress reports and special remarks can be entered in the database by Administrator(s).

- **Queries**
  Detailed information of the crime can be entered and retrieved by administrator(s) only because of the security point of view.

- **Registration**
  Secure registration and profile management facilities are available for detectives and security agencies.

- **Validation of Data entered by the user and error handling**
  In this module, the validity of data entered by the user during the various processes is checked through various validation checks. For example, there shouldn’t be any characters entered in the numeric fields. Likewise if there is any error it should handle that particular error and give the appropriate messages.

6. CONCLUSION

The world is experiencing an information knowledge revolution that is fundamentally transforming the way in which human activities are carried out. Governments worldwide are adopting e-government as a means of improving their services to businesses and citizens, promoting economic and social development, and enhancing the effectiveness and efficiency of government operations. In current competitive scenario every business/public establishment needs quality and systematic process to increase their working efficiency as well as improve their productivity.

It is keeping in mind this business philosophy that we propose.

Crime Reporting System

In conclusion, we have, in this study, looked at the various definitions of criminal statistics. Finally, a prototype crime reporting system was designed that relies on four reporting forms: a complaint or dispatch reporting form, a crime event report form, follow-up investigation report form, and an arrest report form. The system consists of three functional modules: a data capture module, a report management and control module, and a data utilization module. The system maintains an event or case file and a police activity file. The conceptual crime reporting system design and data elements thus developed must now be tested and evaluated in an operational environment.

7. RECOMMENDATION

Societies all over the world expand and develop continuously, as such human relationship and activities also expands. The results of dynamism of the growing population give room for crime. These societies therefore strive to establish and develop institutions that can ensure peace as well as security of lives and property of its citizenry.
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Issues on Mobile Agent Technology Adoption

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ABSTRACT
The design, development, deployment and use of mobile agent in computing is a relatively new paradigm in distributed systems environment. The deployment of mobile agent in creating distributed systems has been shown to help reduce network load, overcome network latency and encapsulate protocols as well as help the dynamic adaptation, and asynchronous and autonomous execution of distributed applications. Despite these benefits, mobile agent technology adoption is still very low even in the face of high research activities in the area and this is a serious hindrance to tapping the computational benefit of mobile agent technology. This paper explicates the nitty-gritty behind mobile agent technology and exposed the factors militating against its adoption. This will help expose critical areas one need to focus on in mobile agent research to increase the adoption of mobile agent technology.

Keywords: Software agent, Mobile agent, Technology adoption and Distributed application

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1. INTRODUCTION
A mobile agent is a software agent, enabled with the capability of hopping or migrating from one host to another via a network, and can suspend execution in one location and resume at another location in carrying out task(s) on behalf of its owner [2, 3, 8, 15]. Mobile agent technology involves the design, development, deployment and use of mobile agents in computing. Mobile agent technology gained popularity in the nineties when research in the area was very active due to paradigm shift from standalone applications to distributed applications as a result of the advent of the internet.

The deployment of mobile agent in creating distributed systems has been shown to help reduce network load, overcome network latency and encapsulate protocols as well as the dynamic adaptation, and asynchronous and autonomous execution of distributed applications [1, 4, 10, 17, 21]. Other benefits include: support for heterogeneity, robustness and fault-tolerance. Applications such as e-commerce, personal assistance, secure brokering, distributed information retrieval; telecommunication network services, workflow applications and groupware, monitoring and notifications, information dissemination, and parallel processing are already enjoying the benefits of mobile agent technology [1, 10, 21]. Despite the potentials of mobile agent technology, its use is dwindling so much so that some of the use of some systems that were built on mobile agent technology has been discontinued over the years [15, 16, 21]. What is more worrisome is that the low adoption of mobile agent persists even when the research domain is increasingly active [21].

What could be responsible for the low adoption of mobile agent technology considering its immense potentials and high research activity? This question is particularly important considering the fact that the research effort into mobile agent technology may be futile if its adoption problems are not addressed; for a technology that cannot be used no matter how beautiful it may appear is as worthless as it not being in existence. This is the essence of this paper, to account for the low adoption of mobile agent technology.

2. BACKGROUND INFORMATION
Mobile agent technology is a relatively new paradigm in distributed systems environment. An approach believed, will replace the normal client-server model and its architecture [1]. Several definitions have been ascribed to mobile agents; some of them are presented next. A mobile agent can be seen as a program that is goal-directed and capable of suspending execution on one platform, moving to another platform where it can resume execution. That is to say, a mobile agent exercises its owner’s authority, work autonomously towards a goal and can also meet and interact with other agents [8]. A mobile agent is also seen as a particular class of software agent that can migrate during execution from one host to another where it can resume execution [2]. Mobile agent can also be seen as an autonomous software entity with the capability of roaming among nodes in a network-aware fashion. It can move from host to host to find the needed resources [4].
[21] described mobile agent as a process that can move its state from one environment to the other holding its data intact as they migrate and can perform appropriately in the new environment.

2.1 Characteristics of Mobile Agents

A mobile agent is a software agent. A software agent differs from other programs because of the following properties [7, 17]:

- **Intelligence**: a software agent employs a technique from the field of artificial intelligence which makes it possible for them to act and perform task(s) on behalf of their owners in such a way that one would think that the tasks were carried out by human. That is to say, they can actually act as if they have intelligence.

- **Autonomy**: this is the ability of the agent to exercise control over its own actions. It can decide the sequence of action to perform in order to achieve the user’s task once specifications are given to the agent.

- **Responsiveness**: this is the ability of an agent to perceive its environment and respond in real-time to changes in the environment. Apart from being reactive to their environment they are also goal-oriented (proactive and purposeful), taking advantage of opportunities when necessary.

- **Communicative ability**: an agent does not work in isolation. They are sociable entities and as such interact and collaborate with other software agents in carryout their tasks. For this reasons, agents should provide a friendly interface to allow for easy interactivity with other agents.

- **Adaptability**: agents learn about user’s behaviour and adjust to changes based on previous experience.

- **Ragged**: mobile agents usually have the ability to recover from errors whenever they occur.

From the definitions of mobile agents, one can see it combines the properties of a software agent and “mobility” as a property; i.e. $MAp = SAP + Mobility$. Where $MAp$ is the properties of a Mobile Agent and $SAP$ is the properties of a Software Agent.

The mobility exhibited by a mobile agent could either be weak or strong [20]. We say it is weak if the mobile agent transports or migrates itself (code) with its data and if it transports or migrates itself with its data and state, we say it is strong. Thus we write:

- Weak mobility = mobile agent code + data
- Strong mobility = Weak mobility + state

A mobile agent code is the set of instructions describing the execution of the agent while data is an information storage area used by the agent. Results of executions are usually stored in this area. This part of the agent is reserved for storing information regarding the state of the agent.

2.2 Mobile Agent Life Cycle

Mobile agents go through some processes to get job done. The entire process is termed Mobile Agent Life Cycle; it is depicted in figure 2.1 and highlighted as follows [17, 21]:

- **Creation**: this is the first phase of a mobile agent life cycle. Once a request is made to a mobile agent, an instance of the mobile agent is created and its state is initialized.

- **Dispatch**: this involves the movement of the mobile agent from one node to the other and can be achieved by specifying the address of the destination.

- **Cloning**: this refers to creating a copy of the original mobile agent object. That is to say, a twin agent is born and the current state of the original is duplicated in the clone.

- **Deactivation**: a mobile agent is put to sleep and its state is stored on a disk of the host.

- **Activation**: a deactivated mobile agent is brought back to life and its state is restored from disk.

- **Retraction**: an agent is brought back from a remote host along with its state to the home machine after the completion of its job.

- **Disposal**: this is done at the end of the mobile agent life cycle. The agent is terminated and its state is lost forever.

From the definitions of mobile agents, one can see it combines the properties of a software agent and “mobility” as a property; i.e. $MAp = SAP + Mobility$. Where $MAp$ is the properties of a Mobile Agent and $SAP$ is the properties of a Software Agent.
2.3 Mobile Agent Model
A mobile agent must contain all of the following models: an agent model, a life cycle model, a computational model, security model, a communication model, and a navigation model [19].

2.3.1 Agent Model
This model defines the internal structure of the intelligent part of the agent [13]. The structure of this model actually defines the autonomy, learning and cooperative characteristics of an agent. Besides, it specifies the reactive and proactive nature of the agent.

2.3.2 Life-cycle Model
This model defines different execution states of a mobile agent and the events that caused the movement from one state to another. Prominent amongst life cycle models are the persistence process model adopted by Telescript and agent TCL and the task based model adopted by Aglets [5, 25]. When a mobile agent is transported from one node to the other, the process in the running state is check-pointed and the agent enters what is termed “frozen” state. Next, the context is delivered to the destination mode where the process is resumed and re-enters the “running” state at the point it left off.

2.3.3 Computational Model
The computational model refers to the computational capabilities of an agent, which include data manipulation and thread control primitives. That is to say, computational model defines how a mobile agent executes when it is in a “running” state. This model takes place in an environment and it is facilitated by some form of processor. A processor could be the CPU of the computer or more abstract processor as can be found in Java virtual machine. Besides, implementers of mobile agents gain access to other models via the computational model; hence its structure affects all other models.

2.3.4 Security Model
The security model describes the ways in which agents can access network resources, as well as the ways of accessing the internals of the agents from the network. This model is very important because a mobile agent system is an open system and just like every other open systems, it is subject to different attacks. There are three fundamental security issues specific to mobile agent systems [10]. These are:
- Protecting the host (platform) from the mobile agent,
- Protecting the mobile agent from other mobile agents, and
- Protecting the mobile agent from the host.

2.3.5 Communication Model
The importance of this model cannot be over-emphasized. Without this model, interaction with other entities in a computing environment will not be possible. Communication can be synchronous, asynchronous or deferred. Communication is synchronous when the agents need to interact with one another in real time with the communicating agents exclusively bound to one another and when they are not
exclusively bound in real time during communication we say communication is asynchronous. Deferred communication [12, 23] is a hybrid model, in which the sending agent continues with other activity until the desired results are available. Communication is used when there is a need to access services outside of the mobile agent for the sake of cooperation and coordination.

There are quite a number of languages for communication and coordination of agents referred to as Agent Communication Languages (ACLs). Table 2.1 enumerates and describes the most prominent examples of ACLs as in [24].

### Table 2.1: Most prominent Agent Communication Languages [24].

<table>
<thead>
<tr>
<th>Agent Communication Language</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Knowledge Query and Manipulation Language (KQML)</td>
<td>It is perhaps the most widely used agent communication language (Weiβ, 2002).</td>
</tr>
<tr>
<td>2. ARTIMIS Communication Language (ARCOL)</td>
<td>It is the communication language used in the ARTIMIS system. ARCOL has smaller set of communication primitives than KQML, but these can be composed.</td>
</tr>
<tr>
<td>3. FIPA Agent Communication Language (FIPA-ACL)</td>
<td>It is an agent communication language largely influenced by ARCOL. Together FIPA-ACL, ARCOL and KQML establish a quasi-standard for agent communication languages.</td>
</tr>
<tr>
<td>4. Knowledge Interchange Format (KIF)</td>
<td>It is a logic based language that has been designed to express any kind of knowledge and non- knowledge. KIF is a language for content communication whereas languages like KQML, ARCOL and FIPF-ACL are for intention communication.</td>
</tr>
<tr>
<td>5. Domain independent COOrdination Language (COOL)</td>
<td>It aims at explicitly representing and applying coordination knowledge for multi-agent systems and focuses on rule-based conversation management. Language like COOL can be thought of as supporting a coordination/communication (or protocol-sensitive) layer above intention communication.</td>
</tr>
</tbody>
</table>

2.3.6 Navigation Model

This model concerns itself with all aspects of agent mobility from the discovery and resolution of destination hosts to the manner in which a mobile agent is transported. This concept may not be evident in agents that execute remotely without the need to meet other agents at a place, but for agents that execute locally where meeting at a place which could either be in a shop or home is of importance, the navigation model is paramount.

2.4 Implementation of Mobile Agents

There are different languages for implementing mobile agents. Some languages such as obliq and telescript have been designed specifically for writing mobile agents. There are also many mobile agent technology and platforms (see Table 2.2) implemented in general purpose languages with an extended special library.

### Table 2.2: Mobile Agent Systems [18]

<table>
<thead>
<tr>
<th>Mobile Agent</th>
<th>Language</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ajanta</td>
<td>Java</td>
<td>University of Minnesota, U.S.A</td>
</tr>
<tr>
<td>ARA</td>
<td>Tcl, C, Java</td>
<td>University of Kaiserslautern, Germany</td>
</tr>
<tr>
<td>Agent Tcl</td>
<td>Tcl</td>
<td>Dartmouth College, U.S.A</td>
</tr>
<tr>
<td>Aglets</td>
<td>Java</td>
<td>IBM, Japan</td>
</tr>
<tr>
<td>Concordia</td>
<td>Java</td>
<td>Mitsubishi, U.S.A</td>
</tr>
<tr>
<td>CyberAgents</td>
<td>Java</td>
<td>FTP Software Inc., U.S.A</td>
</tr>
<tr>
<td>fMAIN</td>
<td>Tcl, Perl, Java</td>
<td>University of Frankfurt, Germany</td>
</tr>
<tr>
<td>FIPA-OS</td>
<td>Java</td>
<td>Emorphia, UK</td>
</tr>
<tr>
<td>Grasshopper</td>
<td>Java</td>
<td>IKV, U.S.A</td>
</tr>
<tr>
<td>Java-to-go</td>
<td>Java</td>
<td>University of California Berkeley, U.S.A</td>
</tr>
<tr>
<td>Kafka</td>
<td>Java</td>
<td>Fujitsu, Japan</td>
</tr>
<tr>
<td>Messengers</td>
<td>M0</td>
<td>University of Zurich, Switzerland</td>
</tr>
<tr>
<td>MOA</td>
<td>Java</td>
<td>The Open Group, U.S.A</td>
</tr>
<tr>
<td>Mole</td>
<td>Java</td>
<td>University of Stuttgart, Germany</td>
</tr>
<tr>
<td>Monja</td>
<td>Java</td>
<td>Mitsubishi, Japan</td>
</tr>
<tr>
<td>Odyssey</td>
<td>Java</td>
<td>General Magic, U.S.A</td>
</tr>
<tr>
<td>SOMA</td>
<td>Java</td>
<td>University of Bologna, Italy</td>
</tr>
<tr>
<td>TACOMA</td>
<td>Tcl, C, Python</td>
<td>Cornell, U.S.A i Tromso, Norway</td>
</tr>
<tr>
<td>Telescript</td>
<td>Telescript</td>
<td>General Magic, U.S.A</td>
</tr>
<tr>
<td>Voyager</td>
<td>Java</td>
<td>Object Space Inc., U.S.A</td>
</tr>
</tbody>
</table>
Some of these languages are described as follows:

### 2.4.1 Obliq
This is a lexically scoped, un-typed interpreted language that supports distributed object computation. The language supports objects and not classes. It uses the prototype based model of object oriented programming. Obliq uses runtime type checking. It has built-in procedures for importing and exporting procedures and objects between machines.

### 2.4.2 Java
The Java environment is an approach to distributed computing. It is a general purpose language. It is an object oriented language. Java programs are compiled to Java byte codes, binary instructions for the Java Virtual Machine. More so, Java programs can run on any platform with JVM interpreter which makes its programs highly portable. Though the language was not designed for writing mobile agents, it has the necessary capabilities for mobile agent programming which has made it a basis for many implementations of mobile agent systems. Most of the systems make use of Java RMI - Remote Method Invocation. For example Aglet - uses an event driven approach to mobile agents that is analogous to the Java library Applet class [22].

### 2.4.3 Perl 5
Penguin is a Perl 5 module with functions enabling the sending of Perl scripts to a remote machine for execution and for receiving perl scripts from remote machines for execution. The scripts are digitally signed to allow authentication and are executed in a secure environment. Mobile agents written in Perl are restricted in that they must always restart execution at the same point. There is also no support for agents saving their state on migration. A new Agent Module v3.0 is being created to give Perl 5 more sophisticated mobile agent capabilities. The additional features include giving agents the ability to save their state on migration.

### 2.4.4 Python
Python is an object-oriented scripting language. The Corporation for National Research Institution, USA uses Python as a language for implementing Knowbot programs. It is also one of the languages used in developing Tacoma.

### 2.4.5 Telescript
It is a Remote Object Oriented mobile agent language. It claims to be “a platform that enables the creation of active, distributed network applications”. Its main achievement is in its use in the Magic Link Project, Magic cap product and electronic market places. Telescript has three main concepts; agents, places and the “go” instruction. Agents travel from places to places using the “go” instruction. They can interact with each other and any services located at the places visited through the use of “meet” instruction.

Telescript is a whole new platform independent system consisting of a language and an interpreter called the Telescript Engine. The computational model is the Telescript language itself and the agent model is simply a Telescript object. Special instructions implement part of the other models. The navigational model is implemented by the concept of places and the “go” instructions. The “meet” and “connect” instructions are the basis of communication model. Finally, the security model is implemented with the authority, region and identity concepts. In general, any language used for writing a mobile agent must support some of the following [22]: agent migration, communication between agents, access to server resources, security mechanisms, appropriate efficiency, the ability to run on multiple platforms, and ease of writing mobile agent application. Besides, the degree to which a language can support the above listed characteristics determines its level of suitability (usefulness) for writing mobile agent applications.

### 2.5 Agent Systems
Agent systems are implemented through agent platforms, the underlying software for the system.Platform defines a standard around which a system can be developed. Platform may provide support for migration, naming, location and communication services. Examples of agent platforms are as shown in table 2.2. Furthermore, an agent system consists of one or more execution environments or agencies. How an agency is constituted or built is dependent on the type of agent system one is building, but a generic architecture is as shown in figure 2.2.
2.6 Benefits of Adopting Mobile Agent Technology

There are at least seven good reasons why mobile agents should be used [10]. They are highlighted as follows:

i. They reduce network load - distributed systems often rely on communication protocols involving multiple interactions to accomplish a given task. This usually results in a lot of network traffic. Mobile agents allow users to package conversations and dispatch it to a destination host where interactions take place locally. Also, load in a network may be high as a result of movement of large data via the network as could be seen in a normal client server approach. The use of mobile agent can help ameliorate this because computation is moved to data rather than data been moved to computation.

ii. They overcome network latency – in critical environment such as real time where time of response to change is a crux, controlling such systems through a potentially large network involves significant latencies which for critical real-time systems are not tolerable. Mobile agents offer a solution because they can be dispatched from a central controller to act locally and execute the controller’s direction directly.

iii. They encapsulate protocols – when data is exchanged in a distributed system, each host owns the code that implements the protocols needed to properly code outgoing data and interpret incoming data. However, as protocols evolve to accommodate new requirements for efficiency or security, it is cumbersome if not impossible to upgrade protocol code properly. As a result, protocols often become a legacy problem. Mobile agents on the other hand can move to remote hosts to establish channels based on proprietary protocols.

iv. They execute asynchronously and autonomously – tasks requiring continuously open connection between a mobile device and a fixed network are probably not economically or technically feasible. To solve this problem, tasks can be embedded into mobile agents, which can then be dispatched into the network. After being dispatched, the agents become independent of the process that created them and can operate asynchronously and autonomously.

v. They adapt dynamically – mobile agents can sense their execution environment and react autonomously to changes. Multiple mobile agents have the unique ability of distributing themselves among the hosts in the network to maintain optimal configuration for solving particular problem.

vi. They are naturally heterogeneous – network computing is basically heterogeneous from both hardware and software perspective. Mobile agents provide optimal conditions for seamless system integration because they depend only on their execution environments and independent of hardware and transport layer.
They are robust and fault tolerant – mobile agents’ ability to react dynamically to unfavourable situations and events makes it easier to build robust and fault tolerant distributed systems. If a host is being shut down, all agents executing on that machine are warned and given time to dispatch and continue their operation on another host in the network.

2.7 Trends in Mobile Agent Technology

The emergence of the internet brought about a shift in paradigm from building standalone applications (i.e. desktop application) to building distributed applications. This shift in paradigm was accompanied by problem of network load and latency, heterogeneity and network failure problems and in solving these problems; a new technology in the name mobile agent was born. Mobile agent technology did not emerge from the oblivion rather it came to being through evolution. In the first step of the evolution, we find the mobility of files, for example with the FTP protocol. After this, there was the Remote Procedure Call (RPC) in which case data is moved between a client and a server; as depicted in figure 2.3.

![Figure 2.3: Remote Procedure Call (RPC) [20].](image)

Next was Remote Evaluation (REV). This is in all ways similar to RPC, the only difference being that code is the parameter transported instead of data. After REV came Code on Demand (COD). In the code on demand (COD) paradigm, the computational component, client has local access to the resources, but does not know how to execute the task. Thus, it contacts a computational component, server, on a different site, which provides the know-how. The client loads the know-how from the server and executes the task locally, as shown in figure 2.4.

![Figure 2.4: Code on Demand [20]](image)

Finally, active entities were able to change the environment where they are executing. Thus, the natural evolution of mobility resulted in code mobility. New technologies usually go through stages termed “life-cycle”. A model of life-cycle of a technology could be seen as pictorially described by [14] in figure 2.5. Mobile agent technology holds no exception to this. It is important to note that mobile agent technology is still at the irruption stage [11] due to its poor adoption [21] though one probably would have thought that by now the adoption of the technology should have grown past this stage of irruption.
Attempt would be made in the next session to explicate factors that has kept mobile agent at the irruption stage. This will help expose how we may improve the level of adoption of mobile agent technology.

3. FACTORS MILITATING AGAINST THE ADOPTION OF MOBILE AGENT TECHNOLOGY

Various factors have been identified to be responsible for the low adoption of mobile agent technology. These factors include language of implementation of the agent, coordination model, security, efficiency and standardization [1, 4, 9, 8, 16, 18, 21].

3.1 Language of Implementation

There are different languages for implementing mobile agents. Languages such as Telescript and Obliq were built specifically for implementing mobile agents while languages like Java, Python, Tcl, and Perl 5 amongst others were not but have capabilities which make them applicable in the domain. The challenge here is the need for compatibility of the agents with their agencies. Agency is the environment in which an agent carries out its activities.

Every language for implementing mobile agents imposes a constraint which in the long run affects the way the agents behave in its running environment. It is therefore important for builders of agent systems to take into consideration the platform and environment in which the agent is to carry out its activities and put in place machinery that will allow for compatibility. However, Java is gradually becoming a de facto language despite its support for weak mobility.

This is as a result of its support for platform independence. This blurs the need of having to know about the agency on which these agents will run. It is therefore pertinent to painstakingly weigh all pros and cons of our choice of language of implementation of the mobile agents to be sure that the desired and the most appropriate in a given scenario is used. This undoubtedly will help guarantee the sustainability of the system.

3.2 Coordination

Coordination is another factor seriously affecting the adoption of mobile agent technology. Agents are usually not built to operate in isolation but to interact with other agents in a distributed environment. If agents must interact with one another, then a mechanism must be in place to ensure proper coherence of actions amongst them. This mechanism that ensures effective interaction amongst agents defines coordination. The challenge really is in identifying these mechanisms that allow agents to coordinate their activities or actions automatically without the need for human supervision [4]. When coordination is carried out amongst agents with a common goal in mind, it is referred to as cooperation. If mobile agents must achieve their purpose in a distributed environment, then the issue of coordination of these agents must be given a proper attention otherwise, its adoption rate will continue to plummet.
3.3 Standardization
Standardization is one very important issue that cannot be thrown out in the field of mobile agent technology. Agents are built by different persons, laboratories and companies with different philosophies. Agents’ environment by nature is heterogeneous and for entities in this domain to interact appropriately, there is a need for standardization at least in the area of communication, coordination and transportation [1]. That is to say, how agents communicate with one another and other entities, how they are coordinated to achieve their goals and how they navigate. There are currently two standards for mobile agent technology.

The Object Management Group’s Mobile Agent System Interoperability Facility (MASIF) - managed by the Object Management Group with CORBA being its most famous standard and the other is the specification managed by Foundation for Intelligent and Physical Agent (FIPA). OMG enforces such standards as making sure messages are schedulable as well as event driven, support of transportation mechanism for unique addressing as well as role-based addresses and support of transportation mechanism for unicast and broadcast modes of mobile agents.

MASIF basically provides interface between agent and agent systems and it is limited to the interworking of agent systems using same language – a serious barrier to interoperability of mobile agent in a heterogenous platform while the strength of FIPA is on communication among agents and not in mobility i.e. FIPA is weak transportation standards which is however necessary for the mobility of agents [18]. Obviously, therefore, we need uniform standard that will guarantee the standardization requirements of mobile agents – communication, coordination and transportation; as exposed by [1]. Until this is done and enforced, we may continue to experience low adoption of mobile agent technology.

3.4 Security
This is one aspect of mobile agent technology whose importance cannot be over-emphasized. Security is the key reason why mobile agent adoption is low [17]. One may of course argue that despite the security challenges in some technological domains, the adoption of those technologies is still high and as such, mobile agent technology should not be an exception. Unfortunately, security as it affects mobile agents, stems from two directions which complicate the security problem of mobile agent. The first is as a result of the properties exhibited by mobile agents and the second stems from the fact that mobile agents dwells in an open system. The higher the degree of mobility, autonomy and execution of an agent, the more vulnerable a mobile agent is to security threat [15]. As earlier stated, [10] exposed three fundamental issues specific to mobile agent systems as an open system. They are: protecting the host from the agent, protecting agent from another agent and protecting the agent from a host; as discussed in the following subsections.

3.4.1 Protecting the Host from the Mobile Agent
This could be in the form of masquerading in which case an unauthorized agent claims the identity of another agent. The masquerading agent may pose as an authorized agent in an effort to gain access to services and resources to which it is not entitled. The masquerading agent may also pose as another unauthorized agent in an effort to shift the blame for any actions for which it does not want to be held accountable. A masquerading agent may damage the trust the legitimate agent has established in an agent community and its associated reputation.

It could be a denial of service attack where mobile agents launch attacks by consuming an excessive amount of the agent platform's computing resources. This denial of service attacks can be launched intentionally by running attack scripts to exploit system vulnerabilities, or unintentionally through programming errors. A rogue agent may carry malicious code that is designed to disrupt the services offered by the agent host, degrade the performance of the host, or extract information for which it has no authorization to access. Depending on the level of access, the agent may be able to completely shut down or terminate the agent platform. It may also occur in the form of unauthorized access where an agent gains access and privilege to services and resources of the host.

Access control mechanisms are used to prevent unauthorized users or processes from accessing services and resources for which they have not been granted permission and privileges as specified by a security policy. Each agent visiting a platform must be subject to the platform's security policy. Applying the proper access control mechanisms requires the platform or agent to first authenticate a mobile agent's identity before it is instantiated on the platform. An agent that has access to a platform and its services without having the proper authorization can harm other agents and the platform itself.

3.4.2 Protecting the Mobile Agent from other Mobile Agents
The agent-to-agent category represents the set of threats in which agents exploit security weaknesses of other agents or launch attacks against other agents. This could be in the form of masquerading, unauthorized access, denial of service and repudiation. Many agent platform components are also agents themselves. These platform agents provide system-level services such as directory services and inter-platform communication services. Some agent platforms allow direct inter-platform agent-to-agent communication, while others require all incoming and outgoing messages to go through a platform communication agent. Agent-to-agent communication can take place directly between two agents or may require the participation of the underlying platform and the agent services it provides.
An agent may attempt to disguise its identity in an effort to deceive the agent with which it is communicating. An agent may also pose as a well-known vendor of goods and services, for example, and try to convince another unsuspecting agent to provide it with credit card numbers, bank account information, some form of digital cash, or other private information. Masquerading as another agent harms both the agent that is being deceived and the agent whose identity has been assumed, especially in agent societies where reputation is valued and used as a means to establish trust.

Agents can also launch denial of service attacks against other agents. This they can achieve by repeatedly sending messages to another agent, or spamming agents with messages, may place undue burden on the message handling routines of the recipient. Agents that are being spammed may choose to block messages from unauthorized agents, but even this task requires some processing by the agent or its communication proxy. If an agent is charged by the number of CPU cycles it consumes on a platform, spamming an agent may cause the spammed agent to have to pay a monetary cost in addition to a performance cost. Agent communication languages and conversation policies must ensure that a malicious agent does not engage another agent in an infinite conversation loop or engage the agent in elaborate conversations with the sole purpose of tying up the agent's resources. Malicious agents can also intentionally distribute false or useless information to prevent other agents from completing their tasks correctly or in a timely manner.

Repudiation occurs when an agent, participating in a transaction or communication later claims that the transaction or communication never took place. Whether the cause for repudiation is deliberate or accidental, repudiation can lead to serious problems that may not be easily resolved. An agent platform cannot prevent an agent from repudiating a transaction, but platforms can ensure the availability of sufficiently strong evidence to support the resolution of disagreements. This evidence may deter an agent that values its reputation and the level of trust others place in it, from falsely repudiating future transactions. Disagreements may arise not only when an agent falsely repudiates a transaction, but also because imperfect business processes may lead to different views of events. Since an agent may repudiate a transaction as the result of a misunderstanding, it is important that the agents and agent platforms involved in the transaction maintain records to help resolve any dispute.

If the agent platform has weak or no control mechanisms in place, an agent can directly interfere with another agent by invoking its public methods (e.g., attempt buffer overflow, reset to initial state, etc.), or by accessing and modifying the agent's data or code. Modification of an agent's code is a particularly insidious form of attack, since it can radically change the agent's behaviour (e.g., turning a trusted agent into malicious one). An agent may also gain information about other agents' activities by using platform services to eavesdrop on their communications.

3.4.3 Protecting the Mobile agent from the Host

This appears to be the most serious of the three fundamental security issues. No solution has been found for this problem yet, though effort has been made by some researchers to solve the problem and research effort is still been put into this area [1, 2, 21]. So far, partial solution is what has been achieved. Categories of threats in this area could be in the form of masquerading, denial of service attack, eavesdropping and alteration. Due to some of the issues discussed above, most hosts will not allow interaction with an agent for they may see them as worm (virus) especially given the fact that the operation of a worm is similar to that of agents and vice versa. Nonetheless, an attack of a malicious host on an agent by changing the agent’s behaviour or stealing secrets such as credit card information could pose a serious economic threat [6].

3.5 Social – Economic Factor

This is one area that should not be ruled out as hindrance to mobile agent adoption. Mobile agent technology was created to help remove some problems associated with distributed systems, but a situation where a technology will ensure reduction in economic value which is the quest for man’s survival will definitely not be tolerated. Most sites carry out one form of advert or the other while some are heavily dependent on marketing advert. How often the sites are visited will go a long way affecting the wide spread of the products being show-cased on these sites. If mobile agents are indiscriminately allowed to interact with such sites in the place of human, then these adverts will of course become useless since adverts are made for human and such sites will loose revenue. This is one key aspect that should be put into serious consideration if there must be increase in the adoption of mobile agent technology.

4. DISCUSSION

Overall, the problem created by the choice of language of implementation of a mobile agent can easily be solved by understanding exactly what the agent should achieve and the characteristics the agent should possess. A mobile agent can exhibit a weak or a strong mobility. If a mobile agent is to achieve strong mobility then a language like Java is not apt for such an agent because Java has support for weak mobility. A language like Telescript with features that can enhance strong mobility should not be used if weak mobility is the developer’s quest. Besides, understanding the agency/platform where agents carry out its activities will help determine what language to use in order to ensure compatibility between agents and its agency.
The issue of coordination can easily be addressed if builders of agents are careful enough to develop agents with the mind that the agents will interact with one another. This will necessitate putting proper mechanisms in place to ensure coherence. The need for standardization arose as a result of differences in the philosophies of mobile agents’ vendors. With OMG and FIPA around, standards can be institutionalized to enforce some minimum requirements which will ensure commonality amongst different vendors.

Most of the issues responsible for low adoption of mobile agent contribute to security problems directly or indirectly. The degree of mobility is directly proportional to the level of security threat. So, if at the inception of the creation of the agent, one knows exactly what the agent is to do, the characteristics it should possess, then the developer will know what language can help realise such a mobile agent and as well be aware of the type of security mechanism to implement in the agent based on the chosen language. It is obvious that managing orproffering solution to other problems which contribute to security challenges will undoubtedly help mitigate security challenges and this in turn will help increase the adoption of the technology.

5. CONCLUSION

Mobile agent technology is a paradigm that involves the migration of an agent from one host to the other in performing a task on behalf of the user, suspending execution at one location and resuming at another location from where it stopped. Various benefit have been put forward for the use of mobile agent technology, these include; bandwidth reduction, reduction of network latency, autonomous execution, fault tolerance amongst others. This not withstanding, the adoption of the technology is dwindling due to barriers posed by the language of implementation, coordination, standardization, security, and social economic interest. Research geared towards addressing these mobile agent technology challenges is therefore of urgent importance to encouraging high adoption of mobile agent technology.

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Factor Analysis of the Adoption of Cloud Computing In Nigeria

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ABSTRACT
Research has indicated that cloud computing will become the mainstream in computing technology and an effective tool for businesses. Traditionally, companies build corporate data centers, install applications and are responsible for maintaining their IT infrastructures. However, cloud computing removes the need for organizations to own corporate data centers and install enterprise applications. Instead, cloud provides businesses with the advantage of scalability, on-demand service, flexibility and reduced cost of computing, an increase has been identified in the acceptance and adoption of this new computing model in developed and developing countries. So then this research was carried out to investigate the acceptance and adoption of cloud computing in Nigeria. These objectives were achieved through Quantitative and qualitative research methodologies, the basis of the research consists of two separate questionnaires that was designed and administered. The exclusion criteria are Non-IT firms, Telecommunication companies and those who are not aware of cloud computing. While the inclusion criteria are IT & Telecommunication employees, IT managers and people who are aware of cloud computing. Questionnaires were designed and distributed using survey monkey, an online survey application. A number of semi-structured interviews were conducted through Skype with some employees and IT managers to produce a further, in-depth investigation. Analysis of the findings from both interviews and questionnaire served to provide an insight to the objectives of this research. Following the outcome of the research, Proper awareness by the cloud service providers on the risk and benefits of cloud, availability of more cloud service providers and free trial of cloud services to clients will encourage adoption of cloud computing.

Keywords - Nigeria, cloud, computing, technology, IT, adoption, analysis, telecommunication.

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1. INTRODUCTION
The significance of cloud computing as the new paradigm in computing cannot be over emphasized, as most businesses are looking for opportunities to maximize profit whilst reducing cost. Looking into the trend of adoption of cloud computing in developed and developing countries, an increase has been identified in the acceptance and adoption of this new computing model. The increasing adoption has motivated the study of cloud computing in Nigeria. According to [National Bureau of Statistics (2012)], Nigeria’s economy consists of many different business sectors. The Information and telecommunication industry is a valuable sector within that industry which has become a great value to the economy. This sector has gradually improved over the recent years and Information technology in Nigeria, has brought about many changes in many sectors of the country. These include Telecommunication and IT firms, Education, Health, Agriculture and Banking to name but a few. There has been a remarkable growth in the telecommunications industry due to an increase in the availability and quality of service.

However, telecommunications and technology in Nigeria initially developed as a result of the trunk telephone service which linked two towns in 1923 [[Ofulue, 1980]. Between 1955–1962 the introduction of very high frequency radio system also allowed for the expansion of trunk cables on a nationwide basis. Nigerian External Telecommunications (NET) Limited was consequently, established to manage the external services and the installation of many more telephone lines. In 1971, Nigeria’s first international telecommunication satellite became operational and in subsequent years more satellite stations, including digitalized Earth stations have been built. In efforts to improve the quality of the telecommunication service, the telecommunication arm of the Post and Telegraph Department of Nigeria, Nigeria External Telecommunications (NET) Limited were merged in 1984. However, the emergence of cellular phones in 1992, led to an unmet demand for more efficient telecommunication services, such as faster bandwidth, which resulted in congestion during peak periods, poor service delivery and a slow growth in infrastructure because more people use mobile phones and used the Internet.
In order to meet with increasing demand for a better quality of service, Nigerian Telecommunications Limited (NITEL), a government owned company, was sold off and became a private company. However, the licensing of the telecommunication service providers has led to an increase in the number of IT and telecommunication companies in the country and competition in the sector. This shift of monopoly, to competition, has led to the establishment of multiple networks, an increase in broadband access through the establishment of submarine cables and fiber-optic networks. This has enabled telecommunication and IT firms to provide more value added services by providing more data centers.

This paper tends to investigate the perception of employees in IT & Telecommunication companies and users of devices that support cloud computing, regarding cloud computing being the next generation of computing technology, the extent of cloud computing adoption and to identify the motivating factors, current issues affecting the adoption of cloud computing in Nigeria, and it will be done as follows: Section 1 of this paper is about technology evolution in Nigeria, section 2 gives brief reviews on cloud computing. Section 3 will discuss the survey and interview carried out to achieve the objectives of the research. Section 4 is the analysis on data, result of the survey and interviews. Section 5 will discuss the findings while Section 6 will give recommendation and conclude the paper.

2. BRIEF REVIEW OF CLOUD COMPUTING

[Youseff et al. (2008)] stated that cloud computing is not a completely new concept but a combination of new and already existing technology. Cloud computing is not a revolution in information technology but an evolution of existing technologies as the main revolution occurred long before the advent of cloud computing [Anjomshoaa, Tjoa (2011)]. For this piece of paper, the author has decided to use the definition of cloud computing as stated by the U.S National Institute of Standards and Technology (2011) because this definition has gained in popularity and the definition captures the unique features of cloud computing. The U.S National Institute of Standards and Technology (NIST) defines Cloud computing from the characteristic point of view as being “a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction” [NIST 2011].

2.1 Cloud Computing Services

Cloud computing services are grouped into three areas: software as a service (SaaS), platform as a service (PaaS) and Infrastructure as a service (IaaS) [Zhang et al. 2010]. These services are arranged in layers and they replace the traditional “in-premises” computing systems [Barnatt, 2010].

Software as a service (SaaS): This is the top-most and easiest layer of cloud computing. As Fig 1 shows below, this is because this layer involves applications such as word processors, video editors and databases to be hosted by cloud service provider and is made readily available to the customers on demand or pay as you go, through the internet. Examples of software as a service include Customer Relation Management (CRM) online applications for managing customers, email messaging, Google Document (Doc) [Leavitt, 2009; Barnett, 2010].

Platform as a service (PaaS): This is the middle layer between SaaS and IaaS (see Fig 1). It consists of operating systems and application development platform which can be accessed and utilized through the Internet [Zhang et al. 2010]. Developers use this platform to develop, test, deploy and host web application as a service via the internet. For example: Google Application Engine, Microsoft Windows Azure and International Business Machine (IBM) are providers of such platforms as a service [Barnett 2010].

Infrastructure as a service (IaaS): As Fig 1 illustrate below, this is the bottom layer and is basically what software applications run on and where data is stored [Barnett 2010]. This service provides available storage, servers, networking, management and support components for organizations, on demand, making use of virtual servers [Vaquero et al. 2009]. These servers and storage infrastructures are accessed through the internet [Leavitt, 2009], thereby, enabling businesses to move their data to cloud and dissolve their in house data centers. Examples of this include Google grid, layered technology and Joyent. Each of these services can be deployed by organizations or individuals either as a private cloud, public cloud, hybrid cloud and community cloud.

2.2 Cloud Computing Development Model

There are four types of cloud computing deployment models, which include private, public, hybrid and community cloud computing.

Private cloud: Private cloud also referred to as internal cloud, [Zhang et al. (2010)] is exclusive to the internal use of an organization. It is either managed by the organization itself, or managed by a third party. (It provides the highest form of control over reliability, performance and security).
Public cloud: Involves making services such as application, hardware and servers available to the general public [Dillon et al. 2010]. Some of the applications are made available for free, to the public whilst others are accessed on a pay as you go service. It is easy, and inexpensive, to deploy because it requires no capital investment on infrastructure and cloud service providers are solely responsible for making policy, profiting, cost and value as regarding it.

Hybrid cloud: This is a combination of two cloud models: public, and private or public and community etc. The clouds, which are bound together by standardization, allows for data and application portability [Dillon et al. 2010]. Hybrid cloud computing are used to maximize resources.

Community cloud: Is provided exclusively for a set of users within an organization having a shared and common goal [Dillon et al. 2010]. Example, security requirement.

2.3 Extent of Cloud Service Adoption

[Kshetri (2010)] explains the extent of cloud adoption as the amount of cloud services used in businesses in term of the frequency of use and the number of businesses using it. Surveys have been conducted to identify whether the cloud service is mostly adopted in businesses or not. The survey conducted by information Technology (IT) decision makers (2009) stated in its executive summary, that software as service, was the mostly embraced by companies compared to infrastructure as a service and platform as a service. More than 90 % of users were very satisfied with applications of software as a service and more than 60% said they would increase the use of software as a service in the following year, but feared its reliability. Also, the results of the survey conducted by KPMG one of the largest professional services companies in the world and one of the Big Four auditors. KPMG (2010) of 125 decision makers and business managers in the Netherlands, also shows that a larger percentage of people no longer consider cloud computing as “hype”. For example, 41 % believe that cloud computing is the future IT model, 18 % strongly believe that cloud computing is the future IT model, 29 % are undecided and 12 % disagree that cloud computing is the future IT model. This shows that 59 % (which is the sum of those who agree and strongly agree) and just 12 % disagree. However, these surveys show that the perception of cloud computing is improving year after year and companies are beginning to test and use cloud computing.

3. SURVEY AND INTERVIEW

3.1 Data Collection

The data collected for this research were from both primary and secondary sources. The primary source data were collected using questionnaires and interviews, while the secondary source data were gathered from academic Journals, publications, the Internet and literature based on cloud computing. The information gathered from secondary data was the building blocks with which the researcher was able to develop the paper topic and also determine the information necessary in obtaining the primary data for the research.

3.2 Primary Data Collection

3.2.1 Questionnaires

The questionnaires were distributed using survey monkey, an online survey application because this allowed for easy administration of questionnaires once they were designed. It also allowed for easier statistical analysis and then can be administered asynchronously without the need of an administrator.

3.2.2 Interview

The researcher employed a semi-structured interview online through Skype for the participants. This method was used, because it has the potential to provide a wealth of thick description of the research topic and would help to clear the air of any ambiguity regarding the responses of participants. Interviews are also used to discover how participants feel about a subject, in this instance cloud computing and then provide an in-depth response, or answer, to the research questions.

3.2.3 Secondary Data

The secondary data used for this research was obtained from textbooks, academic journals from science direct, Emerald, Google scholar search engines, IEEEXplore digital library etc. Also, many useful publications from internet were used. The data from these resources were useful in developing the literature review, the research objectives and research plan.

4. ANALYSIS ON DATA AND RESULT

This section presents an account of the research findings gathered from both questionnaires and interviews tailored at determining the extent of cloud computing adoption in Nigeria. The questionnaires were aimed at addressing the research while semi structured interview questions were used to provide an insight into the research objectives as well as validate the credibility of the findings gathered from the questionnaire.

4.1 Analysis of Questionnaire

In order to know the extent of cloud computing adoption in Nigeria, two separate questionnaires were administered through online survey monkey. One of the questionnaires was targeted at IT managers in 15 different IT and Telecommunication companies, and the other set of questionnaires were addressed to employees in IT and Telecommunication companies & users of devices that support cloud computing in Nigeria. The first questionnaire was sent to 15 IT managers of which all responded. The second questionnaire was sent to the employees and users of devices that support cloud computing. 70 responses were received out of which 55 response represent 78.6% of the sample size, 3 did not consent to take the survey and 12 were not aware of cloud computing [See Fig 2].

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The research objectives below were addressed using this sample size.

**Research objective 1:** To investigate the perception of employees in IT & Telecommunication companies and users of devices that support cloud computing, regarding cloud computing being the next generation of computing technology. In order to achieve this goal, a number of questions were asked and the survey revealed that only 7.4% of respondents were very aware about cloud computing and believe it will be the next generation of computing technology. 77.8% were aware and also believe it will be the next generation of computing technology while 14.8% were not very aware. See Fig 3.

**Research objective two:** To know the extent of cloud computing adoption in Nigeria: the level of cloud adoption in Nigeria is perceived to be low with 40 respondents representing 74.1% of the population, 13 respondents representing 24.1% believing that adoption is still on average and just one respondent representing 1.9% says the level of adoption is high. This is represented in fig 4 below.

**Fig 2: Research Population**

**Fig 3: Level of awareness**

**Fig 4: Cloud Adoption in Nigeria**

However, the survey revealed that web-based email is the highest cloud service used, which is represented by 100%, in the figure below, followed by cloud based collaborative tools represented by 46.7% and no respondent opted for development software, project management applications, or servers as shown below.

**Fig 5: Cloud adoption in Nigeria**
Research objective three: To identify motivating factors for cloud computing adoption in Nigeria.

In order to achieve this, the benefits of cloud computing were used as the determining factors. The result identified three important reasons for adopting the cloud which are represented in the figures below.

**Increased focus on core business:** 88.5% of the sample size strongly agreed that increased focus on core business is a major factor for adopting the cloud while 11.5% of respondents were neutral, but no respondent strongly disagreed. This is shown in the figure below.

![Fig 6: Factor motivating cloud adoption](image)

**Easy Accessibility:** 85.5% of sample size strongly agreed that easy accessibility of data using any device and at any time was a motivating factor for adopting cloud computing, while 9.1% of respondents were neutral and 5.5% strongly disagreed as shown in the graph below.

![Fig 7: Factor motivating cloud adoption](image)

**Collaboration:** 83.3% of respondents strongly agreed that collaboration was a motivating factor for cloud adoption while 16.7% of the sample size where neutral and no respondent strongly disagreed. This is shown in the figure below.

![Fig 8: Factor motivating cloud adoption](image)

**Reduction in IT staffs:** However, 21.8% of respondents strongly disagreed that the reduction in IT staff will motivate the adoption of the cloud computing. See the fig below.

![Fig 9: Factor motivating cloud adoption](image)

Research objective four: To identify current issues affecting the adoption of cloud computing in Nigeria.

To achieve this objective, many factors were considered and some were considered significant. The result identified three major factors affecting adoption rate in the country.

**Poor awareness:** Poor awareness of cloud computing representing 88.9% of respondents who strongly agreed, 9.1% of respondents were neutral while 1.8% strongly disagreed.

![Fig 10: Factor mitigating adoption of cloud computing](image)
**Unstable Power:** Unstable power supply in which 87.3% respondents strongly agreed, 12.7% respondents were neutral about it but no respondent disagreed as shown in Fig 11.

![Fig 11: Factor mitigating adoption of cloud computing](image1)

**Inconsistency:** Inconsistency as well as high cost of internet services, was also a huge factor in which 83.6% of respondents strongly agreed and 16.4% respondents were neutral, as shown in Fig 12.

![Fig 12: Factor mitigating adoption of cloud computing](image2)

**Trust of a cloud provider:** Trust of a cloud provider was also highlighted and the percentage of respondents that strongly agreed were 56.4% and 38.2% of respondents were neutral while 5.5% of respondents strongly disagreed, as shown below.

![Fig 13: Factor mitigating adoption of cloud computing](image3)

**Cost of cloud computing:** 50.9% of respondents were neutral about the cost of cloud computing being high in the future and 29.1% strongly agreed, while 20.0% strongly disagreed as shown in the graph below.

![Fig 14: Factor mitigating adoption of cloud computing](image4)

### 4.2 Qualitative Data Analysis-Interview

The author sent an individual email to seven participants describing what the study entails, plus an invitation letter asking for a suitable date and time for the interview to take place, together with an informed consent. Their approval of the informed consent form and invitation were delivered back through mail to the researcher. The researcher sent a confirmation email to the seven participants who agreed to be interviewed. The interviews were conducted between January and February 2014. The interview was conducted through Skype, as this method was considered more cost effective and convenient. The interview lasted approximately forty to forty-five minutes for each participant. And the discussions were based on the research objectives.
Respondents | Field | Size of firm | position
--- | --- | --- | ---
Respondent A | IT firm | Small Medium Enterprise | IT manager
Respondent B | Telecommunication | Large scale | IT manager
Respondent C | Telecommunication | Large scale | Employee
Respondent D | IT firm | Small Medium Enterprise | Employee
Respondent E | IT firm | Small Medium Enterprise | Employee
Respondent F | IT firm | Small Medium Enterprise | Employee
Respondent G | IT firm | Small Medium Enterprise | Employee

Fig 15 Respondent of interview

**Research Objective one:** To investigate the perception of employees in IT & Telecommunication companies and users of devices that support cloud computing, regarding cloud computing being the next generation of computing technology. Participants were asked their opinion of cloud computing. All respondents agreed that cloud computing is the next computing technology. However, when asked if Nigeria was ready for cloud computing, there were varying responses. Respondent A said I don’t think so, because only a few people know about the technology. Respondent B said ‘not really until the factors affecting adoption of cloud computing is addressed’. Respondent C said ‘I think we will be ready for cloud computing in a couple of years’ time but for now, we are not ready’. Respondent D said ‘yes and No’. ‘Yes because there is an available market and businesses if aware of the benefit, will adopt cloud services’. ‘No’ because ‘the basic infrastructure needs to be put in place and IT personnel have to be trained to handle necessary tasks with regards to the use of those services where necessary’. Respondent E said ‘Nigeria is always ready for anything but people are just lazy to start’ and Respondent F said ‘yes’ because ‘some companies have already taken the bold step of adopting the cloud’. However, few respondents stated that Nigeria is ready for cloud computing.

**Research Objective two:** To know the extent of cloud computing adoption in Nigeria. Respondents were asked if they use or have deployed any cloud computing service and what they think or know about cloud deployment and usage in Nigeria. All respondents indicated that they use some form of cloud service in their company. But most of them stated that they are basic cloud services. Respondent A said ‘we use software as a service, like human resource cloud services, web-based email and infrastructure as a service but they are the basic cloud service’. However his company is currently working on a project to provide infrastructure as a service to clients, but he thinks large scale companies will be the first to adopt their services because ‘based on the infrastructure by the provider, the service it’s quite expensive’. Respondent B said they have adopted both software as a service and infrastructure as a service. Respondent C said we use public cloud, and I think ‘most small and medium IT firms use public cloud usually in form of software as a service’. Respondent D said they have adopted software as a service and thinks ‘large scale companies will adopt private cloud computing because most small scale companies either do not have knowledge of cloud computing or do not have the fund to deploy such services’.

**Research Objective three:** To identify motivating factors for cloud computing adoption in Nigeria. All respondents indicated that for businesses to be highly encouraged, major factors regarding basic infrastructure and awareness need to be addressed.

**Research Objective four:** To identify current issues affecting the adoption of cloud computing in Nigeria. Most respondents stated poor awareness of cloud computing as the major problem affecting its adoption in Nigeria. Respondent A said awareness is the basic for cloud adoption. Respondent B stated it is ‘mainly ignorance of its availability’ Respondent C said the primary factor is knowledge of cloud computing. If there is no knowledge of it, then it can’t be adopted. Also, Basic infrastructure is a major factor affecting the adoption of cloud computing. Respondent D said ‘we still have power outages and it’s quite expensive to host a cloud 24/7’. Most of the respondents stressed on awareness and inadequate infrastructure before referring to the issue of trust and security. Only few respondent regarded security as the first major issue affecting the adoption of cloud computing in the country. Respondent E said the key factor is more of privacy and security. And then said that ‘there is no direct solution to this, I believe that an awareness of basic security principles would go a long way to help the Nigerian society adopt this service’. Respondent F said lack of cloud computing knowledge, some people even who use devices that support cloud, use the technology without knowing. Like converting their word to PDF or vice versa online. Respondent G said security, trust and poor power supply.

5. DISCUSSION OF FINDINGS

This research seeks to evaluate the factors affecting the adoption of cloud computing in Nigeria. This was achieved quantitatively with the use of online surveys and qualitatively, with interviews. The findings gathered have been analyzed in the previous chapter. The finding of both research methods will be discussed in relation to the research objectives and literature reviewed.

5.1 Discussion of findings

**Research objective 1:** To investigate the perception of employees in IT & Telecommunication companies and users of devices that support cloud computing, regarding cloud computing being the next generation of computing technology. The survey revealed that a large percentage of employees in the IT and telecommunication companies and users of devices that support cloud computing have some knowledge of cloud computing which amounted to 78.6% of the sample size. The survey also showed that employee’s perception of cloud computing as the next generation of computing technology was very high. This corresponds to the results obtained from the qualitative research (All respondent agreed that cloud computing is the next computing technology). The majority of the respondent believed that the adoption of cloud computing in the country is still very low.
This is because most companies utilize majorly basic cloud services as represented in the graph, such as web based email and collaboration tools and only a few indicated that Nigeria is cloud computing ready. These shows that while cloud computing is perceived as the next generation in computing technology, there are still factors affecting its adoption [Leavitt, 2009] and that transition to cloud computing is still at an early stage.

**Research objective 2:** To know the extent of cloud computing adoption in Nigeria.

Majority of the respondent believed that the adoption of cloud computing in the country is still very low. Though the survey and interview revealed that a large percentage of companies use mostly Software as a service (SaaS) and very few companies use Infrastructure as a service (IaaS). This validates findings from Colt a leading provider of integrated managed IT and networking solution, commissioned industry research (2011) and KPMG (2010) that Software as a service (SaaS) has a higher rate of adoption than Platform as a service (PaaS) and Infrastructure as a service (IaaS).

**Research objective 3:** To identify motivating factors for cloud computing adoption in Nigeria.

Findings from both survey and interview differed on this point. The difference in the findings could be as a result of the closed ended questions, which did not provide the participants view to be disclosed. From the survey, most respondents’ regarded an increased focus on primary services, collaboration and easy access of data were the main causes of adoption. On the other hand, findings from the interviews showed that the major motivating factor for cloud adoption requires the provision of a basic infrastructure. Furthermore, a lack of basic infrastructure will impact on cloud providers due to relatively few clients. However, providers will have to find alternative ways to encourage growth of cloud usage before infrastructure are provided.

Also, findings from the survey showed that a reduction of IT expertise was less of a motivating factor for adopting cloud computing. This is because cloud adoption is seen as a disadvantage rather than an advantage for most IT personnel. [Khajeh-Hosseini et al. 2010] highlighted that cloud computing would lead to the downsizing of staff in IT departments if they are major into providing hardware and software support.

**Research objective 4:** To identify current issues affecting the adoption of cloud computing in Nigeria.

The survey revealed that three major factors which have greatly affects the adoption of cloud computing. 89.1% of respondents indicated that poor awareness of cloud computing had been a setback for using cloud computing. Findings from the interview also supported this fact that people are not aware of the benefits of cloud computing. The major issue of adoption is awareness. Just a few businesses have identified with cloud computing because the awareness level is still low. Unstable power supply was another major factor which can lead to loss of data and inaccessibility of cloud service [Greengard, 2010].

Also, the high cost of bandwidth when transferring data-intensive application through the internet, unreliability of internet service due to distance barrier and low bandwidth capacity [Leavitt, 2009] In addition, the position of [Qamar et al 2010] on the issue of security and privacy was supported by some respondents. This finding was also supported with the result gathered from the survey conducted by CIO (Chief Information Office) stating cloud adoption considered as a risk due to insecurity and loss of privacy. This shows that security will continually be a concern as regards adoption. However, it was interesting to find out that security was not a major concern for cloud adoption as compared to survey findings of developed country.

However the survey showed that more respondents were neutral as regards cost of cloud computing. Different reviews on cost of cloud computing show it is still uncertain that the cost of cloud computing will eventually cost more or if it will actually be cost effective. Moreover, [Durkee (2010)] associated increased cost of computing with cloud service providers but Ambrust et al. (2010) said cloud computing will remain cost effective due to elasticity and transference of risk during under provisioning and over provisioning of IT resources.

6. RECOMMENDATION AND CONCLUSION

6.1 Recommendation: In this section the author will discuss briefly the recommendations, contribution to knowledge, future work, and conclude this paper based on the outcome of the research. Following the outcome of the research, the following recommendations are put forth to boost the growth of cloud computing in Nigeria.

1. **Proper awareness by the cloud service providers on the risk and benefits of cloud, for instance, what it takes to migrate to cloud and how to migrate to cloud should also be given consideration by cloud service providers.**
2. **Availability of more cloud service providers will encourage adoption of cloud computing. This will increase the awareness of cloud computing and reduce issues of inaccessibility due to wide geographical distance between computing resources and consumers.**
3. **Cloud providers should provide free trial of cloud services to clients for a stipulated period to encourage adoption of cloud computing.**

6.2 **Contribution to knowledge:**

The findings showed that Cloud computing will be the next generation computing model in Nigeria. (Refer to Research objective one under section 5.1 Discussion of findings.)

The adoption of cloud computing in Nigeria is low as surveyed in this research. (Refer to Research objective two under section 5.1 Discussion of findings.)
SaaS (Software as a service) is the most used cloud service in Nigeria. (Refer to Research objective two under section 5.1 Discussion of findings.)

Increased focus on primary services, collaboration, easy access of data and provision of basic infrastructures were identified as the motivating factors for cloud computing adoption in Nigeria. (Refer to Research objective 3 under section 5.1 Discussion of findings.)

The research revealed three factors that have greatly affected the adoption of cloud computing in Nigeria. These factors are:
1. Poor awareness of cloud computing
2. Unstable power supply
3. High cost of internet bandwidth and unreliability of internet service. (Refer to Research objective 4 under section 5.1 Discussion of findings.)

6.3 Future works: Based on the outcome of the research. The extent of cloud adoption in Nigeria is low, current factors affecting the adoption of cloud computing were analyzed and the factors that will motivate the adoption were stated in this paper. Future research on this topic should focus on identifying the extent of adoption of cloud computing, after the current factors identified in this research have being considered.

6.4 Conclusion: the following are the core finding of the research. Overall, cloud computing is no longer a hype but a technology that is set to change the way business operation are implemented. It allows computing resources readily available on demand, flexible and scalable. This study reveals that the perception of cloud computing being the next computing tool is similar with findings of previous surveys. Cloud computing is the next computing technology but the extent of adoption in Nigeria is low compared to some countries. This shows that the adoption of cloud computing varies across countries as stated by [Wyman 2008]. This can be as a result of lack of adequate infrastructure as in the case of Nigeria.

This study also reveals there is need for continuous improvement on basic infrastructure. The availability of basic infrastructure and awareness of cloud computing are necessities for more businesses to consider cloud adoption. While in developed countries, the major factor slowing down the adoption of cloud computing is security. This is also a concern for cloud adoption in Nigeria but awareness and availability of adequate infrastructure are the major determinant for cloud adoption.

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Distributional Errors Normalisation Model (DENoM) for Improving the Variability of Supervisors’ Appraisals Ratings

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ABSTRACT
Distributional errors characterise the performance appraisals of many large organisations, and the prevalence of these errors often renders an entire appraisal process worthless. The literature also indicates that the prevalence of these errors is dangerous to both employees and the organisation, as it facilitates a situation whereby poor performers under a lenient supervisor get relatively high pay increases and promotions, whereas the strict supervisor denies the superior performing subordinates of their deserved rewards. This has been proven to have demoralizing effect on the morale and motivation of the top-performing employees, as it promotes mediocrity and relegates excellence to the background. This paper therefore, identifies that the common indicator for determining the presence of distributional errors in the ratings of a supervisor is low-variability of the scores. Consequently, the paper formulates a database dependent computational model, known as the “Distributional Errors Normalisation Model (DENoM)”. DENoM integrates the appraisal data from all the supervisors in an organisation, and creates a correction factor used to obtain the eventual adjusted Total Rating for the employees. The purpose of the model is to improve the variability of the appraisal values awarded to employees across the various units in the organisation. It is our position that when the variability of the appraisal scores are improved, there will be improved feeling of equity among the staff, irrespective of the tendencies of their supervisors.

Keywords - Distributional Errors, Normalisation, Variability, Performance Appraisal, Correction Factor.

1. INTRODUCTION
Public service organisations and indeed other large corporations decentralise into work structures, usually referred to as Units or Departments. Each Unit will therefore, have a supervisor, who oversees the day to day work-related activities of the subordinate employees within the Unit. Consequently, one of the responsibilities of a supervisor will be to evaluate the performances of the subordinate employees. The evaluation instrument(s) always surely includes the section(s), whereby the supervisor appraises the performances of each employee for the period under review. And entries made by the supervisors are also always used for arriving at employees’ career decisions. However, [11] posits that, as “people differ on many psychological and physical characteristics”, so also are people different in performing personnel functions, such as employees’ performance evaluations. It is in the light of this position that the literature identifies “Strictness, Leniency, and Central” supervisor tendency rating errors, as the “most serious problem that needs to be dealt with” among the common rating errors in employees’ performance evaluations [6]; [9]; [10]; and [7].

Murphy and Cleveland in [8] indicate that “Strictness, Leniency, and Central” supervisor tendency rating errors in employee performance evaluations are generally referred to as “distributional errors”. As their identities suggest, the distributional errors are those that occur due to supervisors who tend to rate all their subordinates consistently lowly, highly or averagely, respectively [6]. The strict supervisor gives ratings lower than the subordinate deserves, and by implication disfavours the superior performing subordinates. In the same vein, the lenient supervisor tends to give higher ratings than the subordinate deserves, thereby rewarding poor performing subordinates with undeserving high scores. Similarly, the central tendency supervisor tends to rate all employees as average, using only the middle part of the scale.
These errors characterise the performance appraisals of many large organisations. In fact, [10] identifies the appraisal process in public service organisations as a good example of domains where the pervasiveness of distributional errors often renders an entire appraisal system worthless. In support of this position, [9] reports of a study involving 5,970 employees, where two supervisors working with the same set of employees within the same period, awarded inconsistent performance ratings to the employees, such that, 62 percent of the time, employees rated outstanding by one supervisor were rated lowly by their other supervisor. In other words, the poor performers under a lenient supervisor get relatively high pay increases and promotions, whereas the strict supervisor denies the superior performing subordinates of their deserved rewards.

More so, distributional errors are also a source of problems when an organisation wants to terminate an employee because of poor performance, as well as when personnel decisions are based on comparisons of appraisal ratings [10]. Consequently, [7] asserts that the existence of these errors in performance evaluations is dangerous to both employees and the organisation, as it will have a demoralizing effect on the morale and motivation of the top-performing employees. For instance, it could get to a point where some of the superior performing employees, working under strict supervisors decide to leave the organisation, while some of the low performing employees under lenient supervisors grow on the job, and probably becoming the supervisors of tomorrow. This tendency therefore, promotes mediocrity and relegates excellence to the background with ominous consequences.

Eventually, [7] posits that, “the worst situation is when a firm has both lenient and strict supervisors and does nothing to level the inequities”. In view of this position, this paper develops the Distributional Errors Normalisation Model (DENoM).

DENoM is a database dependent computational model, aimed at minimising the inequities (imbalance) occasioned by supervisors’ appraisal tendencies. The model integrates the appraisal data from all the supervisors in the organisation, and creates a correction factor used to obtain the eventual adjusted Total Rating for the employees. The purpose of the model is to improve the variability of the appraisal values awarded to employees across the various units in an organisation, irrespective of the tendency of the supervisor. The testing of the impact of this model in a real-life organisational appraisal data is ongoing in an empirical study, and will be published in a subsequent paper.

2. ORGANISATION OF PAPER

This paper begins with a review of the literature, aimed at identifying the relevant issues to be addressed. This is followed with the formulation of the Distributional Errors Normalisation Model (DENoM). Discussions on the purpose of the model, as well as the process of transforming appraisal data using the model, are also presented.

3. RELATED WORKS

Murphy and Cleveland in [8] indicate that distributional errors are thought to be present in employees’ performance appraisal data when the plotted distribution of ratings differs from the normal distribution of scores. And a normal distribution of scores approximates to a bell-shaped curve, representing a normal distribution-Gaussian curve [5]. Consequently, the presence of distributional errors leads to a score distribution that approximates to a curve that is tilted from the standard distribution curve [5]. In order to make the preceding discussion clearer, a graphical representation describing how the distributional error curves shift from the normal distribution curve is shown in Figure 1.

Other terms used to represent distributional errors are “low mean rating”, “high mean rating”, and “scale around midpoint rating” [8]. Low mean rating obtains from a strict supervisor, whereby the mean of all his ratings are substantially lower than the midpoint rating. On the other hand, high mean rating obtains from a lenient supervisor, whereby the mean of all his ratings are substantially higher than the midpoint rating. Similarly, the scale around midpoint supervisor follows the central tendency leaning.
Murphy and Cleveland in [8] indicate that, for a distribution of performance to be true (normal), the variability of the scores should be substantial. Variability refers to how "spread out" a group of scores is [14]. Datasets are said to have high variability (dispersion) when they contain values considerably higher and lower than the mean value [14]. The literature identifies many attempts towards substantially improving the variability of ratings awarded by each supervisor. Some of these attempts are presented below. Rater training to improve the variability of ratings has been the focus of numerous studies in employees’ performance appraisals [13].

The advocates of this approach indicate that raters’ education will positively influence ratings through better knowledge of key cognitive and observational demands of the rating process [10]. However, [8] posits that the effects of applying this recommendation depend highly on the individual tendencies of the trained rater. While some will react positively, others may ignore it. Furthermore, [9] reports of another approach popularly referred to as calibration meetings.

A calibration meeting involves the contribution of scores from all the supervisors that worked with an employee within the period under consideration. Eventually, the average of the supervisors’ scores for each employee is considered to be his/her eventual score. The calibration meeting exposes talent to a much larger group of supervisors, and motivates them to work really hard to justify the ratings awarded to their subordinates. Its drawback, however, is the additional layer of administration, which could hinder some of the supervisors from doing the right things [3]. DeNisi and Griffin in [2] indicate that the forced distribution method is another approach being applied by many organisations to ensure that ratings conform to variability standards. This method involves the grouping of employees into predefined frequencies of performance ratings. The frequencies are determined by the organisation in advance, and are imposed on the raters. Supervisors appraising employees under a forced-distribution system would be required to place a certain percentage of employees into various performance categories [4].

For example, it may be required that: 10% of employees are rated as “Excellent”, 10% as “Above Average”, 65% as “Average”, 10% as “Below Average”, while the remaining 5% are rated as “Poor”. This approach results in a normal distribution of ratings. However, it has the drawback that it may disenfranchise certain categories of staff that are actually performing well, but could not be accommodated within the restricted range. Nevertheless, even in the midst of applying the aforementioned approaches, many of the supervisors still exhibit the tendencies that introduce low variability in their appraisal scores. Consequently, it is imperative to pre-determine the variability of ratings from different raters, to ensure that their ratings conform to the normal distribution curve.

Variability measures, such as, standard deviation, which has been described as “the most robust and widely used measure of dispersion”, can be used to test their level of compliance with standards [12]. The outcome of the testing will determine if further action will be needed. Following this line of thought, [8] advises that “rater error measures are the most common indices of the accuracy of ratings”. And in support of this position, [10] asserts that the “methods currently used to examine the quality of ratings (i.e., detect rater errors) do so from an aggregated perspective”. The description in the preceding paragraph is representative of the “model-fit (or person-fit)” approach as stated in [10].

The notion behind this approach is that rater errors are believed to be systematic, and therefore, are detectable as patterns in the ratings assigned by raters. Consequently, the author further posits that, “rather than using techniques to control errors (e.g., format, training), it may be better to utilize methods to detect those who are committing errors and deal with their ratings accordingly”. This paper adopts this approach in the formulation of the model, which tests for distributional errors in inter-Departmental employees’ performance appraisal data, and proceeds to ensure that they conform to the normal distribution curve.

4. METHODOLOGY

Berry in [1] indicates that leniency, strictness, and midpoint scaling in a set of employees’ performance evaluation data can be determined as follows: (1) Leniency error: the resulting mean rating score is high, the variability among scores is low, and the scores are concentrated at the high end of the distribution, (2) Strictness error: the resulting mean rating score is low, the variability among scores is equally low, and the scores are concentrated at the low end of the distribution, (3) Central Tendency error: the resulting mean rating score is relatively average, the variability among scores is low, and the scores are concentrated at the middle of the distribution. Proceeding from the above paragraph, it is sufficient to state that the common indicator for determining the presence of distributional errors in the ratings of a supervisor is the low-variability of the scores that is either clustered around the top, the middle or at the bottom.

The focus of this paper therefore, is to introduce a model, which will integrate the organisational appraisal data into a central database, and produce Total Ratings with improved variability, which is distributed among employees in the various departments. The model is tagged “Distributional Errors Normalisation Model (DENoM)”. The description for deriving the model is presented below. The availability of n units in an organisation implies that there should be n supervisors. If a supervisor $S_i \ (i = 1, \ldots, n)$ has m subordinates $S_j \ (j = 1, \ldots, m)$, then the Total Score ($TS_i$) awarded by the Supervisor is derived, as shown in Equation 1.
The next stage is to determine the Correction Factor distributive set corresponding to each of the Supervisors: $S_i = \{S_{i1}, S_{i2}, S_{i3}, \ldots, S_{in}\}$. The essence of this step is to round the total of the NCF’s to 1, such that the final value remains a multiple of 1. To obtain this, we take the sum of all NCF’s, such that:

$$\sum_{i=1}^{n} NCF_i = 1$$

In other words, take the sum of NCF, (i = 1, 2, . . . , n), as in: NCF$_1$+NCF$_2$+NCF$_3$+NCF$_4$+…+NCF$_n$, and store the value in a temporal variable. Then determine each Supervisor’s Correction Factor (SCF$_i$), by dividing each supervisor’s NCF, * $\phi$ the sum of the NCF’s as previously stored in the temporal variable. Consequently, for each supervisor $S_i$, the SCF$_i$ is derived as shown in Equation 8.

$$SCF_i = NCF_i \div \sum_{i=1}^{n} NCF_i$$

SCF as computed in Equation 8 represents the Correction Factors for the contributing supervisors $S_i$ (i = 1, 2, 3 . . . n).

For the purpose of this study, we assign the SCF’s to the symbol ($\phi$). Consequently, the Correction Factors corresponding to the supervisors: $S_1$, $S_2$, $S_3$ . . . , $S_n$ will be: $\phi_1$, $\phi_2$, $\phi_3$ . . . , $\phi_n$ respectively.

5. DISCUSSION

DENoM, as structured above involves several mathematical computations. Furthermore, it requires the integration of the databases of the submissions of the supervisors in different units of the organisation to form a common pool of the appraisal data. Furthermore, in very large organisations with number of employees varying between 500 and 5000 (+), it becomes almost impossible to accurately normalise the Appraisal scores manually within a meaningful time-frame. Consequently, we recommend the computerization of the entire appraisal process in order to effectively achieve the benefits of this model.

Within a fully computerised and inter-networked system of databases, the appraisal entries by staff and supervisors are made through computer screens. The data transformation of the appraisal data is achieved by dividing each employee’s Total Score by his/her supervisor’s SCF. Preliminary results obtained using this model indicates shows that the objectives of developing this are achieved. The results further indicate that the variations are proportionate to each employee’s supervisor’s appraisal tendencies.
The values generated will usually be greater than 100. The distributive set can also be processed, as shown earlier, in order to adjust it to the range of 100 and below. This Employee Adjusted Total Rating becomes the new Employee Total Rating, which will be used in the determination of appraisal rewards.

An extensive testing of the impact of this model in a real-life organisational appraisal data is ongoing in an empirical study, and will be published in a subsequent paper. In order to determine the effect of the Correction Factor on the Employee Total Ratings, we compare the standard deviations and the coefficient of variation (CV) of the old and the new values. The old value is the original Employee Total Rating before the transformation, while the new value is the Adjusted Total Rating.

6. CONCLUSIONS

The literature identifies Distributional errors as the “most serious problem that needs to be dealt with” among the common rating errors in employees’ performance evaluations [6]; [9]; [10]; and [7]. The literature further indicates that these errors occur due to supervisors who tend to rate all their subordinates consistently lowly, highly or averagely, respectively [6]. This tendency therefore, promotes mediocrity and relegates excellence to the background with ominous consequences.

This paper therefore, identifies that the common indicator for determining the presence of distributional errors in the ratings of a supervisor is low-variability of the scores. Consequently, the paper formulates the Distributional Errors Normalisation Model (DENoM), which integrates the appraisal data from all the supervisors in the organisation, and creates a correction factor used to obtain the eventual adjusted Total Rating for the employees. The purpose of the model is to improve the variability of the appraisal values awarded to employees across the various units in an organisation, irrespective of the tendency of the supervisor. And it is our position that when variability of appraisal scores are improved, there will be improved feeling of equity among the staff, irrespective of the tendencies of their supervisors.

DENoM is a new approach developed in this paper for the purposes outlined earlier. Preliminary tests results have provided indications that the objectives of developing this model have been achieved in a particular setting. DENoM therefore, is a contribution to knowledge.
REFERENCES


Cost Minimization of Power System Generation
Using Artificial Neural Network (ANN)

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ABSTRACT
Attempts to generate electricity at a minimal cost or economic dispatch (ED) are a problem for many operators in the power industry. The activities involved are very complicated, evolves in time due to unpredictable events. Currently the application of Artificial Intelligence methods in this industry has produced tremendous positive results. In this regard, this study developed Rivann software to provide the best load distribution for optimal power generation with minimal fuel cost using artificial neural network (ANN). The approach is validated by using the lagrangian multiplier method. Result obtained from Rivann show daily cost saving or Netelectric derived from optimal distribution of load as against equal distribution of load. The system will assist operators in thermal power plants with the task of planning power generation economically. The result obtained from the application also explains the important role intelligent support systems can play in the management of the electricity generation industry.

Keywords: Artificial Intelligence, Minimizing cost of generation, Artificial Neural Network, Economic Dispatch, Lagrangian multiplier method, decision support software.

1. INTRODUCTION
Rapid growth in power system industry has made the issue of optimization in power generation, distribution and transmission to become very significant. In the very recent time, deregulation in power industry has changed the part played by various units in the electricity industry for efficiency reasons [1], Services provided by electric power vendors which originally used to be one single entity are now unbundled into three different entities: production, transmission and distribution. The service providers’ compete in providing good electricity delivery and at the same time strive to make profit. To maintain efficiency, security and reliability of supply are not compromised otherwise customer interest and protection will not be guaranteed. In other to achieve these, best practices in economic dispatch [2] are employed. The objective of ED is to systematically seek the lowest cost of electricity production that will be consistent with electricity demand. To minimize cost, ED will increase the use of more efficient generating unit and at the same time address three issues of concern - better fuel usage, reduce maintenance cost and reduced greenhouse gas emission [3, 4, 5], that would result from less efficient generation. Economic dispatch therefore seeks to minimize the total cost of generating power (production cost) at various stations while satisfying the loads and the losses in the transmission lines.
Computer applications as decision support tool (DSS) can be used to provide fair and consistent decisions, and at the same time it can improve the effectiveness of decision making process [6]. A DSS Application as an approach for supporting decision making is typically built for solution of a certain problem or to evaluate an opportunity. It is based on this fact that this paper presents a decision support system Rivpann that uses artificial neural network method to reduce cost during electricity generation process.

Many solution techniques have been proposed and also available to solving economic dispatch problem with varied degree of successes. They can be divided into two main categories, the algorithmic mathematical solution and artificial intelligent solution as reported in several literatures. Among the algorithmic solutions are Interior point (IP) algorithm [7], Simplex algorithm (SA), Quadratic programming (QP), and Dynamic programming (DP) [8]. Lagrange relaxation method (LRM) [9, 10], linear programming (LP), Non-linear programming (NLP) and Newton-based methods have also been reported. These methods failed to solve Optimal Power flow problems because most iteration converge slowly, have difficulty in detecting infeasibility, tendency to error due to linear approximation of non linear estimates and high computational complexity of solution due to large sparse linear system. As a result they converge at sub optimal solutions or local minima. But currently proposed Artificial Intelligent optimization methods based on heuristics and operational research presented by researchers have emerged with global optimum solution for power system optimization. They include Expert system (ES), Ant Colony search (ACS) [11], Simulated annealing (SA) [12], Artificial Neural networks (ANN) [13, 14, 15, 16, 17], Fuzzy logic (FL) [18] and Genetic Algorithm (GA) [19]. Others include Meta heuristic methods such as Tabu search (TS) [20], Particle swarm optimization (PSO) [21] and Evolutionary programming (EP) [22].

Application of these methods depends on the researchers’ area of interest as each method has its own advantages and disadvantages; and notably ANN has proved to be very efficient in solving complex problems because of its properties of robustness, fast computation, non linear modeling and learning ability.

2. PROBLEM STATEMENT

In most developing countries there is persistent power outage mainly due to high cost of electricity production. Standard of living in these countries is generally poor because the per capita consumption of electricity is low. Nigeria for example, with a per capita consumption of less than 136 kW/hour; is almost the lowest in sub-Sahara Africa. The good news is that the application of the principles of ED would enhance electricity generation and would improve infrastructural development. This approach also need to be delivered in a simple and user friendly manner to enable operators effectively apply it. Based on these considerations, Rivpann, a decision support software application that would provide informed decision on minimal cost of electricity production is presented.

3. ED FORMULATIONS

Generally, power system can be operated optimally if the principles of equal incremental cost rate are applied to the problem of optimal distribution of loads among the various stations forming a power pool [23]. The most precise way to describe such operation is to use the relation between the input and output characteristics as available from the generation data of the individual generators.

The characteristic of this relation is described mathematically as:

\[ I = a + bP + cP^2 + dP^3 + \ldots + nP^n \]

where I is the input (cost of fuel) and P (power produced by generator) with coefficients a, b, c to n. Alternatively, it can be represented graphically as shown in Fig 1.

---

**Fig 1:** Input - Output characteristic of a generator.
\( I_0 \) in Fig 1 represents the amount of input required to keep the generator functioning when there is no load. The slopes of the curve at various load-points give the incremental cost rate. If \( I_1 \) and \( I_2 \) are the inputs corresponding to the loads \( P_1 \) and \( P_2 \) respectively, the increase in input required for meeting the increase of load from \( P_1 \) to \( P_2 \) is given by:

\[
I_2 - I_1 = \int \frac{dI}{dP} \, dP
\]

The area under the curve between \( P_1 \) and \( P_2 \) is the incremental rate. Similarly, from no load to \( P_1 \), the increase in input \( I_1 - I_0 \) is given by the area under the incremental rate curve from \( P = 0 \) to \( P_1 \). \( R_i \) is the incremental rate. By differentiating the expression in equation 1 (stopping at the third power), we obtain the incremental rate characteristic as:

\[
R_i = \frac{dI}{dP} = b + 2c(P) + 3d(P^2)
\]

3.1 Generation Cost Minimization

The objective of generation cost minimization is to schedule generation such that input \( I \) is minimum for the given total power \( P \), subject to restriction that sum of \( P_k = P \) is the total load received, where \( P_k \) is the output of unit \( k \). Using the lagrangian method if

\[
f(P_1, P_2, \ldots, P_n) = 0
\]

And

\[
\sum_{k=1}^{n} P_k - P = 0
\]

Then

\[
\sum_{k=1}^{n} P_k = P \quad \text{Apparent Power } (P) = \sqrt{(\omega)^2 + (VAR)^2}
\]

If I represent the cost of input, the minimum input cost is realized when

\[
\frac{dI}{dP_k} = 0 \quad \text{where } I_i = \sum_{k=1}^{n} I_k
\]

Applying lagrangian type multiplier where

\[
I = I_i - \lambda f \quad \lambda = \text{lagrangian type of multiplier}
\]

\[
\frac{dI}{dP_k} = \frac{dI_i}{dP_k} - \lambda \frac{df}{dP_k} = 0
\]

Where \( f \) is the function of total power received i.e.

\[
f(P_1, P_2, \ldots, P_n) = 0 \quad \text{or } \sum_{k=1}^{n} P_k - P = 0
\]

But RHS \( \frac{dI}{dP} = \lambda \) and \( \frac{d}{dP} \left[ \sum_{k=1}^{n} P_k - P \right] = \lambda \)

Hence

\[
\frac{dI}{dP_k} = \lambda \quad \text{.................................................................}(6)
\]

The incremental cost of input to \( k^{th} \) unit in Naira per MW hour is equal to the incremental cost of the received power. The equation (6) may be rewritten as:

\[
\frac{dI_1}{dP_1} = \frac{dI_2}{dP_2} = \frac{dI_3}{dP_3} = \ldots = \frac{dI_n}{dP_n}
\]

If the incremental rate of \( k^{th} \) unit in written as \( R_k \), then

\[
R_{i1} = R_{i2} = \ldots = R_{i20} = R_k = R_n = \lambda \quad \text{.................................................................}(8)
\]

Using symbols, \( C \), for incremental production cost in Naira per MW hour then:

\[
C_{i1} = C_{i2} = \ldots = C_{i20} = C_i = C_n = \lambda
\]

\( \lambda \), - the lagrangian multiplier - is the incremental cost of received power in Naira/MW hour.

3.2 Artificial Intelligence Solution:

With the increasing demand for power, power system network continues to expand; control of energy management system becomes more complex. Parameter of the new power system network introduces additional complexity and these results to discontinuity. To sort for solution, in most cases, the lemma ‘divide and conquer’ is applied to efficiently solve the complex problem through decomposition of simpler elements. Solution to these elements when combined together forms the solution to the complex system. In the last decade, traditional power system computation uses AI methodologies to decompose problems into various functions performing task. Although many AI methods are being used in power system operation, ANN has received more attention.
This is because of its clear model, easy implementation and good performance. Precisely, the technique involved in ANN-based methods does not require explicit models to represent the complex relationship between the various factors that determine the problem [13, 15]. Only parametric data in respect of the problem (which may historical or online) are needed. ANN with its parallel architecture can approximate any continuous function due to its robustness, and fault tolerance capability [16]. ANN models are proven to be superior to other empirical regression models.

3.2.1 The Neural Model

In general, suppose we consider the case of a five-bus power system network in a one line diagram as shown in Fig 2. The five-bus power system network consists of three generator buses (P_G1, P_G2, P_G3) and two load buses (P_D3 and P_D4). A computer based application for the optimal distribution cost using artificial neural network solution can be developed based on the above background information. For the task of minimizing the input cost of generating power for the model we begin with the specification of the neural network parameters (in this case historical) as follows:

![Fig 2: One-Line Diagram of a Five Bus System](image)

Input parameter

C_i -- Cost of fuel (gas) in Naira/mmsef per day for all the generators.

Output Parameter

P_r -- Total output power/load in MW per hour serviced by the generators per day.

A neural model for the operation of the station generators is shown in Fig 3. The input parameters C1 to Cs are cost of fuel used by the three generators in Fig 2. The Pr is the total output power produced by the combined three generators to service a load. This specification will propagate the input parameters (cost) through the network to the output. During this process the network learns (neural learning) with different inputs and the weight(chg wght) values are changed dynamically until their values are balanced (output equals target) or the error (MSE = d) is minimal or zero. The activation function (Obj fxtn) is sigmoid and the learning algorithm is back propagation. Table 1 shows the historical data for the operation of the five-bus network. The table contains data of generator input cost as C1, C2, C3, while P1, P2, P3, are power generated data for P_g1, P_g2, and P_g3 generators respectively for the five-bus network in Fig 2. It is derived based on the fuel input and power output of the polynomial of equation (3).

![Fig 3: Neural model.](image)
Table 1: Sample of Output Power and Cost of Input in Naira Per Hour

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</table>

3.2.2 Specification of the Neural Architecture

The Network architecture usually describes the number of layers in a network, the number of neurons in each layer, each layer’s transfer function, and how the layers are connected to each other. The best architecture depends on the type of problem to be represented by the network. The architecture employed in the above neural model is multilayer feed forward network with one hidden layer. The performance function (MSE) is given by:

\[ MSE = \text{Performance function} = \frac{1}{N} \sum_{i=1}^{N} (t_i - a_i)^2 \]  \hspace{1cm} (9)

Network functions are determined by connections between elements. Learning for a particular function is by adjusting the values of the connections (weights) between elements. The sigmoid activation function is given by:

\[ \rho = \frac{1}{(1 + e^{-x})} \]  \hspace{1cm} (10)

The back propagation learning algorithm updates the network weights and biases in the direction in which the performance function decreases most rapidly – the negative of the gradient. Each one of the iteration is of the form:

\[ x_{k+1} = x_k - \alpha_k g_k \]  \hspace{1cm} where

\[ x_{K+1} \]  a vector of the next weight iteration, \( x_k \) = a vector of current weight and biases , \( \alpha_k \) = learning rate., \( g_k \) = current gradient.

Based on the data in table 1 the neural architecture for the five-bus network is shown in fig 4. The input and output parameters are also stated as for the neural model.
Input Parameters for the Model:
\( C_s \) - Total fuel cost Consumed by the station per generator

Output Parameters for the Model:
\( P_r \) - Total output power/Load demand

4. RESULTS

Results obtained from ‘Rivpam’ decision support application are shown in table 2 for various load demands. Expectedly the difference between operating the station optimally as against equal distribution is clearly identified in the table as NetSave. The daily cost saving (NetSave) for each of the load demands per day is also shown. The table 2 also shows result of optimal load scheduling (OPS) for various load demands. This provides operators with information on how to allocate loads for optimal operation.

### Table 2: Sample of Optimal Distribution Cost from the Neural Network Per Load Demand

<table>
<thead>
<tr>
<th></th>
<th>L1</th>
<th>L2</th>
<th>L3</th>
<th>L4</th>
</tr>
</thead>
<tbody>
<tr>
<td>EQD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load</td>
<td>90.0001</td>
<td>100.0001</td>
<td>110.0001</td>
<td>120.0001</td>
</tr>
<tr>
<td>Gen1</td>
<td>715</td>
<td>920</td>
<td>1057.381</td>
<td>1058.866</td>
</tr>
<tr>
<td>Gen2</td>
<td>686</td>
<td>872</td>
<td>996.8257</td>
<td>998.1753</td>
</tr>
<tr>
<td>Gen3</td>
<td>582</td>
<td>728</td>
<td>825.9004</td>
<td>826.9589</td>
</tr>
<tr>
<td>OPD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load</td>
<td>90.0001</td>
<td>100.0001</td>
<td>110.0001</td>
<td>120.0001</td>
</tr>
<tr>
<td>Gen1</td>
<td>439.596</td>
<td>686.105</td>
<td>962.8247</td>
<td>967.452</td>
</tr>
<tr>
<td>Gen2</td>
<td>625.845</td>
<td>810.234</td>
<td>1015.205</td>
<td>1018.632</td>
</tr>
<tr>
<td>Gen3</td>
<td>849.827</td>
<td>973.088</td>
<td>1107.18</td>
<td>1109.421</td>
</tr>
<tr>
<td>NetSave</td>
<td>1625.568</td>
<td>1213.752</td>
<td>4922.466</td>
<td>5076.134</td>
</tr>
<tr>
<td>OPS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load</td>
<td>90.0001</td>
<td>100.0001</td>
<td>110.0001</td>
<td>120.0001</td>
</tr>
<tr>
<td>Gen1</td>
<td>15.71987</td>
<td>20.00069</td>
<td>30.23796</td>
<td>30.88555</td>
</tr>
<tr>
<td>Gen2</td>
<td>26.6199</td>
<td>29.99997</td>
<td>38.18352</td>
<td>38.70122</td>
</tr>
<tr>
<td>Gen3</td>
<td>47.60993</td>
<td>50.00027</td>
<td>56.54367</td>
<td>56.95782</td>
</tr>
</tbody>
</table>

Key: EQD = Cost of Equal Distribution of load: L1, L2, L3, L4 = load demand: OPD = Cost of Optimal Distribution of load: OPS = Optimal Scheduling of load per generator
5. DISCUSSIONS

For the theory of incremental rate to apply it is assumed that the following conditions would exist:
(a) Input - output curves are continuous
(b) First derivatives of the input - output curves are continuous
(c) Value of the incremental rate increases with the increase in output

In the analysis of optimal load division between the various units of a plant, it is expected that the available historical data on cost is absolutely correct. The implementation of the ‘Rivpann’ program is based on data set for the test cases of table 1. The input cost function is derived from equation 3 with all coefficients positive. (The coefficients for input cost equations are obtained using Matlab Curve Fitting Toolbox). The DSS software was formulated using artificial neural network method and developed as an interactive application for operators at gas turbine generating (GTG) plant. The design uses a special object oriented methodology feature of MatLab called handle graphics technology (HGT).

This approach provides menu-driven guides that would enable operators with little knowledge of computer to navigate through the application without difficulty. Each set of input parameter is stored in an excel file to avoid error while entering data. Line plots of cost versus power output are shown in fig 3. The optimum economy is achieved if every unit (i.e. $P_{g1}$, $P_{g2}$, and $P_{g3}$) operates at the same incremental cost (IC). At any point on the incremental cost, the three generators are operated optimally and fuel utilization is seen to be less. Neural output of simulation in plot and numerical values, daily cost saving and network performance plot derived from Rivpann application are shown in fig 5 and fig 6. The output of daily net saving per load demand when multiplied by 30 days will give the cost savings per month.

6. CONCLUSION

Minimizing cost of fuel in generating electricity is a real world problem and requires practical solution. This paper presented Rivpann decision support application tool designed to determine the best combination of power generating plant to produce electricity with less fuel cost. The small difference in error when compared with the lagrangian multiplier method can be ignored due to network compensation. Robustness and fault tolerance are qualities of this approach over the lagrangian method. Simulation data from other stations tested on Rivpann show no significant difference in result implying that the system can be deployed in a dissimilar geographical location.

7. RECOMMENDATIONS FOR FUTURE DEVELOPMENT

Rivpann can be extended to include an embedded form. When interfaced with a sensor can automatically control the switching of power plant for optimal operation. Additional testing data with varying load for each power output data case can also be simulated. Data for a short duration load and load demand located beyond the protection zone need to be included in the network training as well. The location of a load data plays important role in the power trip decision.

8. CONTRIBUTION TO KNOWLEDGE

This shows that power system optimization by using neural network is possible in Nigeria. The Rivpann software application developed here is the first of its kind because of its strict analytical formalism. Currently, this is the only application in power system industry that has applied the standard concepts of Lagrangian Multiplier theory and Artificial Neural Network techniques in the Economic analysis of Power generation.
Fig. 5 Sample screen for the neural network ED with training plot inserted.

Fig. 6: Sample screen for the Neural network ED with output of simulation in plot and numerical values, daily cost saving and network performance plot.
REFERENCES


Author’s Brief

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An Efficient Wireless Video Surveillance Network System

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ABSTRACT
Video surveillance network structure which can transmit pixels across surveillance infrastructure for monitored scene has been employed in many areas for security purpose. However, the absence of cost effective nodes in surveillance network structure appeared not to have been widely considered. In this research, graph technique was used to develop a model: Far Multi-Node Network (FarMuNNet) for surveillance platform by organically integrating distributed wireless video sensor network (WVSN) on a wireless mesh network topology. We obtain more comprehensive and precise results for solving minimum connection problem without the limitation of the line-of-sight of far surveillance nodes by using minimum spanning tree algorithms and our FarMuNNet model is implemented using both Kruskal’s and Prime’s minimum spanning tree algorithms coded in C++ programming language. The algorithms showed different cost of minimal spanning trees which specified the routes to follow in transmitting pixel packets across the network. With their respective outputs, it is observed that the distances were less compared to the main distance on the existing network structure thereby reducing the cost of transmitting pixel packets from sensor node to receiving node on the network.

Keywords: Surveillance Network structure, Wireless Mesh, Minimum Spanning Tree, FarMuNNet.

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1. INTRODUCTION
In recent times, the rapid increase of insecurity in many countries of the world (specifically in Nigeria) and the quest for an efficient network structure for pixel packet transmission for video surveillance, a simple wired network cannot fully meet the demand, nor the efficient and most economical way. Furthermore, as the world becomes more responsive to the subject of security, the market and demand for multi-site surveillance solutions meeting the most rigorous, video-based security standards is growing. One of the most recent challenges the security professionals are facing is the deployment of viable, cost effective security network structures interconnecting multiple remote sites. Therefore, “A Cost Effective Wireless Video Surveillance network System” is a special and more proactive solution for solving these challenging problems than the conventional wired CCTV surveillance systems.

This research uses graph technique to develop a surveillance network system that will be use for security operations and other surveillance needs, at a minimal cost of transmitting pixel packets which is the objective of this paper.

2. REVIEW OF RELATED LITERATURE
In some past decades, there have been a number of researches done in the area of video surveillance network system. We briefly survey some of these related works and outlined them as follows:

2.1 Closed Circuit Television/Digital Video Surveillance (CCTV/DVS)
Video-surveillance systems, e.g. Closed Circuit Television (CCTV) are increasingly being replaced by more advanced Digital Video Surveillance (DVS) solutions, often utilizing Internet Protocol (IP) technologies and networked architectures, Nelson (2009). Besides the ever-increasing demand for security, the low cost of cameras and networking devices has contributed to the spread of digital distributed multimedia surveillance systems. This now constitutes an emerging field that includes signal and image processing, computer vision, communications, and hardware. The automated analysis and processing of video surveillance is a central area of study for the computer vision and pattern recognition research community. IBM Research’s People Vision project (People Vision), for example, has focused on the concept of Smart Surveillance Hampapur et al., (2003). The VIEWS system Tan et al., (1998) is a 3D model-based vehicle tracking system. The Pfrender system Wren et al., (1997) is used to recover a 3-D description of a person in a large room. It tracks a single non-occluded person in complex scenes, and has been used in many applications. The system at CMU, Lipton et al., (1998) can monitor activities over a large area using multiple cameras that are connected into a network.
As far as hardware for video-surveillance is concerned, companies like Sony and Intel have designed equipments suitable for visual surveillance, e.g., active cameras, smart cameras, Kirstein (2008), omni-directional cameras, Boult (1998); Bouis and Southwell (2008), and so on. Networking devices for video surveillance are the Intelligent Wireless Video Systems proposed by Cisco with the 3200 Series Wireless and Mobile Routers. Another important focus of research into video surveillance systems is on communications between far networked cameras and video processing systems. This is the field of concern of this our research. The classical approach to digital video surveillance systems is based on wired connections with existing Ethernet and ATM dedicated-medium networks, Tan, et al (2002). Another wired-based approach is proposed in Chandramhan, et al., (2002), where IEEE 1394b FireWire is investigated as a shared medium protocol for ad hoc, economical installation of video cameras in wireless sensor networks (WSNs).

The latest step in the evolution of video surveillance systems, aimed at increasing the scalability of large video surveillance systems, is the migration to wireless interconnection networks. Many solutions have been proposed in this context, by both industries and research institutions. Firetide Inc., a developer of wireless multi-service mesh technology, and Axis Communications, a company working on network video solutions, have announced a strategic partnership to deliver high-quality video over wireless mesh networks, which are being used by a number of cities to provide wireless video surveillance.

A great amount of work has been done to reduce power consumption in wireless video surveillance networks. Feng, et al (2001) defines some QoS-parameters in video surveillance, like video data quality and its distortions in network transmission (jitter). Further parameters include quality metrics such as image size, data rate or the number of frames per second (fps). The work in Chandramhan, et al (2002) and Munakata, et al (2008) investigates the trade-off between image quality and power consumption in wireless video surveillance networks. However, existing implementations lack comprehensive handling of these three correlating parameters.

Another important issue to be considered from the communications point of view is routing. A very large amount of research has been carried out regarding routing in ad-hoc wireless networks. Now we have to take into account that the network environment we are considering is a wireless mesh network, which is a particular case of wireless ad-hoc networks. In addition, as we will illustrate in latter sections, we will apply multi-path routing, given that multiple paths can provide load balancing, fault-tolerance, and higher aggregate bandwidth, Bramberger, et al (2006). Load balancing can be achieved by spreading the traffic along multiple routes. This can alleviate congestion and bottlenecks. From a fault tolerance perspective, multi-path routing can provide route resilience. Since bandwidth may be limited in a wireless network, routing along a single path may not provide enough bandwidth for a connection.

However, if multiple paths are used simultaneously to route pixel packet, the aggregate bandwidth of the paths can satisfy the bandwidth requirement of the application. Also, since there is more bandwidth available, a smaller end-to-end delay can be achieved. Many multi-path routing protocols have been defined in the past literature for ad-hoc wireless networks. The Multi-path On demand Routing (MOR) protocol, Bocchetti, et al (2009) was defined to connect nodes in wireless sensor networks. Other important routing protocols for ad-hoc networks are DSR, Cristani, et al (2007), TORA, Zhang and Liu (2003) and AODV Perkings (2003). DSR is an on-demand routing protocol which works on a source routing basis. Each transmitted packet is routed carrying the complete route in its header. TORA is an adaptive on-demand routing protocol designed to provide multiple loop-free routes to a destination, thus minimizing reaction to topological changes. The protocol belongs to the link reversal algorithm family. AODV is an on-demand distance vector routing protocol, based on hop-by-hop routing. It is a modified DSR protocol incorporating some features presented in the DSDV protocol, such as the use of hop-by-hop routing, sequence numbers and periodic beacon messages.

However, all the above protocols are reactive, or on-demand, meaning that they establish routes as needed. The advantage of this approach is obvious if only a few routes are required, since the routing overhead is less than in the proactive approach of establishing routes whether or not they are needed. The disadvantage of on-demand establishment of routes is that connections take more time if the route needs to be established. However, given that the wireless mesh networks considered in this research have stable topologies because nodes are fixed and powered, the proactive approach works better.

2.2 Multimodal Fusion and Sensor Collaboration

A greater understanding of the human perception has led researchers to use cross-modality in numerous projects for increase in accuracy and reliability in security surveillance systems. Authors of Tan, et al (1998) proposed an algorithm to track humans in an indoor environment based on the vision and microphone array and discuss the general problem of the information fusion in multi-modal systems. In Neuman, et al (2007), authors treated the microphone arrays as generalized cameras and employed computer-vision inspired algorithms to treat the combined system of arrays and cameras. Reference Cristiani, et al (2007) presented a new method to integrate audio and visual information for event recognition.

2.3. Audio/Visual Synchronization

There have been a large number of efforts focused on Audio/Video (A/V) synchronization in the traditional TCP/IP and 802.11 networks. The related applications mainly include

3. ANALYSIS OF THE PROPOSED NETWORK SYSTEM

Our proposed system; Far Multi-Node Network (FarMuNNet) consists of two kinds of network nodes: Wireless Video Sensor Node (WVSN) consisting of IP-cameras which forms the visual surveillance network and an interconnected Wireless Local Area Network (WLAN) consisting of routing devices. Video sensor as the terminal of the visual surveillance network connects with network infrastructure through WLAN/LAN. At the same time, the video sensor also acts as the pixel capturing or receiving and transmitting nodes in the WVSN to aggregate the video and audio streams. On our surveillance network system architecture, the image or object pixel packets received by the video sensor nodes are then transmitted through wireless links over the wireless LAN to neighbouring nodes. The proposed FarMuNNet system architecture is illustrated in fig. 3.

![Figure 1: Proposed FarMuNNet System Architecture](image)

From the system architecture in fig.1, video sensors are scattered randomly and interconnect at various nodes with each other in a self-organizing way via a wireless link on a wireless mesh topology. Once some events are detected, the video sensor will report streams to the sink or nearest node through multi-hops in a smart manner by spanning through the entire nodes to find the best path by using minimum spanning tree algorithm. On the platform, the visual surveillance network works as the backbone to undertake the transmission of all the video streams to the monitoring station/system and the WLAN is like the outbreak nerve endings which can transmit even tiny pixels. By combining the advantage of these two kinds of network, we developed a robust and efficient surveillance platform called FarMuNNet. The following are the various components of the FarMuNNet system as shown in fig. 1.
The Video Capture Module

The video capture module is responsible of managing the input video stream from different IP-cameras over a wireless mesh WAN/LAN where each camera can be accessed by its IP address. Accordingly, this module generates report about failures in the video capture process or in the network itself.

Object Detection and Tracking

In this module, the video streams captured from the above module (image capture) is detected and tracked and then passed over to the next module for gathering image information.

Node Information Module

Spanning tree algorithm is applied to gather information such as: closest node of the object, the distance of the object from each node, etc., this information is then pass on to the monitoring station/system.

Monitoring Station/System

The object and the surveillance network details are monitored by the monitoring station which generates alert/signer in case of any intrusion detection to the nearest node of the intrusion.

The Image Analysis module

The image analysis module includes all the image processing tasks applied on the video stream to extract relevant information such as motion detection, tracking, etc.

Image Understanding Module

The image understanding module represents the master piece of the video surveillance network system. Among its tasks: detecting behaviour of moving objects in the scene, etc.

Event Generator Module

The abnormal behaviour is forwarded to the event generator module, which generates a notification for the user and helps the image analysis module to tune the image processing tasks to enhance the behaviour for easier perception and monitoring.

3.1 Algorithms of Implementation

Algorithms are useful procedures for finding solutions to problems in optimization related operations and computer programs related concepts. As algorithms shows finite sequence of steps for solving problems, spanning tree algorithms (Prime and Kruskal) are adopted for finding optimal path on our network system that consists of multi nodes interconnected by wireless links. The algorithms are as follows:

Primes Algorithm

We start from an arbitrary vertex \( r \), and builds up a single partial minimum spanning tree \( T \), at each step adding an edge connecting the vertex nearest to but not already in the current partial minimum spanning tree. It grows until the tree spans all the vertices in the input graph. This strategy is greedy in the sense that at each step the partial spanning tree is augmented with an edge that is the smallest among all possible neighboring edges, Chazelle (2000). Thus:

**Input:** A weighted, undirected graph \( G = (V, E, c) \)

**Output:** A minimum spanning tree \( T \)

<table>
<thead>
<tr>
<th>( T \leftarrow \alpha )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Let ( x ) be an arbitrarily chosen vertex from ( V )</td>
</tr>
<tr>
<td>( U \leftarrow {x} )</td>
</tr>
</tbody>
</table>

**While:**

| \( |U| < n \), Do; |
| --- |
| Find \( u \in U \) and \( v \in (V - U) \) such that the edge \((u, v)\) is a smallest edge between \( U \) and \( V - U \). |
| \( T \leftarrow T \cup \{(u, v)\} \) |
| \( U \leftarrow U \cup \{v\} \) |

End.

Kruskal’s Algorithm

Kruskal’s algorithm creates a forest where each vertex in the graph is initially a separate tree. It then sorts all the edges in the graph. For each edge \((u, v)\) in sorted order, we do the following: If vertices \( u \) and \( v \) belong to two different trees, then add \((u, v)\) to the forest, combining two trees into a single tree, Chazelle (2000). It proceeds until all the edges have been processed.

**Input:** A weighted, undirected graph \( G = (V, E, c) \)

**Output:** A minimum spanning tree \( T \)

<table>
<thead>
<tr>
<th>( T \leftarrow \beta )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sort the edges in ( E ) in non-decreasing order by cost ( c ).</td>
</tr>
<tr>
<td>( T \leftarrow \beta )</td>
</tr>
<tr>
<td>Create one set for each vertex;</td>
</tr>
<tr>
<td>For each edge ((u, v)) in sorted order, do;</td>
</tr>
<tr>
<td>( x \leftarrow \text{Find}(u) )</td>
</tr>
<tr>
<td>( y \leftarrow \text{Find}(v) )</td>
</tr>
<tr>
<td>IF: ( X &lt;&gt; y )</td>
</tr>
<tr>
<td>Then:</td>
</tr>
<tr>
<td>( T \leftarrow T \cup {(u, v)} )</td>
</tr>
<tr>
<td>UNION ((x, y))</td>
</tr>
</tbody>
</table>

End.

3.2 Graph Network Structure of the System

In this section, we formulate, develop and analyse an efficient Far Multi-Nodes Network model called “FarMuNNet” from our surveillance system architecture in fig.1 that will be used for implementing wireless video surveillance network system. Now, consider an undirected and connected multi nodes network in fig.2, where the \( n \) nodes include at least one packet supply node and at least one packet demand node as shown in fig. 2:
From the dense nodes network structure in fig. 2, we formulate the nodes distance table. The nodes distance table shows the cost or weight of transmitting pixel packets from one node to another node. Example, the cost of transmitting 216 pixel value from node A to node E is 8km.

From Table 1, the total cost of all the edges (distances between nodes) across the entire nodes (24 nodes) on the dense node network structure in fig.2 is **495km**.
Table 1: Nodes Distance Table for the Graph Network Structure.

<table>
<thead>
<tr>
<th>Packet Transmission Line</th>
<th>Cost (km)</th>
<th>Edge</th>
</tr>
</thead>
<tbody>
<tr>
<td>A - F</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>F - I</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>I - L</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>L - O</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>O - R</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>R - T</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>T - X</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>X - Z</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>A - B</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>A - E</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>E - F</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>F - H</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>H - I</td>
<td>16</td>
<td>13</td>
</tr>
<tr>
<td>I - K</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td>K - L</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>L - N</td>
<td>19</td>
<td>16</td>
</tr>
<tr>
<td>N - O</td>
<td>6</td>
<td>17</td>
</tr>
<tr>
<td>V - X</td>
<td>12</td>
<td>21</td>
</tr>
<tr>
<td>V - Z</td>
<td>10</td>
<td>22</td>
</tr>
<tr>
<td>Z - Y</td>
<td>12</td>
<td>23</td>
</tr>
<tr>
<td>B - E</td>
<td>8</td>
<td>24</td>
</tr>
</tbody>
</table>

|                     | E - H     | 5 | 25 |
|                     | H - K     | 4 | 26 |
|                     | K - N     | 4 | 27 |
|                     | N - Q     | 4 | 28 |
|                     | Q - S     | 8 | 29 |
|                     | S - V     | 6 | 30 |
|                     | V - Y     | 8 | 31 |
|                     | B - C     | 21| 32 |
|                     | C - E     | 12| 33 |
|                     | D - E     | 19| 34 |
|                     | G - H     | 24| 35 |
|                     | J - K     | 10| 36 |
|                     | M - N     | 16| 37 |
|                     | P - Q     | 21| 38 |
|                     | P - S     | 19| 39 |
|                     | U - V     | 21| 40 |
|                     | U - Y     | 24| 41 |
|                     | P - U     | 8 | 42 |
|                     | P - M     | 5 | 43 |
|                     | M - J     | 8 | 44 |
|                     | J - G     | 5 | 45 |
|                     | G - D     | 4 | 46 |
|                     | D - C     | 5 | 47 |

3.3 Data Representations

Two main data structures for the representation of graphs are commonly used in practice today. The first is called an adjacency list, and is implemented by representing each node as a data structure that contains a list of all adjacent nodes. The second is an adjacency matrix, in which the rows and columns of a two-dimensional array represent source and destination vertices and entries in the array indicate whether an edge exists between the vertices. Adjacency lists are preferred for sparse graphs while an adjacency matrix is preferred for dense graphs.

However, based on suitability of adjacency matrix, we adopt and represent our set of data using adjacency matrix.
Table 2: Adjacency Matrix for the Packet Transmission Network

| No | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
| A  | 1 | 2 |   |   | 8 | 6 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| B  | 1 | 2 | 1 | 8 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| C  | 2 |   | 5 | 1 | 2 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| D  | 5 | 1 | 9 | 4 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| E  | 8 |   | 2 | 9 | 8 | 5 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| F  |   | 6 | 8 |   | 6 | 5 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| G  |   | 4 |   |   | 2 | 4 | 5 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| H  |   | 5 | 6 | 4 | 6 | 4 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| I  |   |   |   |   | 5 | 6 |   |   | 8 | 6 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| J  |   |   |   |   | 5 |   |   | 1 | 0 | 8 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| K  |   |   |   |   | 4 | 8 | 0 | 1 | 2 | 4 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| L  |   |   |   |   |   | 6 | 1 | 2 |   | 9 | 8 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| M  |   |   |   |   |   | 8 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| N  |   |   |   |   | 4 | 9 | 6 | 6 | 4 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| O  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| P  |   |   |   |   |   | 5 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Q  |   |   |   |   |   |   | 2 | 1 |   | 9 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| R  |   |   |   |   |   |   |   | 4 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| S  |   |   |   |   |   |   |   |   | 5 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| T  |   |   |   |   |   |   |   |   |   | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| U  |   |   |   |   |   |   |   |   |   | 6 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| V  |   |   |   |   |   |   |   |   |   |   | 6 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| W  |   |   |   |   |   |   |   |   |   |   |   | 6 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| X  |   |   |   |   |   |   |   |   |   |   |   |   | 5 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Y  |   |   |   |   |   |   |   |   |   |   |   |   |   | 2 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Z  |   |   |   |   |   |   |   |   |   |   |   |   |   |   | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |
4. EXPERIMENTATIONS AND RESULTS

Results:
When Prime’s Algorithm was used: after the computation the result is given as:

- Connecting node A
- Connecting edge A-F
- Connecting edge F-I
- Connecting edge I-L
- Connecting edge L-O
- Connecting edge N-Q
- Connecting edge Q-S
- Connecting edge S-V
- Connecting edge V-Y
- Connecting edge Y-Z
- Connecting edge Z-X
- Connecting edge X-T
- Connecting edge T-R
- Connecting edge R-O
- Connecting edge N-K
- Connecting edge K-H
- Connecting edge H-E
- Connecting edge E-B
- Connecting edge E-C
- Connecting edge C-D
- Connecting edge D-G
- Connecting edge G-J
- Connecting edge J-M
- Connecting edge M-P
- Connecting edge P-U

**Total distance: 155km.**

![Figure 3: Resultant MST](image)

When Kruskal’s Algorithm was used: after the computation the result is given as:

- Connecting node A
- Connecting edge A-F
- Connecting edge F-I
- Connecting edge I-L
- Connecting edge L-O
- Connecting edge N-Q
- Connecting edge Q-S
- Connecting edge S-V
- Connecting edge V-Y
- Connecting edge Y-Z
- Connecting edge Z-X
- Connecting edge X-T
- Connecting edge T-R
- Connecting edge R-O
- Connecting edge N-K
- Connecting edge K-H
- Connecting edge H-E
- Connecting edge E-B
- Connecting edge E-C
- Connecting edge C-D
- Connecting edge D-G
- Connecting edge G-J
- Connecting edge J-M
- Connecting edge M-P
- Connecting edge P-U

**Total distance: 149km.**

![Figure 4: Resultant MST](image)
From our results, we could see that the minimum spanning tree is calculated for the surveillance network system and the cost is drastically reduced from 495km to 155km and 149km when Prime and Kruskal algorithms are applied respectively because the shorter the distance the smaller the cost and the clearer the pixel value will be to the receiving neighbouring nodes which will enhance image (or object) quality on the surveillance network structure. We were able to obtain more accuracy and efficiency; because no matter how far an object may be within the line-of-sight of sensor nodes on the wireless network, the minimum spanning tree algorithm determines the minimal route for the pixel packets to be transmitted to neighbouring nodes in a cost effective manner.

This implies that at lower cost, more pixel packets will be transmitted on the wireless surveillance network to form a clear image to surveillance application. From our experience in the research work, Prime’s algorithm always stays connected as a tree, this ensures or guarantee that pixel packets are transmitted continuously in stream to neighbouring nodes on the wireless network structure without a break of transmission link unlike Kruskal’s which begins with forest and merge into a tree – which may cause jitter and clutter of pixels packets.

5. CONCLUSION

This work employed the use of graph techniques to formulate and describe a far multi-node network model for a wireless video-surveillance system, illustrating the overall architecture and the structure of each component block. Specifically, video sources use multi-path to transmit pixel packets across other nodes, while the access network is a graph network implementing spanning tree protocol for multi-path pixel packet transmission by using minimum spanning tree algorithms to enhance object quality by reducing connection cost and minimizing delay. However, this (delay) causes jitter, which is not acceptable for video-surveillance applications but can be compensated at destination if delay statistics or rate are known. Output results from our C++ program implementation of the spanning tree protocol have demonstrated that multi-path pixel packet transmission guarantee minimal cost and less delay reporting security alert and the best quality of image at destination. So it is the best solution for any proposed video surveillance network system.

REFERENCES


Authors Brief

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WHLK: Framework for Software Authentication and Protection

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ABSTRACT
In the last decade, numbers of algorithms were developed to control the piracy. In most of the existing algorithms and software registration schemes, the identity of users and software is not taken into account. After identifying the fundamental weakness of existing piracy control measures, this paper proposes the implementation and testing of WHLK Model [1] in which we introduced an integration of Software Watermarking, Hardware Parameters and License Key that can greatly reduce unauthorized use of software. Unlike traditional static piracy prevention techniques, this new technique would embed the user identity in the software using dynamic watermarking algorithm. The hardware characteristics, which are extracted, and License Key of the software are integrated and then randomizing to generate a unique key dynamically during the software installation on the client machine. In this paper a novel approach is presented which secures the software from being pirated and makes it possible for genuine client to use the same. The proposed model is implemented and tested on 198 machines and the model works with an accuracy of 99.22%.

Keywords: Software security, dynamic software watermarking, control measures of software piracy, harddisk loading, types of software piracy.

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1. INTRODUCTION
In current research, we introduce a low-cost software protection scheme that is secure, flexible and convenient for users. The scheme is based on Software Watermarking [2], Hardware parameters and License Key to avoid the most common attacks to software protection mechanisms such as multiple installations from a single legal license, reverse engineering analysis, and production of unprotected (pirated) copies of the software. We showed that how this new technique can be applied to build secured applications.

The organization of this paper is as follows. In the next section, we have explained the software piracy and the need for the protection of the software. Section 3 elaborates related work in the fields of software protection and watermarking to position our contribution. The Architecture of our Model has been graphically presented in Section 4. Section 5 shows the benefits and improvements of the proposed model, which is followed by the working description of same. The testing and implementation of this model is presented in Section 6. In Section 7, the empirical evaluation of the tested model has been shown. Section 8 analyses the results obtained after empirical tests, and, finally, Section 9 summarizes the conclusions and prospects for future work.

2. SOFTWARE PIRACY
There is a new generation of distributed applications, such as distributed object systems, web services, electronic commerce and grid computing, that have the potential to represent substantial advances in the use of Internet resources. However, security problems become an insurmountable barrier for the widespread deployment of those types of applications. Solving software protection problems is not a trivial task. Several issues of research concerning the piracy of software are:

- Intellectual property protection: The objective is to link the software with information about its author by using techniques such as watermarking [3].
- Protection against function analysis: The objective here is to prevent a malicious host from discovering what function is being computed by a software element. Techniques such as code obfuscation [4] or function hiding [5] are used, sometimes complemented by the use of hardware tokens [6].
- Software use-control: This is aimed at guaranteeing that only authorized users can run the software according to some contractual conditions.
The work presented in this paper focuses on all the above mentioned issues. We also discuss the possibilities and implications of protecting software in order to prevent software piracy, and ensure that the software is installed for an intended user only. Software piracy is the unauthorized utilization, replication, and distribution of commercially available or copyrighted software. A report by the Business Software Alliance (BSA, 2012) noted that for the past five years worldwide, software piracy has hovered between 38% - 42% and losses amounted to billions of dollars [7]. The prevalence and significant growth of software piracy in the past four decades since the advent of computer technology has warranted attention of the researchers, software developers, educators, intellectual property advocates etc. Therefore, the fight against software piracy is becoming an extremely important issue for all these stakeholders.

Surprisingly, the best results against software piracy in recent years have not come only from new software protection mechanisms but the other reasons for controlling the piracy are:
- Software companies have tried to have an effective legal sales presence in all areas of the world.
- Software companies achieved better user support for their legal products.
- The price of software has come down, narrowing the difference between legal and illegal versions.
- Some organizations, like the BSA, promoted high profile legal proceedings against companies using illegal software.
- Governments have cooperated to provide legal protection for intellectual property and to criminalize software piracy.

We are now again witnessing an increase in software piracy because of the popularity of the internet. Despite the use of deterrent and preventive measures to combat software piracy this problem seems unabated and it is observed that previous measures will not achieve better results.

3. MOTIVATION AND BACKGROUND

In today’s computing world, maintaining security is a challenging issue. Customers are expecting security to be delivered out of the box, even on programs that were not designed with security in mind. The challenge is even greater when legacy systems must be adapted to networked/web environments, while they are not originally designed to fit into such high-risk environments. Tools and guidelines have been available for developers for a few years already, but their practical adoption is limited so far. Nowadays, software maintainers must face the challenge to improve program security and are often under-equipped to do so.

Addressing issues related to software piracy is an on-going challenge. While software companies and lawmakers have developed and attempted corrective measures to fight the trend of piracy through security design patterns, birthmark, protection schemes, application virtualization, exterior component, secure coding, copy-protected software, product identification key, hardware dongle, the problem of piracy remains prevalent and significant.

As for security engineering, it aims at considering security early into the development life cycle of software. A number of Security Design Patterns (SDP) is available in order to guide software engineers in designing their security models and securing their applications at the design phase. When it comes to security hardening against piracy, these proposed security design patterns are not really relevant. The reason is that we are dealing with already developed applications that are, in many cases, deployed.

Spyros T. Halkidis et.al [8] tried to achieve this goal by applying specific patterns in software architecture. Here, the well-known design patterns for building well-structured software have been defined, a new kind of patterns called security patterns have emerged. These patterns enable to incorporate a level of security at the design phase of a software system. This proposal is not relevant in the setting of security hardening against piracy since we are dealing with already developed software.

The research by Hyun-il Lim et.al [9] proposes a method of detecting the theft of Java programs through analysis of the flow paths (called as FP) of the program, specifically of the FP birthmark which can be used to identify the origin of software by comparing the inherent characteristics of the program. The proposed birthmark is a measure for detecting programs while copying, and can lessen the time and effort required for manual reverse engineering in the identification of software theft. But this method is ineffective if the basic blocks have been decomposed or if the instructions in programs are reordered or changed via modifications.

Ibrahim Kamel [10] proposed a technique that detects malicious attacks with high probability on real datasets using reasonable node sizes and attack model. This paper also presented the increase in detection rate of data alteration at the cost of the attack detection. But this scheme was based on a watermarking scheme to be used only for R-tree data structures instead of designing the watermark for other database indexes like B-trees and Quad-trees. Bin Zhao et.al [11] proposed an enhanced watermarking scheme in the encrypted domain with flexible watermarking capacity. This paper demonstrated that the enhanced watermarking scheme eliminates the drawbacks of other watermarking schemes in the encrypted domain. But there is no use of error correcting codes to correct bit errors and improve the robustness of watermark sequence against other severe attacks in the encrypted domain.

Several watermarking schemes have been proposed distinctively whether it is viable to hide the information in the program/code itself or dynamically. Xuesong Zhang et.al in his paper [12] proposed a hash function based dynamic software watermarking algorithm which is able to withstand a variety form of transformation attacks. But still there is lack of effective feature code matching and extraction feature to identify the hash function.
Rafael Augusto Teixeira et al. [13] presented a work for an on-demand software deployment system based on application virtualization concepts which eliminates the need of software installation and configuration on each computer. As many a commercial software still uses the license per installation, it is a real problem in this application streaming solution. Qiang Liu [14] used Exterior Component method which allows only authorized users to run the software. So without this exterior component software cannot be run, and thus they will protect against illegal copying and use of software. Although this method can be applied to some commercial software, it is still at high cost to apply to the personal computer users.

Various strategies have been employed to make unauthorized duplication and use of software more difficult [15]. One such approach is to provide a hardware “key” which is typically installed in the parallel port or USB of the computer to provide a software interlock. If the key is not in place, the software will not execute. This method is relatively expensive for the developer and cumbersome for the authorized user while remaining vulnerable to the theft conducting piracy by duplication of the hardware key. Another approach requires the user to enter a serial number or customer identification number during the installation of the software. Missing or invalid registration information prevents the installation of the software. This approach is easily defeated by transferring the serial number or customer identification number to one or more unauthorized users. Yet another approach requires registering the software with the manufacturer or distributor to obtain an operational code or password necessary for the installation of the software. Again, once the operational code or password is obtained, it may be perpetually transferred along with pirated copies to numerous unauthorized users.

Concerning the secure coding approach, it presents either safe programming techniques, or a list of programming errors together with their corresponding solutions [16]. Several publications compiled common errors and vulnerabilities in code production languages such as C/C++. Their intent is to instruct software developers to avoid these errors. Such proposals are not relevant in the setting of security hardening against piracy since we are dealing with already developed software. Moreover, these secure coding practices are very often manually applied and our aim is actually to elaborate a systematic and even preferably automatic approach to security against piracy.

Yawei Zhang et al. [17] proposes a software-splitting technique which put the split contents on the client instead of the remote trust server. This new technique would encrypt the extracted contents from the software by a key relating to the hardware characteristics, and then decrypt them dynamically during the main program running. In spite of the usefulness of this technique, it is not stimulating for some explanation programming languages such as VB, JAVA because it’s nearly impossible to directly manipulate in the memory for these programming languages.

As a result, integrating security into software to prevent piracy is becoming a very challenging and interesting domain of research. Above mentioned research projects motivated to create methods and solutions to integrate systematically secure components into software. Our proposition is inspired by the best and most relevant methods and methodologies found in each one of the aforementioned concepts and approaches. This research provides secure software by hardening framework for installation and registration. The experimental results presented explore the efficiency and relevance of our approach.

### 4. ARCHITECTURE OF THE WHLK MODEL

The model provides an integration of the privacy of users, security of information and license key, together for the control of the piracy. Our system enjoys a modular design and can be implemented by any machine with flexible configurations and windows X operating systems. Furthermore, the proposal allows flexible registration information definition. This Model not only makes it harder to create an additional available copy based on diversity, but also prevents illegal uses on the copy.

The architecture of our Model has two phases:

- **Client-Vendor Interaction Design (Phase I):** Fig. 1
- **Installation and Registration Design (Phase II):** Fig. 2
Fig. 2
5. BENEFITS AND WORKING OF WHLK MODEL (IMPROVED)

5.1 Benefits of WHLK Model
The current research is carried out after collecting data from academic as well as industrial sector for finding the most common cause of piracy. Numbers of causes are discussed in the literature and most common cause of piracy found is Hard Disk Loading. It is a method of software piracy where hard disk of the new customer is loaded by the vendor of the hardware with the different software available with him. It has been observed that the hard disk loading and softlifting are the common practice of making an illegal copy of the software.

We have studied different control measures for curbing the software piracy in Section 3 and no such measure has been found for doing so. We have implemented our technique on different machines with variant configurations and versions of windows X operating system which shows that it is flexible with any of the machines and is not limited to some specially configured machines.

An integrated (dual) approach is applied to secure the software from being pirated. Our Model has been designed in two phases including Client-Vendor Interaction Design (Phase I) as shown in Figure 1 and Installation and Registration Design (Phase II) as shown in Figure 2. In phase I, Dynamic Watermarking Algorithm is implemented to annotate, embed, tracer and recognize a watermark (as a component) in the software using SANDMARK, which was proposed by Collberg and Thomborson [18]. Also, the Obfuscation algorithm is applied to encrypt this watermarked file. It helps in encrypting the user identification.

An algorithm is used for encrypting the information fetched from the machine and the user in coded form. The unique keys are generated in a randomizing pattern by applying these algorithms in the Installation phase, thus, securing them from being revealed to secondary users. Registration Code (RGCN), in encrypted form, is generated randomly on the basis of unique keys generated through algorithms unlike other registration schemes where registration is done storing the information as it is on the server thereby inviting a risk of being hacked. User information is not at any risk of being misused or misinterpreted elsewhere.

A timeframe has been set using an algorithm for those software users who have either formatted their machine or purchased new hard disk or machine. The client can re-use the software on new machines using existing Registration Code (RGC) provided to them during the first installation of watermarked software. No other user installs or uses the software on their machines. The cost of this technique is rather low as compared to others. We don’t need any hardware i.e. dongles for the implementation of secured software installation. It is rather convenient for the developers to implement this strategy.

5.2 Working of WHLK Model
Noting the weakness in existing approaches of software registration, we incorporated the new processes in the process of software registration. First, instead of preventing from illicit copying, we force the software to be only used by an authorized running environment. In order to accomplish this task, the user is required to submit his identification details which are being applied through algorithms to generate random unique key (string) and this key is embedded as a watermark in the program. Also, an automated program fetches the uniquely identifying characteristics of running environment such as the physical sequence numbers of the CPU, the main board, processor and other hardware information. These hardware characteristics and the License key are integrated to be used as parameters. All of these parameters are encrypted using a predefined code generating a new random unique number called as Registration Code (RGCN) which is acknowledged to the user.

The working of WHLK has been categorized in two phases:

5.2.1 Phase I
In this phase, the client is required to provide his personal details to the software vendor including his Name, Affiliation and Social Security Number / ID. This process is the first process for the authorization of software user and represented as Process P in Fig. 1. The details are entered by the user and fetched through Process P1. This Phase enters into a new Process P2. Software vendor applies an automated algorithm on these details to generate a Unique Key (UK). This Unique Key was generated on the basis of programming code extracting certain alphanumeric characters of each of these details randomly. UK is used as a parameter for Sandmark watermarking tool. The Collberg-Thomborson (CT) software watermarking algorithm is applied to embed this key (watermark) into the class files of the software program. This algorithm embeds the watermark into the topology of graph structure built at runtime in response to a sequence of special user actions.

To use this algorithm, the calls are embedded to sandmark.watermark.ct.trace.Annotator.smmark(*) into the software program. These points represent the locations where watermark code can be inserted. Then run a trace with a special input sequence in SandMark and finally watermark is embedded. The software is watermarked with the key (watermark) and called as Watermarked Software (WS). Before distributing this watermarked software WS to the Client, it is obfuscated to remove the risk of being susceptible to collusive attacks. Then WS is supplied to the client as per his requirement.
5.2.2 Phase II
During the process of installation, an automated process P6 fetches the hardware characteristics of this machine which includes the CPU Identification (ID), Hard Disk ID, MAC ID and Processor Serial Number. These Hardware parameters (HW) are being forwarded to the Hardware Database (D1) for checking their existence in the database. D1 validates the HW and responds in different ways.

If all or any of the HW already exists in the database, it means that the user is already registered for the software on the machine with same HW and that he had already received the Registered Code (RGC). If user forgets his E-Mail ID, he has to use the License Key given by the vendor for re-registration. In extreme case of non-availability of License key, he has to contact the vendor who can trace the RGC using the user details given to him by the user while purchasing the software.

If HW does not exist in D1, it means that the user has not registered yet and a new registration process begins. An acceptance note has been sent through Process P7.2 to pass the hardware parameters to P8.1. Here the process generates a Unique Key (UK1) taking HW to be used as parameters in programming. This Unique Key was generated on the basis of programming code extracting certain alphanumeric characters of each of these hardware parameters randomly. UK1 is being sent through P8.5 to be stored in Key Generation Database (D3).

In the next step of installation, the user has to provide his E-Mail ID (Identification) which is again processed through an automated program of generating a unique key. UK2 has been generated in this step and stored in D3. In addition to this, Process P8.2.1 sends the User E-mail ID to the Registration Database through P8.2.2.

In its next step, the user has to provide the License key provided by the software vendor while purchasing the software. This License key is being labeled inside the product CD Box. Taking this License key as a parameter, the automated program does the process of generating the Unique key (UK3). UK3 has been sent to D3 for storage.

Process P8.4 receives UK1, UK2 and UK3 from D3 to concatenate them in a pre-defined sequenced manner and then generates a Unique Key (UKM). This Key is generated in a programmed way using the algorithm designed. Algorithm is applied taking UKM as a parameter and its different positioning values. A new code occurs which is called as new registration Code (RGCN) for the user. The generation of RGCN is well disguised of its original values and is in encrypted code. Process P10 stores RGCN in the Registration Server D2.

P11 receives RGCN (in coded form) from D2 and acknowledges it to the E-Mail ID of the user. Before sending it to the E-Mail ID, it verifies it with the user and then sends RGCN to the E-Mail ID of the user in coded form. With this installation process completes and software is ready for the use. The sequence of steps proves that the software has been installed on a genuine and authenticated machine.

6. IMPLEMENTATION AND TESTING
This Section has two parts: Implementation and Testing

6.1 Implementation
The proposed model has been implemented by watermarking of Java bytecode within the SandMark software protection research framework. Our implementation consists of five phases

6.1.1 Annotations take the form of extra method calls added to the source code. In this phase, calls to sandmark.watermark.ct.trace.Annotator.snmark(*) are added to scprog.java, which is the source program of application software, in suitable locations to insert watermarking code. Then scprog.java is compiled and packaged into a jar-file scprog.jar. The methods also write messages to a tracing log while they are in execution.

6.1.2 In the tracing phase, the dynamic behavior of the program is determined by tracing its execution path on a particular input sequence (the secret watermarking key). The jar file of source program is traced, i.e. run with a special (secret) input sequence. This constructs a trace-file, a sequence of mark() calls, that were encountered during the tracing run.

6.1.3 The next phase is embedding phase where the watermark is actually added to the program, using the data from the tracing run. After generating trace file, we have started embedding watermarks. We have provided our own watermark which consists of customer name, affiliation and identification number. The output of the embedding module is a new watermarked jar-file scprog_wm.jar. Other files generated during the execution are:

- Watermark.dot has been generated which is the watermark graph (in the dot format) embedded into the application software.
- Traceforest*dot are generated call-graphs during tracing.
- Watermark.java is a generated class file containing the watermark-building methods.
6.1.4 The next phase is Obfuscation phase, where scprog_wm.jar is being obfuscated using the Class Encrypter Obfuscating Algorithm. This algorithm encrypts the file using an encryption key and causes them to be decrypted at runtime. The output of the obfuscator is a new watermarked jar-file scprog_wm.jar. This program is served as input to the recognizer.

6.1.5 In the recognition phase, the scprog_obf.jar is traced again (using the same secret input), and the branch sequence is checked for the watermark.

6.2 Testing
Our technique has been tested on different machines with different configurations and versions of Windows X operating system to check its reliability, accuracy and integrity. Firstly the watermarked software has been installed on the client machine and then the process of validation on the server for its authentication and security are carried out.

6.2.1 Client-Side Installation
The testing of our technique starts with an executable file running a sequence of steps for installing the software on the client machine. Hardware parameters are extracted from the machine and submitted to the server for validation. This process has been done with an algorithm designed for executing these validation checks on server. In next step, the user identification and License Key, provided with the software pack, is collected, fetched, integrated and processed at different steps. An algorithm, which is designed for generating unique keys randomly, is being applied on this integrated information. Then this information is being submitted and stored at the server and registration code (encrypted code) is generated which is being acknowledged to the client machine. The process of installation finishes after completing all its steps and the software is ready for use. This is an automated program designed with different algorithms and program codes. This phase secures the authenticity and usage of the software.

6.2.2 Server-Testing
Server side testing algorithms are designed to test and validate the data provided by the user, generated on client-side machine during installation process.
- Algorithm for validating the hardware parameters fetched by the client machine
- Algorithm for securing the registration codes submitted by the client machines
- Algorithm for acknowledging the newly generated registration code to the e-mail of client in encrypted code securing it from being tampered with or being hacked and cracked.

7. EMPIRICAL EVALUATION

7.1 Evaluation In Phase I
We evaluated the watermarking scheme for Java bytecode described in Section 6.1 using an implementation built on top of SandMark, a collection of obfuscation and watermarking algorithm implementation for Java bytecode. The system reads in Java archives (jar-files), applies one obfuscation and watermark, and writes the resulting code to another Java archive. We used 270 jar files with CT Dynamic watermarking algorithm for our experiments. A high percentage of the instructions in these jar files are executed frequently. After all the programs have been transformed, we extracted the watermarks from the programs. We expect that many watermarks will be lost during the transformations and attempt to find the affect of transformations on watermarks.

7.1.1 The Watermarker
We are testing CT dynamic watermarking algorithm from Sandmark watermarking systems. Sandmark is an academic framework and it is the only available system for watermarking Java programs.

7.1.1.1 Sandmark
SandMark is a tool [19] developed by Christian Collberg et al. at the University of Arizona for research into software watermarking, tamper-proofing, and code obfuscation of Java bytecode. The project is open-source and both binaries and source-code can be downloaded from the SandMark homepage [19]. We used version 3.4.0 (Mystique) released in 2004.

7.1.2 The Jar Files
All the jar files that we use in the tests are plugins for the text editor JEdit [20]. These files are fairly small (average 40KB) but represent a collection of real-world Java software. The range of plugins represents a variety of code, and were all written by different programmers but as they are plugins they share some characteristics. For example, some classes may subclass JEdit’s abstract plugin classes to use JEdit’s plugin API. All the test files were obtained by installing JEdit and then using the built-in plugin manager to download the plugin jar files. The average number of classes per jar is 10, while the average number of methods per jar is 77. The average number of fields is 25 and the average number of local variables is 175. The biggest program jar was 742 KB while the smallest was 1.7KB. The largest program jar had 171 classes and the smallest had only 1. Two programs had no fields while the largest program contained 523. The largest program contained 3004 local variables.
7.2 Evaluation in Phase II

We evaluated the installation process of the software dynamically as described in Section 6.2 through the empirical analysis of the algorithms for validation checks on server, generating the unique keys, concatenating the unique keys generated and, lastly, generating the Registration code. We have installed the software on 198 machines with different configurations, versions of windows X operating system and platforms.

7.2.1 Validating Hardware Information

We have tested Validate algorithm for checking whether the hardware parameters fetched exists in the database or not. In some machines, they exist on the database, the instructions have been sent to the client to enter the already provided registration code and submit to the server for Re-registration. The remaining machines complete the rest of installation process.

7.2.2 Generating the Unique Keys

We have tested Gen algorithm for generating the unique keys fetching the characters position wise randomly as programmed in the source code. Hardware information has been fetched and an algorithm has been tested on this information generating a unique key (random number) called as UK1. UK1 has been submitted and stored on SQL Server Key Generation Database D3. Then the algorithm has been tested for E-mail verification. Another unique key UK2 has been generated and stored on D3. Also, the E-Mail ID (in original form) has been sent and stored on Registration Database D2. Lastly, the License Key has been fetched from the user (provided by the software vendor). Further, the algorithm has been tested on this information and a unique key UK3 has been generated which is submitted to the database D3.

7.2.3 Generating the Registration Code

We have tested Con algorithm for concatenating these three unique keys UK1, UK2 and UK3. After this, we have applied the Gen algorithm on this new parameter derived after using the Con algorithm. A new registration Code called as RGCN has been generated and stored on the database D2.

7.2.4 Acknowledging RGCN

We have tested the Sec algorithm on RGCN to be encrypted and then this encrypted RGCN has been acknowledged to the E-Mail ID of the user.

After testing all these steps, we have successfully installed software on the machine for a genuine user in a secured environment.

All tests were run using Sun’s JVM version 1.4.0 and Windows X operating systems.

8. RESULTS

8.1 Observed Results of Evaluation Phase I

After embedding watermarks we obtained 259 out of an expected 270 watermarked jars. 11 watermarked jar files failed to embed the specified watermark, due to error or incompatible program jar. The Collberg-Thomborson (CT) algorithm managed to correctly embed watermarks in all 270 test programs - they were embedded, obfuscated and recognized correctly. Exactly 95.92% of the expected watermarked jar files were actually produced (Fig. 3).

Out of the 259 watermarked jar files all 257 contained watermarks which were successfully obfuscated and recognized. 2 out of 259 watermarked jar files could not be recognized as the input key is not available with the client. This means that 99.22% of the watermarks in the watermarked jar files produced were actually recognized (Fig. 4).

8.2 Observed Results of Evaluation Phase II

After testing Validate algorithm on 198 machines, we found that 38 machines have been already registered for this particular software which means that hardware parameters of 38 machines were found on the server. Instructions were sent to these 38 machines to re-submit their registration code already available with them. Statistically, 19.19% clients were found already registered for using this software (Fig. 5).

When the rest of installation process was being run through the 160 machines, we found that 6 clients have forgotten the details of their E-Mail IDs and 13 clients have lost their License Key. These 19 (adding 13 and 6) clients were not able to complete their installation process. Only 11.87% of clients were not successful in their installation process. A high percentage of 88.12% of clients were able to receive RGCN and install the software on their respective machines (Fig. 6).
9. CONCLUSION AND FUTURE SCOPE

9.1 Conclusion

In this paper we present an approach that illustrates our proposition and methods to harden security into applications. This approach, which is based on Software Watermarking, simplifies security hardening by maintainers and allows developers to perform security hardening of software by providing an abstraction over the actions required to improve the security of programs. We have taken this approach as a measure to control the software piracy which is very commonly prevalent in our technological world. Our model consists of dual aspects. First aspect, occurs at the software vendor side, includes the implementation of dynamic software watermarking in the software program. WHLK offers easy embedding of watermark without affecting the data and control structure of original program and also shield the watermarked program from collusive attacks using obfuscation algorithm.

Second aspect, which occurs at the client machine, fetches the information, processes them using encryption algorithms designed and then submits them to the server for validation. Server validates and puts acceptance to the client by registering its details and acknowledges it to him for software use. We conclude that our watermarking system would mitigate and nullify the threat of unauthorized distributions of copyright software by its secondary users.
9.2 Future Scope
In future, we would like to focus on the following work. Our Model, in its second phase, needs Internet connectivity to complete its process which can be constraint. The techniques can be developed to remove this constraint of Internet. Our scheme works for only HardDisk Loading type of software piracy. We would like to extend the scheme for other types of software piracy like OEM Unbundling, Softlifting, and Corporate Software Piracy. We would like to apply and extend our scheme to other platforms like .NET framework and to carry out experimentation on these machines.

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Mobile Learning Courseware Development Process Using Java Web Services

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ABSTRACT
Various projects have looked into the development of courseware for mobile devices. Examples are the four major projects in mobile learning funded by the European Commission in Brussels. In these projects, mobile learning courseware was created using Microsoft Reader Work; installing a web-authoring tool like Micromedia dreamweaver MX version 1.0 and installing a desktop browser that has page rendering characteristics (opera 7TM); use of Flash Lite etc. This paper examines the process of developing courseware that can be consumed by mobile phone via web services. We discussed briefly the web service technology and also provided its architecture. Besides the presentation of the object-oriented analysis and design for the courseware development, the pseudo-code algorithm for creating courseware, a method of the web service class was provided. Finally, the courseware was developed using Java programming language and employed web services technology.

Keywords: Mobile learning, Courseware, Java web services, Development process, Algorithm.

1. INTRODUCTION
With the advances in mobile technology, it is already possible to support learners and teachers on the move, through what we call mobile learning. Mobile learning is the provision of education and training on PDAs/Palmtops/handhelds, smart phones and mobile phones [1]. Mobile learning through the use of wireless technology allows anyone to access information and learning materials from anywhere and at anytime. Courseware (short for course material in a software format) is considered as software. In particular, it is software designed to provide pre-written courses in an electronic format. The electronic aspect offers several key advantages such as instant access and customizable flexibility so that the trainer can localize the content. The courseware development process may be engineered using a variety of approaches. One possible approach to courseware development process itemizes the various activities or steps that are involved. These steps include: to determine needs and goals, collect resources, learn the content, generate ideas, design instructions, flowchart the lesson, storyboard displays on paper, program the lesson, produce supporting materials, and evaluate and revise [2]. Mobile learning courseware development can also follow these steps listed above, only that those limitations of mobile devices such as limited display and memory capacity should be considered during the development process. Because of these restrictions, some current e-learning course materials may not be in the format that mobile devices would accept. Thus an instructor needs to prepare course materials in a compact form that can be displayed in a user friendly way on mobile devices. The 21st century workforce will be filled with people who have grown up with devices, and are used to having easy access to search engines, sharing and collaboration are the norm, and creative freedom is king [3]. Why not let students use technology they will need in the future? This paper focuses on how to program a lesson for mobile learning assuming that the course material or lesson has already been prepared following the steps mentioned above and making the design compact and readable.

2. LEARNING AND LEARNING PARADIGMS
Education and training is the process by which the wisdom, knowledge and skills of one generation are passed onto the next [4]. Learning is fundamentally a social construct that allows access to instructions, collaboration, informed research, relevant resources, critical analysis and integrated results; which manifest itself in knowledge and often in wisdom [5]. The learning tradition has invariably been based on face-to-face communication from teacher to learner in a learning group, otherwise known as conventional learning.
However, the changing instructional strategy and a constantly evolving set of technological breakthrough introduced another style of learning different from conventional system of learning. Today there are two forms of education and training namely, conventional education and distance education. Distance education can comprise distance learning (d-learning), electronic learning (e-learning) and mobile learning (m-learning). The wonderous developments of technology during the industrial revolution brought about, for the first time in history, possibility of distance education. The developments were particularly important in transport and communication. It was no coincidence that the first trains, the first postal system and the first correspondence course commenced at the same time [4]. The next developments in distance education are attributed to what may be called electronic revolution of the 1980s. The wonderful developments in technology associated with this revolution made it possible for the first time in history to teach (electronically) groups at a distance [4]. The telecommunication industry underwent swift and complex changes in the 1980s, which constitute an electronic revolution. The continuous advancement in computing technologies and further miniaturization of the microprocessor allowed the development of smaller and cheaper mobile devices and thus facilitated the mass growth and adoption of mobile technologies and mobile life (m-life) [5]. With the advent of these mobile devices, mobile learning was made possible. In general, mobile learning can be viewed as any form of learning that happens when mediated through a mobile device and that form of learning that has established the legitimacy of ‘nomadic learning’ [6].

3. WEB SERVICES TECHNOLOGY

Web services are web of software building blocks (routines) stored on one computer that can be accessed via method calls by an application (or other software components) on another computer over a network [7]. Other systems interact with the web services in a manner prescribed by its description using SOAP messages, typically conveyed using HTTP with XML serialization in conjunction with other web-related standards [8]. The computer on which a web service resides is called the remote machine or server and the application that accesses the web service is referred to as the client. The client (application) that accesses the web service sends a method call over a network to the remote machine, which processes the call and returns a response over the network to the application. In Java, a web service is implemented as a class. A web service is said to be published, when it is made available to receive request from client and said to be consumed when it is accessed from a client application. An application that consumes a web service consists of two parts- an object of the proxy class for interacting with the web service and the application that invokes methods on the proxy class. Three standards were developed with the introduction of web services: Web Service Description Language (WSDL), Universal Description, Discovery, and Integration (UDDI), and Simple Object Access Protocol (SOAP) [9]. Programmers use WSDL to publish their web services, thereby making the web services available to other programmers over the network. They use UDDI to locate the web services that have been published and SOAP is used to invoke a particular web service. Shown below is the architecture of web services [8].

![Web services architecture](image-url)
4. MOBILE COURSEWARE DEVELOPMENT PROCESS

In this section, the analysis and design of the courseware development system, pseudo code algorithm for creating coursemodule (courseware) were presented and the system implemented.

4.1 Analysis and Design of the Mobile Learning Courseware Development system

Object-oriented analysis and design methodology was used for the analysis and design of this system because of its benefits such as lower development time and effort, and maintainability of the product. Here, we have the use case diagram, the class diagram, and the database diagram.

Use case diagram

The use case model models the interaction between a system and its external entities (actors) in terms of use case (system capabilities). As shown in the fig 2 below the external actor is the lecturer and he is provided with the following privileges: adding a course, updating a course, adding course–module, updating course-module and viewing course.

Class diagram

This models the class or “building blocks” used in the system and their relationship. Fig 3 below depicts all the class and their associations. Each class contains attributes and operations.

```
Lecturer
-Id:integer
-Name:string
-Address:string
+Add lecturer ()
+Update lecturer()
+Findbyname(name:string):lecturer
+Delete lecturer(id: integer): boolean

Course
-Id:integer
-coursecode:string
-courseid:string
-creditunit:integer
-semester:string
+addcourse()  
+updatecourse() 
+Findcoursecode(code:string):course

Course module
-Id:integer
-name:string
-description:string
-studyorder:integer
-content:string
+addcoursemodule()  
+updatecoursemodule() 
+findcoursemodule(name):coursem odule

<web service> Course ware EndPoint
```

Fig. 2: Use Case Diagram

Fig. 3: Class Diagram
Database diagram

Here, classes are represented as tables, attributes as columns and associations as relationships. The fig 4 below depicts the database diagram.

4.2 Algorithm for the Creation of Coursemodule (Courseware)

The algorithm below shows the step-by-step instructions for the creation of the coursemodule which is one of the operations (methods) of the web service class. The web service class provides services that are consumed by the mobile application. The algorithm can be defined as follows:

```
Long createCourseModule (String name, String description, int studyOrder, String content, long courseId)
1.  Request data
   1.1 Request name
   1.2 Request description
   1.3 Request studyOrder
   1.4 Request content
   1.5 Request courseid
2.  Create Coursemodule
   2.1 Open connection to database
   2.2 Set courseModule = null
   2.3 Create a copy constructor of courseModule
   2.4 Set id for courseModule
   2.5 Insert into CourseModule Table (name, courseModuleId, description, content, studyOrder, courseId)
   2.6 Close connection to database
3.  Return courseModuleId

The algorithm, createCourseModule takes the name (name of the course module), description (description of the course module), studyOrder (study order of the course module), content (content of the course module), courseId (the id of the course that has the module) as parameters and returns courseModuleId to show successful creation.

4.3 The Implementation

Here, implementation means the development of the software for the system using the system design, in any language of your choice. Our system was implemented using Java programming language. Java has become the language of choice for implementing internet-based applications and software for devices that communicate over a network [7]. Netbeans Integrated development Environment (IDE) was used for the development of this application and PostgreSQL Database Management System (DBMS) provides database management support for our system. The database houses the courseware. The deployment platform for the system is windows. Windows offers users robust foundation for high quality experience across applications, services, personal computers and devices. Below is a demonstration of course material that was programmed and made available to students, using java-enabled mobile phone for learning. This was achieved using programming tools such as those mentioned above. Learning supported with mobile device is more practical and enhanced than exclusive classroom learning [10]. Fig 5 is a form showing where the lecturer creates the course module and fig 6 is the view of the course module.
5. CONCLUSION

People tend to be focused on constantly improving their skills, so an environment with a comprehensive mobile learning programme is attractive to them. This will encourage learners by making the cost of learning less expensive. With m-learning, learners are freed up so that they could study at anytime and in any place and in structures suited to their employment and family commitments. The obligation to join a learning group, at a fixed time, at a fixed place, for a fixed period of time, in order to learn is no longer there. In this paper, mobile learning courseware was developed, and the result was tested using Java2 Micro Edition (J2ME) application to access the courseware. This will be of immense benefit to both learners and educators by enabling educators to design learning materials for delivery on mobile technology and enabling learners to access learning materials via their mobile technologies. The big question now is how ready are school administrators to incorporate mobile learning into the mainstream education?
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Authors’ Brief

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On improving Search Result Authoritativeness with an Enhanced Trust Rank Algorithm

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ABSTRACT
In a network of pages (the web), outbound and inbound links are the only connecting flow making the vertexes; while the pages represent the edges as is found on directed graphs. The ranking of a page is dependent on its content and the number of inbound links which are recommendations to the page. Contrary, an outbound link demotes the page. If the Home page (target page) is "good", then there is a flow of Page Rank booster out of it. In this work, we introduced the TrustRank (TrustRank = M - 1 * X) method to become the start process of the Page Rank method (M * PageRank = (1 - d)), since the basic idea is, taking the link structure to generate a measure for the quality of a page by the selection of "good" (trusted) pages for a start (by hand). These pages are the sources of trust. Trust can be transferred to other pages by linking to them. Trust is propagated in the same way as PageRank from thence. Ranked result from this point would be better than those not guided by the "trusted selections".

Keywords: TrustRank, PageRank, Numerical computation, Authoritativeness, Outbound link, Inbound Link.

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1. INTRODUCTION

Page Rank is certainly one of the most important algorithms existing today. It is used by Google to assign a value to each page on the Internet, measuring importance or influence of its content. In order to improve on it, we need to understand how it works with respect to its weaknesses. Every time a page is linked to, it receives a certain amount of Page Rank, depending on how much the giving page has accumulated. Also, every time a page links to another one, it loses certain amount of Page Rank, depending on how many outgoing (outbound) links it has. As illustrated in the site map of Figure 1, every page is linked to or from one another. In other words, page rank flows from page to page, like a juice flowing from glass to glass. At the end, this flow tends to accumulate (or settles) on pages which have more incoming (inbound) links, carrying more Page Rank with them.

Page Rank is a virtual value meaning nothing until you put it into the context of search engine result(s). The most obvious solution will be to get as many incoming links as you can, while shutting down your site and not linking to anyone else. Wikipedia is one example of such closed system, as every outgoing link on WikiPedia is 'no follow' (a web crawler associated term for sites that are out of bound from crawling). However things are not as easy, as Google has tweaked their algorithm over the years and in effort to fight those kinds of Page Rank conservation, they have probably invented numerous algorithms to detect and even punish such sites. Other 'white hat' techniques like 'page rank sculpting' allow you to flow the page rank 'juice' to the areas of your site where you want them most. Page rank juice is hard to control and up to now only the experts could configure the page rank flow on your site.
Fig. 1: Web Sitemap example and its relative links / page rank flow. Source: sitemap; Wikipedia (2012) [10]

Some work provides a new tool that is capable of getting instant Page Rank Juice information for any page. This information will in turn allow you to understand the direction your page rank is flowing to, what you can do to preserve it, and the areas you can channel it to that needs most attention. Higher Page Rank pages will have tendency to rank better in the search engine results provided they are still optimized for the keywords you are searching for. Visitors coming from search engines are most praised kind of visitors because they are generally interested in what you have to say (or sell, if you look at it commercially; they also cost nothing).

2. OBJECTIVE

Considering the weaknesses of Page Rank algorithm, we are hopeful that the rank of a page could be improved upon. Our objective in this paper is to introduce the element of 'trust' from the Trust Rank algorithm into the working model of the Page Rank algorithm. The reason being that: since page Rank value flows from page to page; a bad start page would generate a bad page rank influence.

Since the Trust Rank algorithm makes a selective (by the user or automatically) starts from a page of 'good' standing, it is sure that the flow of Page Rank would start on a good note.

3. LITERATURE REVIEW

A page with a higher PageRank is deemed more important and is more likely to be listed above a page with a lower PageRank [8]. PageRank is Google’s system for ranking web pages. PageRank relies on the uniquely democratic nature of the web by using its vast link structure as an indicator of an individual page’s value. In essence, Google interprets a link from page A to page B as a vote, by page A, for page B. But, Google looks at more than the sheer volume of votes, or links a page receives; it also analyzes the page that casts the vote. Votes cast by pages that are themselves ‘important’ weigh more heavily and help to make other pages ‘important’ [6]. In other words, Google conducts “elections” in which each web page casts votes for web pages with hyperlinks to those pages.
But unlike a democracy, a page can have more than one vote and links from pages with high PageRank are given more weight (according to their ranking) and thus help to improve the targets' PageRank [8]. If you see the PageRank of a page with the PageRank meter in the Google Toolbar (an advanced feature), the more green the higher the PageRank.

Calculating the PageRank is nothing else than solving the following linear system of equation 1.

\[ M \cdot PR = (1 - d) \]

\[ \text{Where,} \]
\[ 0 < d < 1 \text{ denotes a damping factor,} \]
\[ PR \text{ is a N-dimensional vector and } M, \text{ is an N x N-matrix.} \]
\[ N \text{ is the number of pages within the system.} \]

The i-th component of the vector PR, that is, \( PR_i \), is the PageRank of site i.

The matrix M is given by:

\[ M = 1 - d \cdot T \]

\[ \text{Where,} \]
\[ T \text{ stands for the transition matrix. The components of } T \text{ are given by the number of outgoing links:} \]
\[ T_{ij} = 1 / C_j \text{ (if page j is linking to page i)} \]
\[ T_{ij} = 0 \text{ (otherwise)} \]
\[ C_j \text{ is the number of links on page j.} \]

The solution of the linear system of equation 1 is given by:

\[ PR = M^{-1} \cdot (1 - d) \]

The calculation of the inverse matrix \( M^{-1} \) can (in principle) be done analytically. For 0 < d < 1 there are no eigenvalues of M which are zero. Therefore, a unique solution exists. However, for larger N the calculation should be done numerically because it’s less time consuming. This is done by some kind of iteration scheme. The simplest method is the Jacobi-iteration:

\[ PR_{[k+1]} = (1 - d) \cdot T \cdot PR_{[k]} \]

\[ \text{Where,} \]
\[ PR_{[k]} \text{ denotes the value of the PageRank vector after the } k \text{-th iteration.} \]
\[ PR_{[0]} = 1 \text{ can be taken as the initial PageRank vector.} \]

Of course, the solution is independent from the initial guess. The convergence is guaranteed, since the largest Eigen value of d T is smaller than 1. The damping factor specifies the amount of PageRank that is transferred. In case of d=1 the whole PageRank is passed while for d<1 there is a damping. There are convergence problems if d is close to 1 and the number of iterations for a stable solution increases. In practice about 100 iterations are necessary to get a stable result. Obviously, the number of iterations depends on the linking structure as well as the accuracy.

Taking the final result of the last calculation as input for the new iteration reduces the number of iterations (assuming that the linking structure hasn’t changed completely).

Rewriting equation 4, for the components and omitting the denotation for the iteration yields, we have:

\[ PR_i = (1 - d) + d \cdot ( \frac{PR_{X1}}{C_{X1}} + ... + \frac{PR_{Xn}}{C_{Xn}} ) \]

Often this equation is referred as PageRank algorithm [8]. However, strictly speaking this is an iteration scheme to solve the matrix inversion for the equation at the top. Anyway the Jacobi-iteration isn’t the faster way for computation. In general, equations 6 and 7 (minimal residue) are iteration schemes:

\[ PR_{[k+1]} = PR_{[k]} + R_{[k]} \cdot ( \sum R_i M_{ij} R_j ) / ( \sum M_{in} R_n M_{nj} R_j ) \]

\[ \text{Where,} \]
\[ R_{[k]} = R_{[k]} - M \cdot R_{[k]} \cdot ( \sum R_i M_{ij} R_j ) / ( \sum M_{in} R_n M_{nj} R_j ) \]

Converge faster. There are several other iteration schemes such as Over Relaxation Methods, Gauss-Seidel, Conjugate Gradient, Preconditioning Methods, Multigrid and Blocking Techniques.

However, some iterations schemes are restricted to Hermitian matrices [3]. In some cases, the linear system of equation 8:

\[ M \cdot PR = \frac{(1 - d)}{N} \]

is considered, instead of that given by equation 3. Obviously, the solution vector is the same apart from a normalization factor of 1 / N. The case d = 1 (no damping) has to be treated separately. This corresponds to determining the eigenvector of T with eigenvalue 1. The problems are degenerate eigenvalues. They appear for linking structures where not every page can be reached from every other page. This is the case for dead ends (pages without outgoing links) or maple leaves (close structures). In these cases, the numerical solution given by the iteration scheme depends on the initial vector. It is a combination of eigenvectors for the eigenvalue 1. However, for d < 1 dead ends do not cause problem and do not have to be treated differently.

### 3.0.1 Personalized Page Rank

Personalized Page Rank was first suggested by [8]. The basic idea is simple: instead of distributing the sources of Page Rank uniformly, the distribution is modified depending on personal interests. In this case Page Rank is given by:

\[ PR = M^{-1} \cdot V \]

\[ \text{Where,} \]
\[ V \text{ denotes a personalized vector, distributing the sources uniformly} \]
\[ V_i = \text{constant, leads to the usual Page Rank vector.} \]
The selection of \( V \) depends on personal interests. One way would be taking personal bookmarks as sources of personalized vector \( V \).

Either Page Rank has to be computed separately for each personalized vector \( V \) or one has to compute a complete basis set. However, the dimension of the basis is almost the same as the dimension of the system. Therefore, all these calculations are time consuming to be performed in practice [7]. Unfortunately, in practice, the computation is impossible.

### 3.0.2 Topic-Sensitive Page Rank

In case of Topic-Sensitive Page Rank, the transition matrices \( T[i] \) are created for each topic separately. Using:

\[
PR[i] = M[i]^{-1} \cdot (1 - d)
\] ............................... 10

If one gets a Topic-Sensitive Page Rank \( PR[i] \), and the number of topics is fairly small (e.g. the 16 top level topics of the Open Directory Project (ODP)). Individual weighting (\( w[i] \)) of the different topics leads to an individual Page Rank:

\[
PR = \sum w[i] \cdot PR[i]
\] ..............................11

\[\sum w[i] = 1\]

Thus, we are left with a simple form of the Personalized Page Rank.

### 3.0.3 Modular Page Rank

The Modular Page Rank is another approach to Personalized Page Rank. In this case, a set of highly ranked pages is taken as basis (source) set:

\[
PR[i] = M^{-1} \cdot V[i]
\] ................................. 12

Weighting the different \( PR[i] \) according to personal interests leads to a Personalized Page Rank. Taking the limit \( i \rightarrow \) (number of web pages) leads to the general form of Personalized Page Rank as described at the beginning.

### 3.0.4 Block Rank

Block Rank is not a different ranking algorithm but a method to speed up numerical computation of Page Rank. For this purpose Page Rank is first computed on small blocks (e.g. domains) and then for the complete system. This is computationally faster than performing the Jacobi-iteration from the beginning on the whole system. Also this method is advantageous because the process can be parallelized [4]. Using Block techniques for matrix inversion processes is not new. These techniques were used even long before the Page Rank algorithm was published. There are several other techniques for an efficient calculation apart from block techniques. Especially, lattice gauge theory is using improved algorithms to speed up matrix inversion for large sparse matrices.

### 3.0.5 Random Surfer Model

For \( d < 1 \), PageRank can be seen as the probability that a random surfer visits this page. A random surfer starts from a randomly chosen page. On each page he chose randomly a link with probability \( d \) and re-starts from a randomly chosen page with probability \( (1-d) \), respectively. If there are no dead ends within the system, the probability to visit page \( i \) is exactly the PageRank taking the normalization:

\[
M \cdot PR = (1-d) / N
\] .............................. 13

In case of dead ends, the probability vector is proportional to the PageRank vector. In their publications, [8] gave a very simple intuitive justification for the Page Rank algorithm. They consider Page Rank as a model of user behavior, where a surfer clicks on links at random with no regard towards content.

The random surfer visits a web page with a certain probability which is derives from the page's Page Rank. The probability that the random surfer clicks on one link is solely given by the number of links on that page. This is why one page's Page Rank is not completely passed on to a page it links to, but is divided by the number of links on the page. The probability for the random surfer reaching one page is the sum of probabilities for the random surfer following links to this page. Now, this probability is reduced by the damping factor \( d \).

The justification within the Random Surfer Model, therefore, is that the surfer does not click on an infinite number of links, but gets bored sometimes and jumps to another page at random [2]. The probability for the random surfer not stopping to click on links is given by the damping factor \( d \), which is, depending on the degree of probability therefore, set between 0 and 1. The higher \( d \) is, the more likely will the random surfer keep clicking links. Since the surfer jumps to another page at random after he stopped clicking links, the probability therefore is implemented as a constant \((1-d)\) into the algorithm. Regardless of inbound links, the probability for the random surfer jumping to a page is always \((1-d)\), so a page has always a minimum Page Rank.
4. SIMPLE CALCULATIONS / CASE STUDY

We have presented several scenarios / cases to illustrate PageRank calculations using the normalization equation 1. Most of the calculations are done analytically. To get numerical results one has to insert numerical values for the different parameters, e.g. taking $d = 0.85$ for the damping factor. Figures 1 - 3 are simple cases. Figure 1 shows case 1.

![Fig. 1: Case 1](image1)

Not connected pages are the simplest case. One gets

$$PR_A = PR_B = PR_C = (1 - d)$$

All pages have the same PageRank. $1 - d$ is the minimal PageRank value. The solution is independent from the number of (not connected) web pages. Figure 2 shows case 2.

![Fig. 2: Case 2](image2)

Every page is linking to each other page. This yields

$$PR_A = PR_B = PR_C = 1$$

As in Case 1 all pages have the same PageRank. This statement is true for all symmetric linking structures. The solution for this Case is independent from the number of pages. Figure 3 shows case 3.

![Fig. 3: Case 3](image3)

The first non-trivial Case: page B has links to A and C; both pages link back to page B. The PageRank calculation yields

$$PR_B = \frac{1 + 2d}{1 + d}$$
$$PR_A = PR_C = \frac{1 + d/2}{1 + d}$$

Obviously, PageRank of page B is higher than that from page A and C. The sum of all values is equal to the number of pages:

$$PR_{\text{Sum}} = 3$$

A general rule exists: as long as every page has at least one outgoing link (that is, no dead ends exist) the total PageRank of the system is equal to the number of pages.

4.1 Complex Calculations Case Study

Figures 4 - 8 are complex cases. Figure 4 shows case 4.

![Fig. 4: Case 4](image4)

A website containing a single page without outgoing links but with some incoming:

$$PR_{\text{Home}} = (1 - d) + X$$

X denotes the sum of all contributions from incoming links. Figure 5 shows case 5.
A website containing $N + 1$ pages. The homepage links to $N$ subpages ($i = 1, \ldots, i = N, N > 0$), which have a backlink to the homepage. There are some incoming links to the homepage but no outgoing links:

$$PR_{\text{Home}} = (N d + 1) / (1 + d) + X / (1 - d^2)$$

$$PR_i = (N + d) / N (1 + d) + d X / N (1 - d^2)$$

The sum of PageRank for all pages of the website is

$$PR_{\text{Sum}} = N + 1 + X / (1 - d)$$

$N + 1$ is the self 'produced' part while $X / (1 - d)$ is the part from external pages. The factor $1 / (1 - d)$ results from:

$$\sum d^i = 1 / (1 - d).$$

That is, in zeroth-order PageRank $X$ is transferred, in first-order PageRank $d X$ is transferred and so on. As already mentioned, the self produced PageRank is equal to the number of pages. This is valid for every linking structure without dead ends (pages without links on it). Dead ends are a waste of PageRank. This can be easily seen comparing the result for $N = 1$ with Case 4. PageRank has increased not only by 1 through the additional page (and self produced PageRank) but much more.

This linking structure is optimal when one is optimizing PageRank for a single page. Assuming that self-links are not considered for the calculation, there is no linking structure which leads to a higher PageRank for the homepage. Figure 6 shows case 6.

A webpage containing $(N + 1)$ pages. The homepage links to $N$ sub-pages which link to each other page of the website. There are incoming links to the homepage. Links to external pages do not exist:

$$PR_{\text{Home}} = 1 + X (N (1 - d) + d) / (N + d)(1 - d)$$

$$PR_i = 1 + d X / (N + d) (1 - d)$$

The PageRank of all pages of the website is given by:

$$PR_{\text{Sum}} = N + 1 + X / (1 - d)$$

The last result is independent from the linking structure as long as there are no dead ends and no links to external pages. Internal linking just changes the distribution. Comparing the results with those of Case 5 one finds that the PageRank of the homepage is decreased while the PageRank of the sub-pages is increased. Figure 7 shows case 7, while Figure 8 shows case 8.
For simplification, we used \( d = 0.8 \) und \( N = 20 \):

\[
\begin{align*}
PR_{\text{Home}} & = 0.845 + 1.124 X \\
PR_i & = 0.846 + 0.163 X \\
PR_{\text{Sum}} & = 17.78 + 4.38 X
\end{align*}
\]

Comparing these results with Case 6 (\( d = 0.8, \ N = 20 \)) one finds that PageRank decreased:

\[
\begin{align*}
PR_{\text{Home}} & = 1 + 15/13 \times 1 + 1.154 X \\
PR_i & = 1 + 5/26 \times 1 + 0.192 X \\
PR_{\text{Sum}} & = 21 + 5 X
\end{align*}
\]

**5. ALGORITHMS**

Here, we present the Page Rank, Trust Rank and the enhancement on the Trust Rank algorithm. Though, the detail algebraic expansions is not considered in this work.

### 5.0.1 PageRank Algorithm

The original PageRank algorithm was described by Page [8] in several publications. It is given by:

\[
PR(A) = (1-d) + d \left( \frac{PR(T_1)}{C(T_1)} + \ldots + \frac{PR(T_n)}{C(T_n)} \right)
\]

Where,

* \( PR(A) \) is the PageRank of page A,
* \( PR(T_i) \) is the PageRank of pages Ti which link to page A,
* \( C(T_i) \) is the number of outbound links on page Ti and
* \( d \) is a damping factor which can be set between 0 and 1.

PageRank does not rank web sites as a whole, but is determined for each page individually. Further, the PageRank of page A is recursively defined by the PageRanks of those pages which link to page A.

### 5.0.2 Trust Rank algorithm

The TrustRank algorithm is a procedure to rate the quality of websites [5]. The basic idea is similar to the PageRank algorithm - taking the linking structure to generate a measure for the quality of a page. The algorithm can be seen as a further development of the PageRank procedure, except that the user's trusted pages may be involve in starting the ranking flow.

**Trust Rank Presentation**

A simple variant of the TrustRank algorithm is given by:

\[
\text{TrustRank} = M^{-1} \times X
\]

Where, the matrix \( M \) (analogue to the PageRank algorithm) is given by:

\[
M = 1 - d \, T
\]

with

\[
T_{ij} = 1 / C_j \text{ (if page j is linking to page i)}
\]

\[
T_{ij} = 0 \text{ (otherwise)}
\]

\( d \) is a damping factor and \( X \) the source vector of the trust.

The inverse PageRank is given by:

\[
M_{\text{inv}}^{-1} \times X_{\text{inv}}
\]

The inverse transition matrix \( T_{\text{inv}} \) is defined by:

\[
T_{ij} = 1 / n_j \text{ (if page i is linking to page j)}
\]

\[
T_{ij} = 0 \text{ (otherwise)}
\]

\( d_{\text{inv}} \) is an additional damping factor,

\( X_{\text{inv}} \) is the source vector of the spam (the bad pages) and

\( n_j \) is the number of incoming links on page j.

\( M_{\text{inv}} \) is neither the transponent nor the inverse matrix of \( M \).

In contrast to the normal transition matrix which is defined by incoming links, \( T_{\text{inv}} \) is a function of the outgoing links.

Therefore, this measure for spam is propagating backwards.

This means that pages are bad which are linking to bad pages, while good pages are defined as pages which have incoming links from good pages [1].
6. ENHANCED TRUST RANK ALGORITHM

Search engine optimization for TrustRank is the same for PageRank. Additionally, one just has to ensure the Trust pages are not considered as spam. Therefore we have to include an anti-spam trust page vector into equation 15 to act as a smoothening factor.

\[ \text{TrustRank} = M^{-1} \ast X \ast (I/A_{\text{next}}) \]

Where

\( A_{\text{next}} \) a recursively generated vector that indicates no spam, thus propagating only the flow of trusted pages to pages.

Choice of the Trust pages would be masterminded by a look ahead method, whose major aim is to be sure that the next page to point to is, (a) not a spam and (b) ‘good’. The value of \( A_{\text{next}} \) would be smoothened numerically by inverting it. An indirect implementation of this is the 'No follow' rule of Wikipedia thus making it a closed system: You can link to her (wiki) but she (wiki) cannot link out of herself to you.

Implementing the variant of the TrustRank in consideration with the PageRank would yield a better result, this is because the Trust Rank's choice of a Trust page for a start would give the user the option of choosing the best page for a start and the flow of Ranks will start on a good footing. next, other pages to link to or from are determine by the look ahead method to ascertain that we are not link to or from a spam page.

7. CONCLUSION

PageRank does not rank web sites as a whole, but is determined for each page individually. Further, the PageRank of page \( A \) is recursively defined by the PageRanks of those pages which link to or from page \( A \). The PageRank of pages \( T \), which link to page \( A \) does not influence the PageRank of page \( A \) uniformly. Within the PageRank algorithm, the PageRank of a page \( T \) is always weighted by the number of outbound links \( C(T) \) on page \( T \). This means that the more outbound links a page \( T \) has, the less will page \( A \) benefit from a link to it on page \( T \). The weighted PageRank of pages \( T \) is then added up. The outcome of this is that an additional inbound link for page \( A \) will always increase page \( A \)'s PageRank. Finally, the sum of the weighted PageRanks of all pages \( T \) is multiplied with a damping factor \( d \) which can be set between 0 and 1. Thereby, the extent of PageRank benefits for a page by another page linking to it is reduced.

The Trust Rank algorithm is a procedure to rate the quality of websites [5]. The basic idea is similar to the PageRank algorithm - taking the linking structure to generate a measure for the quality of a page. The algorithm can be seen as a further development of the PageRank procedure. The starting point of the algorithm is the selection of good (trusted) pages by hand. These pages are the sources of trust. Trust can be transferred to other page by linking to them. Trust is propagated in the same way as PageRank. Additionally, one can deselect sources of spam.

The negative measure (inverse PageRank) is propagated backwards and is a measure for bad pages (spam). For the ranking algorithm both measures can be taken into account [9]. Hybridizing the two methods would give us a better Page Rank flow from one page to another, thereby yielding a better ranked result. However, the user's view of relevance may be different and a case of next consideration.

REFERENCES


A Study of News and Information Media Usage in Nigeria

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ABSTRACT
This study was carried out to evaluate the medium for news and information dissemination using ICT Based Media and Print Media with usage factors (such as affordability, urgency or immediacy, availability, reliability, interactivity etc.) that influence audience readership in Nigeria. Using a survey approach, we were able to establish the fact the print media is dwindling and concluded that more than being preferred, the ICT based media with the advent of the internet has made the news or information media industries the most preferable and more of a social life that the readership audience have adopted as an opportunity to globally sought after news in diverse media, an advantageous factor that has paved the audience to ICT based from print media as a usable source of information or news dissemination in Nigeria.

Keywords: News media, Information Media, ICT based media, Print media, Readership audience, Media usage factors.

African Journal of Computing & ICT Reference Format:

1. INTRODUCTION
The readership audience seems to have lost the societal value of reading the print media newspaper as the worth a reader gets from reading has been traded for instant gratification: drifting away from the traditional ways of getting news and information for the digital generation using the internet or ICT related with an irreversible impact burring information medium cyberspaces. The usage of print media and ICT based media on gathering reports and dissemination of news across the globe (specifically in Nigeria) cannot be over emphasized as the internet has revolutionized such industry. It is presumed that the radical changes brought in the aspect of communication through information and communication technology’s revolution has affected immensely the dissemination of news in every nation around the globe.

Both the ICT based and print media have help bring information closer to the audience (consumers: readers) from different sources; media, vendors, etc. As news spread is vastly becoming cheaper and faster with increased adoption of ICT in dissemination, this study investigates investigated the factors that influences news and information media and comparatively looking at their usage regarding these factors with the intent to make reccomendations.

Such recommendations would help improve the performance and quality of information (hard:print or electronic:online) disseminated within and outside the nation.

2. BACKGROUND AND LITERATURE REVIEW

2.1 Nigeria News Media: Print Media and ICT Based Media
Nigeria with more than 60 news media (online) is a developing country with a fairly well-established media industry, where the enhanced awareness of the role of the media in development has been demonstrated by the current steep rise in the use of information and communication technologies (ICTs) in varied social processes worldwide (Jibo and Okoosi-Simbine, 2003). The most frequently used sources of information broadcast in Nigeria are radio and television, with radio being by far the most important and television the next most important as an ICT tool. Newspapers and magazines are also frequently the source of in-depth information for the literate who can afford them with respect to print media. Most internet users employ the internet based medium for awareness of information, dissemination and communication by email and research and also for news. Verbal exchange of information is also an increasingly important source of information, especially with the advent of smart mobile phones as noted in Osafo-Kwako and Apampa (2009) quoting Nosaze (2008).

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2.2 Audience Readership via the Print Media Usage

The essence of news dissemination to a large audience (audience readership) by print media is to inform, to interpret the news, to entertain, and to provide a service to readers. This essence is dwindling in the print media sector today, as it was observed by Ganiyu and Akinreti (2011) that there are at least 400 print titles of varying formats in Nigeria, out of this number, 216 are newspapers, 63 magazines, 44 interest magazines, 16 vernacular publications and 16 religious publications. Some of these newspapers are owned by the government but majority by private individuals. The Nigerian newspapers include esteemed dailies, well-liked tabloids and periodicals that defend the welfare of ethnic groups in Nigeria. The Punch was ranked number one selling national daily with circulation of about 34, 264 copies, The Sun ranked third with 25, 632 unit sales, Vanguard got 25, 241, while Guardian and Thisday came 5th and 6th respectively, with 25, 222 and 21, 703 daily sales. Daily Trust, the most popular newspaper up North has 11, 672 daily unit sales. Tribune, the oldest surviving newspaper in Nigeria, was another surprise, managing only 8, 314 daily sales. The above mentioned dailies constitute what is known as the top 8 in the standing while others could barely rake up 1,600 daily sales as disclosed by Abdulraheem et al (2012). Ekeng quoted in Abdulraheem et al (2012) noted that circulation decline is a global phenomenon as the newspaper industry in America, Europe and even Asia is also affected. This, I believe he meant, is primarily due to the impact of Internet, which guarantees quick news for free, revealing with references to the 2010 national report by the Advertisers Association of Nigeria (ADVAN), the daily sales figure of all the newspapers was less than 300,000, meaning that only one in every 470 Nigerians buy newspapers daily as the stockpile of unsold copies of newspapers and magazines presently in the circulation departments of most print media organizations is a vivid sign of this challenge. The future of newspaper in Nigeria might go extinct in the nearest future unless the print media braced up to the challenges posed by the new media.

2.3 Audience Readership via Internet or ICT Based Media Usage

The Internet is becoming the dominant force in the information world, transforming the ways in which information is aggregated, stored, searched, disseminated and retrieved. As purported by Song et al (2010), it’s a major force behind information technology to represent the most significant change in the media market during the past decades. In addition, Campbell et al (2009) noted that the Internet is facilitating the convergence of media forms, “the process whereby old and new media are available via the integration of personal computers and high-speed satellite-based phone or cable links”. These technology components according to Egbokhare and Oliha (2013) are the most overwhelming given the ever expanding number of technology offerings and alternatives. Also with the advent of smart mobile phones emerging as multiple-use device for calls, e-mails, Internet browsing, and GPS navigation, Ekuobase and Oliha (2013) noted that without the usability factor in technological advancement towards our everyday activities, it’s just another technical problem, and these transformational developments tend to leave very little for a newspaper to do”. Virtually all print media of Nigerian newspapers have been adapting themselves to this new media age of online newspaper edition and mobile phone newspapers, given the fact that a certain reader can communicate with a large network of audience. The list of online print media or ICT based news media is available at www.onlinenewspapers.com/nigeria.

The print media’s newspapers have exerted the greatest influence thus ensuring the most up-to-date information and readability by individuals with varying reading abilities as and when they like. Adding to this fact, Mr. Gbenga Adefaye, the Editor-in-Chief, Vanguard Newspapers, argued that the print media was evolving, that in spite of the influx of new technologies, it was still regarded as one of the most trusted sources of information by many Nigerians. He noted that though the new media presently provided various platforms of communicating, a lot of Nigerians were not sophisticated enough to take full advantage of the new technology. He therefore argued that instead of being a threat, the online media platform would only complement the efforts of the print media to survive (Abdulraheem et al, 2012). That being said, many factors seem to have contributed to the dwindling of print media as most adults when younger lacked the enthusiasm to even read books, let alone newspapers (literacy).

The activities of vendors are not also helping matters whereby many of them encourage the free readers’ syndrome, where you can read as many newspapers as possible for a token which goes into the vendor’s pocket. Again he noted that most editors do not connect to the reading public through their publications which in most cases lacks depth and quality content that serves the majority. There is also that of interactivity, affordability, availability, accessibility amongst others. Communication of information seems to be the nut of the shell why there is different readership medium. In this sense, the news or information medium can influence the reader’s choice of usage and based on this theory, this study steeps to comparatively explore the usage of print media and Internet or ICT based media for news dissemination in Nigeria.
3. RESEARCH DESIGN AND APPROACH

The research design is a form of descriptive survey with a systematic approach to collect comparative data through questionnaire on the usage of print media and Internet or ICT based media for news and information dissemination with the intent of presenting results that would help brace the gap that may arise from the vast transformation by new media technologies, if it exists actually. Data were captured via the research instrument from a sample size of four hundred (400) participants in the metropolis city of the heart-beat of the nation (Benin City – Edo State, Nigeria) and the University of Benin as the targeted population, which may be considered a somewhat good representation forming the sampled population of this study due to the diversity of commuters, inhabitants, staff, and students that cut across all states in Nigeria.

3.1 Presentation of Data, Findings and Result Analysis

A total of 400 questionnaires were administered to the participants by the researchers. Analyzing with a simple percent count (needless of complex calculations) it was an acceptable response rate as 396 (99%) were deemed valid and used for this study. The demographic findings exposed that majority of the participants 328(84.3%) were within the age group of 20 – 35 years and other were above 35 years as 268(67.7%) were males and 128(32.3%) females giving a ratio of about 2:1. On the query of literacy, about 36(9.1%) participants had WASSCE as their highest level of education while 156(39.4%) were undergraduates and majority of them 204(51.5%) were graduates, indicating that the majority of the participants who are graduates were prone to be more of the readership audience at the time these data were collected.

Table 3.1: Media Comparison

<table>
<thead>
<tr>
<th>Preferences</th>
<th>Print Media Frequency (%)</th>
<th>ICT Based Media Frequency (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Awareness of and most preferable usage of news dissemination media in Nigeria.</td>
<td>142(35.9%)</td>
<td>254(64.1%)</td>
<td>396(100%)</td>
</tr>
<tr>
<td>2. Most preferable source of accessing news or information on news media.</td>
<td>170(42.9%)</td>
<td>226(57.1%)</td>
<td>396(100%)</td>
</tr>
<tr>
<td>3. Information or news service quality provided by news media.</td>
<td>272(68.7%)</td>
<td>124(31.3%)</td>
<td>396(100%)</td>
</tr>
<tr>
<td>4. Determining and most desiring factors for news media usage:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Affordable cost</td>
<td>186(47.0%)</td>
<td>210(53.0%)</td>
<td>396(100%)</td>
</tr>
<tr>
<td>- Immediacy/Urgency</td>
<td>162(40.9%)</td>
<td>234(59.1%)</td>
<td>396(100%)</td>
</tr>
<tr>
<td>- Searchability: breadth of information</td>
<td>150(37.9%)</td>
<td>246(62.1%)</td>
<td>396(100%)</td>
</tr>
<tr>
<td>- Interactivity</td>
<td>42(10.6%)</td>
<td>354(89.4%)</td>
<td>396(100%)</td>
</tr>
<tr>
<td>- Availability</td>
<td>172(43.4%)</td>
<td>224(56.6%)</td>
<td>396(100%)</td>
</tr>
<tr>
<td>- In-depth information or news</td>
<td>272(68.7%)</td>
<td>124(31.3%)</td>
<td>396(100%)</td>
</tr>
<tr>
<td>- Reliability</td>
<td>258(65.2%)</td>
<td>138(34.6%)</td>
<td>396(100%)</td>
</tr>
<tr>
<td>- Convenience</td>
<td>166(41.9%)</td>
<td>230(50.1%)</td>
<td>396(100%)</td>
</tr>
</tbody>
</table>
Data presented on Table 3.1 evaluated participants on the comparative construct of news and information media in Nigeria between print media and Internet or ICT based media. Responding to the query of participants awareness of both media (print and ICT base), findings revealed they were aware of the various news and information dissemination media as majority of the respondents 254 (about 64%) preferred the ICT based news media as their most sought after usage medium for news dissemination and information gathering compared to print media with about 36%. It also revealed that the ICT based media dominated the print media on the query of most preferable source of accessing the information or news with 226(about 57%) to 170(about 43%) but with respect to information or news service quality, a significant number of the participants 272(about 69%) preferred print media to ICT based with a total amount of 124 (about 31%).

From some of the selected factors that determine media usage form their perpetual readership audience, the query item four (4) on the questionnaire determined the comparative usage choice as it most suit them where about 210(53%) preferred ICT based media with respect to the query of affordable cost, about 234(59%) on that of information urgency or news immediacy, about 246(62%) on that of access to a wider range of news or information “searchability”, about 354(89%) on the query of interactivity, about 224(57%) on that of availability, and about 230(50%) on the query of convenience but about 272(69%) on the query of in-depth and quality information or news and about 258(65%) on reliable source of news and information of the respondents preferred mostly the print media compared to ICT based media. These findings showed an indication that the respondents regarded the ICT based news media usage as their most sought after medium for accessing information and news dissemination compared to print media but in respect of in-depth quality information and reliability, the print media was most preferred.

Table 3.2 presents information on respondent’s comparative usage impression regarding the print media and ICT based media thereby collapsing the indicators: highly satisfied and satisfied together as one indicator ‘satisfied’ making also highly dissatisfied and dissatisfied becoming ‘Dissatisfied’ with the intention to know how satisfied they are with the usefulness of both media in accessing news or information. Responding to the query of the overall usage impression, a total of 254(244 + 10) about 64.1% were satisfied, 44(11.1%) were indifferent in their usage perceptions, and 98 (64 + 34) about 24.8% were dissatisfied on their overall impression on ICT based media usage. On the other hand, it was a mere satisfactory for the print media as majority of the respondents 174(142 + 32) that is about 44% were dissatisfied as 164(16 + 148) that is about 41.4% while 58(14.7%) were unable to remark their impression on their overall impression on print media usage. Clearly, the readership audiences were more satisfied with their overall impression on the usage of ICT based media for news and information dissemination compared to their mere satisfaction with print media.

Table 3.2: Media Usage Impression

<table>
<thead>
<tr>
<th>Preferences</th>
<th>Overall usage impression on news or information dissemination media.</th>
<th>Highly Satisfied</th>
<th>Satisfied</th>
<th>Neutral</th>
<th>Dissatisfied</th>
<th>Highly Dissatisfied</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Print Media</td>
<td>18(4.0%)</td>
<td>148(37.4%)</td>
<td>58(14.7%)</td>
<td>142(35.9%)</td>
<td>32(8.1%)</td>
<td>396(100%)</td>
<td></td>
</tr>
<tr>
<td>ICT based Media</td>
<td>10(2.5%)</td>
<td>244(61.6%)</td>
<td>44(11.1%)</td>
<td>64(16.2%)</td>
<td>34(8.6%)</td>
<td>396(100%)</td>
<td></td>
</tr>
</tbody>
</table>
4. DISCUSSIONS
It was the scope of this study to comparatively explore the usage of print media and Internet or ICT based media for news dissemination in Nigeria form the view of readership audience to help brace the gap that exists in the print media industry due to the vast transformation of new media technologies. Needless of complex analysis, the outcome of this study has revealed that there is more usage of ICT based media for news and information sources which has gained an uprising chart over the years but created a dwindling gap for that of print media. From our findings, this dwindling may have resulted from many factors as it is apparent that the readership audience wanted more media interactivity with respect to urgency, an avenue where they can sort after information, read it, share their thoughts and expect similar ideas from a wide range of audience.

The ICT based media gained more preferences as one can easily read similar information from different sources online for just a token on internet enabled phones at a suitable convenience due to their availability nature of information that breaks faster online than in print media’s newspapers or magazine, which comes the next day or weekly. One of the implication that has increased the dwindling of the print media is that of source or channel of distribution “the vendors” who today do not majorly promote the print media but encourage the audience to read as many newspapers or magazines for a token of money instead of buying. Although many print media owners are now evolving with the ICT has improved with the curve the internet has brought in to news media business, but this gap is yet to be bridged unless the print media braced up these challenges, their readership audience in Nigeria might go extinct in the nearest future.

5. CONCLUSION AND RECOMMENDATION
The results are obvious as they clearly showed that the rate at which ICT or internet based media has burreed in the print media for news dissemination is becoming vast with the arrival of new media technologies day in day out. Determining with the factors selected from the research instrument, the ICT based media was preferred in most except for the factor of reliability of source of news or information that is believed may have been the reason for Mr. Gbenga Adefaye, the Editor-in-Chief, Vanguard Newspapers, to have argued that the print media in spite of the influx of new technologies, was still regarded as one of the most trusted sources of information by many readership audience. It is reasonable to conclude that more than being influential, the ICT based media with the advent of the internet has made the news or information media industries more of a social life (an opportunity to globally sought after news in diverse media), an advantageous factor that has paved the audience from print media usage as source of information or news dissemination in Nigeria.

To this end, this study has shown how ICT has improved with technologies, in promoting the widespread usage of news media and information dissemination in Nigeria and far beyond. It ends by recommends that print media can improve on their service quality to ensure its survival in this age of continuous technological trends, and also the introduction of the internet, social networks sites and online journalism to both print and Internet/ICT based media industries, for easy accessibility, availability and readability of news and information to a larger and different readership audience thereby increasing usability and profits to such media service providers.

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Author’s Bio

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Finite State Machine: A Model for Validating Variants of Input Data

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ABSTRACT
Finite state machine can be regarded as a form of state transition graph. It is a graph, whose nodes represent the states, while the edges represent the state transitions. It can be regarded as a graph or network, whose nodes represent current value of state variables of software and the edges represent the state transitions or change of value of state variables, as a result of valid operations. In computing, finite state machine can be used to model different applications, both in hardware and software design. Any software application that has variables that can assume different values will define the states of the finite state machine. In each state, there are input and output, which represent state transitions into the state, and out of the state. The state transitions are as a result of different operations that cause the state variables to change values. This paper presents a novel way of using finite state machine to validate different types of input data in computer software.

Keywords- Finite state machine, input data format, data validation, state transition graph, spell chacker, parser.

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1. INTRODUCTION
The need for input data validation in application software cannot be overemphasised, this is because data validation adds quality to computer software. Data validation helps to ensure that correct input data are used for data processing in an application software. The need for data validation has been the reason for the use of the slogan, “Gabbage In, Gabbage Out”. Most input data have defined format that can be used to generate a valid input data. Finite state machine can be used to model a particular input data format, which can be used to develop algorithm that can be implemented using a particular programming language. The implemented algorithm will detect correct or wrong input data. The development of computer program that will be used to validate input data is a complex and difficult task, but with the use of finite state machine, the complex task can be reduced to a simple one. Similarly, spell checking can be regarded as a form of input data validation. The spelling of every word follows a defined format, which consists of the specific combination of letters that spells the word correctly. A spell checker will help to detect wrong spelling of a particular word. Most word processing software use spell checker to alert the user of wrong spelling of words. Finite state machine can be used to model a particular word or group of words, which can be used to develop algorithms that can be implemented as a computer program that will detect wrong spelling of words. Any implemented algorithm that performs this function is called a spell checker.

Another variant of input data that finite state machine can be used to validate is computer codes/programs. The process of validating computer codes is called parsing, and the software that is used to do parsing is called parser. The algorithm that can be implemented to become a parser can be developed using finite state machine. Such algorithm is developed by representing the syntax of the various vocabularies of a programming language as a finite state machine. Therefore, any computer code/program written in a particular programming language can be validated by determining if it conforms to the correct syntax.

2. SURVEY OF RELATED LITERATURE
Finite state machine is an important model that has been used to solve important problems in computing. In [1], finite state machine and fuzzy logic have been used for hand gesture learning and recognition, while [2] uses finite state machine and recurrence matrices to develop a secret sharing scheme for secure communication. In [3], FSM has been used to address the problem of encoding the state variable of a finite state machine such that the binary decision diagram representing the next state function and the output function have the minimum number of nodes. Though [4] has identified the use of finite state machine as a model that can be used to develop a spell checker, it emphasizes the use of javascript as a technology that can be used to accomplish this, which is a different approach from the approach that this paper uses.
This paper presents a novel way of developing finite state machine, which can be used to develop algorithms that can be implemented using a programming language. In [5], the author presents a finite state machine pattern-matching algorithm that can be used for bioinformatics applications, while in [6], the author uses it to model and test web applications. On the other hand, [7] uses finite state machine to secure composite web service based on policy approach. The authors emphasize that finite state machine is an artificial intelligence technique, which has a mathematical root and can be used in matching pattern, sequential logic circuit, and implementing computer programs. Though [8] has identified that finite state machine can be used to validate input data, it has not identified other similar applications, like spell checker and parser, which this paper has considered. According to the author, a finite state machine is a collection of nodes (called states) with an arrow leaving each node for each possible input that can be encountered at that node. In [10], the authors present an illustration of what a finite state machine is. According to them, a machine is a system that can accept input, possibly produce output, which has some sort of internal memory that can keep track of certain information about inputs. They emphasize that the complete internal condition of the machine and all of its memory at any time is said to constitute the state of the machine at that time.

3. FSM AS A MODEL FOR VALIDATING INPUT DATA FORMAT

Codes, like vehicle registration number, course codes, GSM numbers can be assigned, using defined formats. It is, therefore necessary that validation checks be made any time users enter these codes on the computer. The validation check will help to sieve out wrong input data. Finite state machine can be used to represent input data format, with the aim of using it to develop algorithm that can be implemented as a computer program that will validate input data based on the defined format. The following guidelines can be used to model an input data format using finite state machine.

- Start every finite state machine with a start state, i.e state, 0.
- Use a circle to represent each of the possible states, and number them.
- Use an arrow to link the various transitions of states, from a particular state.
- Label the arrows to indicate the value of the input character that will be read into the input variable or the value of the count or reset variable.
- You can group consecutive numeric character values; this will help to avoid too many states.
- Make sure that the identified states are distinct states.
- If an input character in the data format appears more than once in such a way that they follow each other, then the state will be treated as repeated state. In that situation, you can use an arrow that originate from a state to itself to indicate repetition of state. However, you need to use a count variable to indicate the number of times that the state will repeat itself.
  - If an input character in the data format appears more than once in such a way that they do not follow each other, then it will not be treated as repeated state. A reset variable will be used, which means that you are entering a state from two or more sources, and each source will lead to a different destination. You can use a reset variable to indicate the particular destination that a particular source will lead to.
  - Terminate every finite state machine with an end state, and number it appropriately.

The following examples will illustrate the use of the guidelines in producing the finite state machine for each of the data format shown below.

A. Course Code Data Format

The task is to develop finite state machine that can be used to develop an algorithm, which can be implemented as a computer program that will check for valid/invalid input data format, using the course code data format, shown in figure 1. The course code data format begins with ‘CSC’, followed by digit space that can be any digit between 1 and 5. Following this is a 0 digit or digit that can be between 1 and 9. If it is a 0 digit, then the last digit will be any digit that is between 1 and 9, otherwise, the last digit will be any digit that is between 0 and 9.

<table>
<thead>
<tr>
<th>CSC</th>
<th>1-5</th>
<th>0</th>
<th>1-9</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-9</td>
<td>0-9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 1: Course Code Data format
The guideline specified in section 3 can be used to develop the finite state machine as shown in figure 2.

Figure 2: FSM for the course code data format

4. DEVELOPING ALGORITHM USING FSM

In the electronic time format shown in figure 3, the first digit space can be 0 – 1 digit or 2. If it is 0 – 1, then the next digit space will be 0 – 9, otherwise, it will be 0 – 3. Following the second digit space is a ‘,’ which is followed in the third digit space with 0 – 5, and following this is 0 – 9 in the last digit space. The guideline outlined in section 3 can be used to produce the finite state machine for the electronic time data format. The finite state machine is shown in figure 4.

Figure 3: Electronic time data format

Figure 4: Finite State Machine For The Electronic Time Format

The algorithm, which can be implemented as a program, first initializes the state variable to zero, and it reads the input data to be validated one character at a time until it encounters the end of line character. Depending on the current value of the state variable, it calls the appropriate algorithm for that state. The algorithm for a particular state will check for the value of the character it has read, if it is the correct character for that state, it changes the state variable to the next state, otherwise it changes the state variable to error state. It continues this process until it reads the end of line character. In order to determine if the input data is correct or not, it checks for the value of the state variable.
If it is the ‘end’ state as specified in the finite state machine, then it means that the input data is correct; otherwise, the input data is wrong. The algorithms for the finite state machine shown in figure 2 and figure 4 follow.

A. Developing Algorithm From Course Code FSM

The algorithm for each of the states of the finite state machine shown in figure 2 has been outlined below:

Void zerotest(char data)
1. Read data
2. Determine zerotest
   2.1 IF data = ‘C’ THEN
   2.2 State := ‘1’;
   2.3 Ck := 1;
   2.4 State := ‘C’
   ELSE
   2.5 State := ‘E’
END

void twotest(char data)
1. Read data
2. Determine twotest
   2.1 IF data = ‘C’ THEN
   2.2 State := ‘1’;
   2.3 Ck := 2;
   2.4 State := ‘F’
   ELSE
   2.5 State := ‘E’
END

void ceetest(char data)
1. Read data
2. Determine ceetest
   2.1 IF data = ‘S’ THEN
   2.2 State := ‘2’
   ELSE
   2.3 State := ‘E’
END

void eeftest(char data)
1. Read data
2. Determine eeftest
   2.1 IF data >= ‘1’ AND data <= ‘5’ THEN
   2.2 state := ‘3’;
   2.3 ct := 1;
   ELSE
   2.4 state := ‘E’
END

void threetest(char data)
1. Read data
2. Determine threetest
   2.1 IF ch = ‘O’ THEN
   2.2 State := ‘6’
   ELSE
   2.3 IF data >= 1 AND data <= ‘9’ THEN
   2.4 state := ‘7’;
   2.5 ct := 1;
   2.6 state := ‘8’
   ELSE
   2.7 State := ‘E’
END

B. Developing Algorithm From Electronic Time FSM

In a similar manner, the algorithm for each of the states of the finite state machine shown in figure 4 has been outlined below:

Void zerotest(char data)
1. Read data
2. Determine zerotest
   2.1 IF data >= ‘0’ AND data <= ‘1’ THEN
   2.2 state := ‘1’;
   2.3 IF data = ‘2’ THEN
   2.4 state := ‘E’
   ELSE
   2.5 State := ‘E’
END

void sixtest(char data)
1. Read data
2. Determine sixtest
   2.1 IF data >= ‘0’ AND data <= ‘9’ THEN
   2.2 state := ‘7’;
   2.3 ct := 2;
   2.4 state := ‘A’;
   2.5 state := ‘B’
   ELSE
   2.6 State := ‘E’
END

void eightest(char data)
1. Read data
2. Determine eightest
   2.1 IF data >= ‘0’ AND data <= ‘9’ THEN
   2.2 state := ‘9’;
   2.3 state := ‘B’
   ELSE
   2.4 State := ‘E’
END

B. Developing Algorithm From Electronic Time FSM

In a similar manner, the algorithm for each of the states of the finite state machine shown in figure 4 has been outlined below:

Void zerotest(char data)
1. Read data
2. Determine zerotest
   2.1 IF data >= ‘0’ AND data <= ‘1’ THEN
   2.2 state := ‘1’;
   2.3 IF data = ‘2’ THEN
   2.4 state := ‘E’
   ELSE
   2.5 State := ‘E’
END
The same guideline outlined in section 3 can be used to develop a finite state machine, which can be used to develop an algorithm that can be implemented as a program that checks for the correct spelling of any word. Illustrating further, the finite state machine shown in figure 5 uses the guideline outlined in section 3, and it represents spelling of the word, ZIGZAG.

Figure 5: Finite state machine for the word, ZIGZAG
In a similar manner, the algorithm for each of the states of the finite state machine follows:

**Void zerotest(char data)**
1. Read data
2. Determine zerotest
   2.1 IF(data = 'Z') OR (data = 'z') THEN
   2.2 state := '1';
   2.3 \( zc \) := 1;
   2.4 State := '2'
   ELSE
   2.5 State := 'E'
END

**void twotest(char data)**
1. Read data
2. Determine twotest
   2.1 IF (ch = '1') OR (ch = 'i') THEN
   2.2 State := '3'
   ELSE
   2.3 State := 'E'
END

**void threetest(char data)**
1. Read data
2. Determine threetest
   2.1 IF (data = 'G') OR (data = 'g') THEN
   2.2 State := '4'
   2.3 gc := 1;
   2.4 state := '5'
   ELSE
   2.5 State := 'E'
END

**Void fivetest(char data)**
1. Read data
2. Determine fivetest
   2.1 IF(data = 'Z') OR (data = 'z') THEN
   2.2 State := '1'
   2.3 \( zc \) := 2;
   2.4 State := '6'
   ELSE
   2.5 State := 'E'
END

**void sixtest(char data)**
1. Read data
2. Determine sixtest
   2.1 IF (data = 'A') OR (data = 'a') THEN
   2.2 State := '7'
   ELSE
   2.3 State := 'E'
END

**Void seventest(char data)**
1. Read data
2. Determine seventest
   2.1 IF (data = 'G') OR (data = 'g') THEN
   2.2 State := '4'
   2.3 gc := 2;
   2.4 state := '8'
   2.5 state := '9'
   ELSE
   2.6 State := 'E'
END

6. **FSM AS A MODEL FOR DEVELOPING ALGORITHM FOR A PARSER**

The syntax of a programming language, like Modula 2 can be expressed using EBNF or the syntax diagram. A finite state machine can be used to model the syntax of a particular vocabulary of a programming language, which can be used to develop an algorithm that can be implemented to become a parser. The syntax analyzer or parser will be used to verify if an input into the parser conforms to the syntax of the vocabulary of the language. The following example illustrate further. Figures 6a – 6d show the syntax of Modula 2 programming language as presented in [9]. Using the same guideline outlined in section 3, the syntax diagram for the vocabulary, integer can be represented as a finite state machine, shown in figure 7.
Figure 6: Syntax diagram of some Modula 2 vocabularies
The finite state machine shown in figure 7 can be used to develop algorithms that can be implemented to become a parser. The parser will check if the input to it is a valid or invalid integer number. The algorithm for each of the states of the finite state machine follows below:

**Void zerotest(char data)**

1. Request data
2. Determine zerotest
   2.1 IF data = octaldigit THEN
   2.2 state = ‘i’
   2.3 oc = oc + 1
   2.4 dc = dc + 1
   2.5 hd = hd + 1
   ELSE
2.6 IF data = digit THEN
2.7 state = ‘m’

**Void mtest(char data)**

1. Request data
2. Determine mtest
   2.1 IF data = digit THEN
   2.2 dc = dc + 1
   2.3 hd = hd + 1
   2.4 IF dc < 5 THEN

**Figure 7: Finite State Machine For The Modula-2 Vocabulary, Integer**
2.5  state = 'm'
ELSE
2.6  IF dc = 5 THEN
2.7  State = 'e'
2.8  State = 'l'
ELSE
2.9  state = 'E'
ELSE
2.10 state = 'E'
END

void itest(char data)
1.  Request data
2.  Determine itest
2.1  IF data = octalDigit THEN
2.2  oc = oc + 1
2.3  dc = dc + 1
2.4  hd = hd + 1
2.5  IF oc < 5 THEN
2.6  state = 'i'
ELSE
2.7  IF oc = 5 THEN
2.8  state = 'j'
ELSE
2.9  state = 'E'
ELSE
2.10 F data = Digit THEN
2.11  dc = dc + 1
2.12  hd = hd + 1
2.13  IF dc = 1 THEN
2.14  state = 'c'
ELSE
2.15  F dc < 5 THEN
2.16  state = 'm'
ELSE
2.17  IF dc = 5 THEN
2.18  state = 'e'
2.19  state = 'l'
ELSE
2.20 state = 'E'
ELSE
2.21 IF data = hexDigit THEN
2.22  hd = hd + 1
2.23  IF hd < 5 THEN
2.24  state = 'd'
ELSE
2.25  IF hd = 5 THEN
2.26  state = 'f'
ELSE
2.27  state = 'E'
ELSE
2.28 state = 'E'
ELSE
2.29 state = 'E'
END

void ctest(char data)
1.  Request data
2.  Determine ctest
2.1  IF data = hexDigit THEN
2.2  hd = hd + 1
2.3  State = 'd'
ELSE
2.4  IF data = 'H' THEN
2.5  State = 'g'
ELSE
2.6  state = 'E'
ELSE
2.7  state = 'E'
END

void dtest(char data)
1.  Request data
2.  Determine dtest
2.1  IF data = hexDigit THEN
2.2  hd = hd + 1
2.3  IF hd < 5 THEN
2.4  state = 'd'
ELSE
2.5  IF hd = 5 THEN
2.6  state = 'l'
ELSE
2.7  state = 'E'
ELSE
2.7  state = 'E'
END

void ftest(char data)
1.  Request data
2.  Determine ftest
2.1  IF data = 'H' THEN
2.2  state = 'g'
2.3  state = 'l'
ELSE
2.4  state = 'E'
END

void jtest(char data)
1.  Request data
2.  Determine jtest
2.1  IF data = 'B' THEN
2.2  State = 'h'
2.3  State = 'l'
ELSE
2.4  IF data = 'C'
2.5  State = 'k'
2.6  State = 'l'
ELSE
2.8  state = 'E'
END

END
7. IMPLEMENTATIONS OF THE ALGORITHMS

Pascal programming languages was used to implement the algorithms. Each of the algorithms for a state of the finite state machine was implemented, as a Pascal procedure, which does not return any value. A test program was written, which requested for the input data, which was read one character at a time until an end of line character was encountered. After reading each character of the input data, it checked for the current state of the state variable and called the appropriate procedure for that state.

8. CONCLUSION

This paper has been able to use finite state machine to model three variants of input data. It has defined algorithms for each finite state machine that has represented a particular variant of input data, the algorithms have been implemented using Pascal programming language and test programs have been written to validate each variant of input data.

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Author’s Brief

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Enhanced Automated Teller Machine Using Short Message Service Authentication Verification

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ABSTRACT
The use of Automated Teller Machine (ATM) has become an important tool among commercial banks, customers of banks have come to depend on and trust the ATM conveniently meet their banking needs. Although the overwhelming advantages of ATM cannot be over-emphasized, its alarming fraud rate has become a bottleneck in its full adoption in Nigeria. This study examined the menace of ATM in the society imposing additional security cost of running ATM services by banks in the country. The researchers developed a prototype of an enhanced Automated Teller Machine Authentication using Short Message Service (SMS) Verification. The usability of the developed prototype was examined using heuristic evaluation with the aid of a questionnaire designed based on validated software usability metrics. Responses from ten (10) respondents who are users of ATM cards in the country and the data collected were analyzed using Statistical Package for Social Science (SPSS). Based on the results of the analysis, it is revealed that the developed prototype will go a long way in reducing the alarming rate of ATM fraud in Nigeria.

Keywords—ATM, ATM Fraud, E-banking, Prototyping.

1. INTRODUCTION
The traditional and ancient society was devoid of any monetary instrument and the entire exchange of goods and merchandise was managed by the “barter system”. The use of monetary instrument as a means of exchange has now replaced the barter system and money in various denominations is been used as the purchasing power. Before the emergence of modern banking system, banking operations were done manually leading to a slow-down in settlement of transactions, this manual system involves posting transactions from one ledger to another which were handled by human beings. Later, most banks started using only one Computer in carrying out transactions thereby ameliorating (improving on) the sluggish nature of banking transactions. All these were not only time consuming, it also reduced accuracy as a result of human errors. The new millennium brought with it new possibilities in terms of availability and accessibility of information simultaneously introducing new challenges in protecting sensitive information from some eyes and making it available to others. The evolution of electronic banking which can be defined as a system through which transactions are settled electronically with the use of electronic gadgets such as ATM, POS etc has become synonymous with today’s banking and financial transactions. Unlike in the time past when a bank’s customer needs to go in person to a branch of a bank, he need to be present right in the banking hall in front of the bank’s cashier before any transaction could be made, today’s electronic payment system especially the use of ATM has changed all that [2]. ATM has remained the most patronized banking transaction channel in the country accounting for over 80-90% of the total e-payment transactions in Nigeria. It’s safety, convenience and ease in settlements of bills and online transactions has unfortunately been lessened by the frauds that are penetrated by these plastic money [9] thereby leading to an undermined customers confidence and a major problem in it’s full adoption in the banking sector [2].
1.1 Research Objectives
The major objectives of this paper are:
(a) To develop an enhanced ATM authentication prototype using SMS verification.
(b) To examine the usability of the developed prototype.

2. RELATED LITERATURE
Automated Teller Machine is a 24 hour teller machine with electronic terminals that allow bank transactions almost every time thereby making cash withdrawals or transferring of funds between accounts possible through the insertion of ATM card and personal identification (PIN). The ATM therefore performs the traditional functions of bank cashiers electronically in real time. A research was carried out and it was asserted that ATM services are highly profitable for banks and hence, banks aggressively market the use of ATM cards [11], [13]. They further stated that off premise ATMs are usually more profitable for banks because it attracts a higher volume of non-bank customers who must pay service fees, unfortunately for the customers using this off premise ATMs, they are more vulnerable to robbery they concluded. Investigations into electronic payment system and telebanking services in Nigeria revealed that there has been a very modest move from cash, payments are now been automated with volumes of cash transactions reduced. The introduction of ATM was applauded by several customers as a suitable substitute to the frustrating queues that portray the country’s banking halls in the past. The benefits of ATM usage in numerous ways, include:
(a) Flexible account access.
(b) Increase in hours of operation to fit client schedules.
(c) Many clients can reach beyond the branch network.
(d) Bank personnels are not required to be present for transactions and they will have to serve other customers in the banking hall.
(e) Convenient way of banking.
(f) Reduction in armed robbery attacks.

Despite the enormous benefits derivable from the ATM, the emerging challenges of ATM fraud has continuously threatened to silence it’s continued [2], [3], [4], [5], [6]. The menace of ATM frauds in Nigeria was blamed on indiscriminate issuance of ATM cards to customers without regards to the customer’s literacy level. [14] sees the new and additional cost of running ATM machines in the country in the cost of the ballooning ATM fraud rate. Concern on the rising ATM fraud rate in the country as the security measures adopted by banks are obsolete thereby making the measures insignificant and allowing increasing fraud rates at the ATM centres was expresse [7], [10]. As the technology of ATM keep developing, the fraudsters also keep improving on ways of carrying out crime while banks are observed not to be putting sufficient measures of control place to avoid fraud at ATM centres.

It was opined opined that if the current upsurge and nefarious activities by ATM fraudsters is not checked, it will result into massive dumping of ATM cards by customers [12]. It was explained that it is disheartening to note that ATM frauds have been successful due to the support and collaboration provided by unscrupulous internal employees of banks, this means that for a longtime, these unbudgeted losses by the customers and banks will continue while the banks are suffering reputational loss [8]. Previous researcher described the high level of ATM fraud in Nigeria as a big shame when most (if not all) of the fraudulent activities could be checkmated or prevented [10].

Five (5) security loopholes in ATM usage are identified [1], [2], these security loopholes are found in:
(a) ATM software
(b) ATM hardware
(c) Poor ATM implementation/maintenance
(d) Physical access security loopholes
(e) Debit/Credit and PIN loopholes.

Fig. 1 Interface (use case)
3. ALGORITHM

The algorithm which is been shown with the aid of a flow chart is as summarized as follows:

(1) Given an ACCOUNT NUMBER and the corresponding PIN, check the bank database to verify the existence of the ACCOUNT NUMBER, it then checks if the corresponding PIN is valid for the ACCOUNT NUMBER.

(2) For an existing ACCOUNT NUMBER and its valid PIN, Select an operation of (1) Balance Inquiry (2) Deposit and (3) Withdrawal.

(3) For Withdrawal Operation, if the amount to be withdrawn is greater than #5,000, the ATM automatically generates a four digit random code, stores the code as the authentication code and send to the phone number corresponding to the account number. However, if the amount to be withdrawn is less than #5,000, the machine dispenses cash immediately.

(4) For a given authentication code, the ATM compares it with the stored authentication code generated and if valid, it dispenses cash.

4. USABILITY TESTING

The usability testing of this research was carried out using Heuristic Evaluation Based on a Questionnaire for User interface satisfaction designed by previous researchers [15].

5. DATA ANALYSIS

For the purpose of clarification and clarity, the questionnaire was divided into four (4) parts:

a) The General Description of the System
b) The Description of the Screen
c) Terminology and System Information
d) Capabilities of the new system
The data gathered is both descriptive and statistical which involves the use of minimum, maximum and mean.

TABLE I: GENERAL FEATURES

<table>
<thead>
<tr>
<th>Feature</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexible</td>
<td>10</td>
<td>1.00</td>
<td>2.00</td>
<td>1.800</td>
</tr>
<tr>
<td>Secured</td>
<td>10</td>
<td>1.00</td>
<td>2.00</td>
<td>1.700</td>
</tr>
<tr>
<td>Easy</td>
<td>10</td>
<td>1.00</td>
<td>3.00</td>
<td>1.700</td>
</tr>
<tr>
<td>Satisfying</td>
<td>10</td>
<td>1.00</td>
<td>2.00</td>
<td>1.600</td>
</tr>
<tr>
<td>Wonderful</td>
<td>10</td>
<td>1.00</td>
<td>2.00</td>
<td>1.500</td>
</tr>
<tr>
<td>Valid N (list wise)</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As shown in Table I, since the mean of the new system’s flexibility, security, easy operation, satisfaction and being wonderful falls between 1 (strongly Agree) and 2 (Agree), the system is perceived to be flexible, secured, easy to operate, satisfying and wonderful.

TABLE II: SCREEN DESCRIPTIVE STATISTICS

<table>
<thead>
<tr>
<th>SCREEN</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCREEN3</td>
<td>10</td>
<td>1.00</td>
<td>2.00</td>
<td>1.800</td>
</tr>
<tr>
<td>SCREEN1</td>
<td>10</td>
<td>1.00</td>
<td>2.00</td>
<td>1.600</td>
</tr>
<tr>
<td>SCREEN2</td>
<td>10</td>
<td>1.00</td>
<td>2.00</td>
<td>1.500</td>
</tr>
<tr>
<td>Valid N (list wise)</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As described in Table II, the clarity, eligibility and arrangement of information on the screen are perceived to be very clear, easy and well organized since their mean values falls between 1 (Strongly Agree) and 2 (Agree).

TABLE III: TERMINOLOGY AND SYSTEM DESCRIPTIVE STATISTICS

<table>
<thead>
<tr>
<th>TERMINOLOGY</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>TERMS7</td>
<td>10</td>
<td>2.00</td>
<td>4.00</td>
<td>2.900</td>
</tr>
<tr>
<td>TERMS3</td>
<td>10</td>
<td>2.00</td>
<td>2.00</td>
<td>2.000</td>
</tr>
<tr>
<td>TERMS6</td>
<td>10</td>
<td>1.00</td>
<td>3.00</td>
<td>1.900</td>
</tr>
<tr>
<td>TERMS2</td>
<td>10</td>
<td>1.00</td>
<td>2.00</td>
<td>1.900</td>
</tr>
<tr>
<td>TERMS5</td>
<td>10</td>
<td>1.00</td>
<td>2.00</td>
<td>1.800</td>
</tr>
<tr>
<td>TERMS4</td>
<td>10</td>
<td>1.00</td>
<td>2.00</td>
<td>1.800</td>
</tr>
<tr>
<td>TERMS8</td>
<td>10</td>
<td>1.00</td>
<td>2.00</td>
<td>1.700</td>
</tr>
<tr>
<td>TERMS1</td>
<td>10</td>
<td>1.00</td>
<td>2.00</td>
<td>1.600</td>
</tr>
<tr>
<td>Valid N (list wise)</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As described in Table III, exploring new features by trial and error is perceived to be difficult as it’s mean value of 2.900 falls between Agree and Disagree. Prompts for input, learning to operate and message positioning are perceived to be very clear, very easy and consistent respectively since their mean falls between 1 (Strongly Agree) and 2 (Agree). Also, error messages generated when user enters an invalid PIN or option is perceived to be helpful as it’s mean of 1.800 also falls between Strongly Agree and Agree. The System is perceived to be good at informing the user about the progress of the system, straight forward in performing of tasks and the terminologies used for the new system are perceived to be well related as their mean falls between 1 (Strongly Agree) and 2 (Agree).
### TABLE IV: SYSTEM CAPABILITIES DESCRIPTIVE STATISTICS

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPABILITY4</td>
<td>10</td>
<td>1.00</td>
<td>3.00</td>
<td>2.100</td>
</tr>
<tr>
<td>CAPABILITY3</td>
<td>10</td>
<td>2.00</td>
<td>2.00</td>
<td>2.000</td>
</tr>
<tr>
<td>CAPABILITY2</td>
<td>10</td>
<td>1.00</td>
<td>3.00</td>
<td>1.700</td>
</tr>
<tr>
<td>CAPABILITY1</td>
<td>10</td>
<td>1.00</td>
<td>2.00</td>
<td>1.600</td>
</tr>
</tbody>
</table>

Valid N (list wise) 10

As depicted by Table IV, it is being perceived that the system is designed for all levels of users, easy in correction of mistakes, reliable and has a high speed in completing tasks as its mean values lies between 1 (Strongly Agree) and 2.1 (Agree/ Not sure).

## 6. CONCLUSION

The adoption of Automated Teller machine banking industry has enhanced Bank’s efficiency by making banking transactions more productive, effective and convenient as it allows ubiquitous banking opportunities. The impact of ATM in electronic banking can’t be overemphasized as it plays a dominant role in communicating good and quality services to the customers. If a lasting solution is being offered to eliminate the alarming rate of ATM fraud, it will better improve and reposition banking sector. The implemented enhanced ATM using short message service verification alert in this research work is not an absolutely reliable means for checking the menace of ATM fraud in Nigeria as network failure or fluctuations in the mobile network provider can truncate the whole transaction process. This gap is left for future researchers in this domain.

### 6.1 Recommendation

Although the implemented prototype is not an absolutely reliable means of putting an end to the menace ATM fraud in the country, however, government participation in ensuring a focused telecommunication industry void of failure and fluctuations will help the developed prototype in reducing to the barest minimum the fraud rate in ATM services if it cannot eliminate it completely. Regulatory authorities like the Central Bank of Nigeria (CBN) should stipulate more standards and protocols for the banks to follow on the use of ATM. Government should also work on the unemployment rate in the country by creating jobs, opening skill acquisition centres, empowering the skilled e.t.c because the an idle mind is the devil’s workshop. Customer’s satisfaction should be the watchword for banks because customers are king in any business organization. Hence, the banking industry needs to go extra miles in finding a lasting solution to the alarming rate of ATM fraud.
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Deployment of Information Communication and Technology in Higher Education Learning Environment of Emerging Nigerian Economy

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ABSTRACT
This paper describes the rationale for the deployment of Information, Communication and Technology (ICT) in learning environment of Higher Education (HE) institutions with a specific focus on the emerging Nigerian Developing Economy (DE). Productive integration of ICT depends on the way it is deployed and positioned. Many HE institutions in the DE has invested heavily in the use of ICT for teaching and learning, however, its impact has been minimal hence the need for redress. ICT facilitates and improve students’ knowledge and promote positive attitude to learning. Academic planners need to provide proactive support in the usage of ICT and E-learning. Significantly, If DE students are to compete with their counterparts in the developed world, effort must be made to develop their ICT abilities. Sadly, many HE institutions in DE have invested in the use of ICT but its benefits are not fully manifested. Choosing a teaching and learning method is not a passive process; stakeholders are expected to provide additional ICT skills given the complex dynamics of the job market and the increasing needs for multi-tasking workforce. This article contributes significantly to knowledge by identifying in coherent manner the various methodological approaches, personal development and supportive learning environment that are mandatory for sustaining HE development in the DE.

Keywords- Information, Communication, Technology, Higher Education, Learning, Environment, Nigeria and Economy.

1. INTRODUCTION
The development, integration and substance of information and communication technologies (ICT) has reshaped the teaching and learning processes in higher education (HE) [1] despite its low uptake [2] in the Developing Economy (DE). Leveraging on global technology improvement, the use of ICT in HE of DE is ever more critical. Increasing numbers of global HE institutions have adopted ICT for teaching, curriculum development, staff development, and as aid to students learning [3]. Although ICT has the potential to improve educational methods and the quality of teaching and learning, the advantages of ICT are often under-realised [4] and more prevalent in the DE (i.e. Nigeria).

It was argued that ICT adoptions are often poorly implemented as a result of unfounded optimism [5]. Regrettably, significant numbers of academia are still reluctant to adopt technology for teaching and curriculum development. It was stated that serious obstacles in integrating ICT in teaching and learning processes are prevalent and that there are no holistic solutions to the predicaments [6], [7]. The rate of adoption is affected by economic, sociological, organisational, and psychological issues [7]. It was later positioned an inter-cultural study and noted that there were substantial variations in respect of barriers to ICT deployment in differing economies [8]. Given the foregoing, a problem statement is articulated in this article that includes poor adoption of ICT in Nigeria HE sector despite the huge investment. Further, this article commented on the inappropriate teaching and learning methods that has significantly affected the fruition of ICT deployment in the education sector. This paper describes the rationale for deployment of ICT in learning environment of HE institutions with a specific focus in DE. It narrated the rationale for clear understanding and deployment of proactive teaching and learning methods that has effectively sustain ICT in teaching and learning environment. It synthesises the rationale for appropriate use of ICT in enhancing teaching and learning in HE and argued for supportive learning environment that proactively engaged teachers and learners in a sustainable manner. It concludes by identifying the crucial ingredients of quality teaching and learning using ICT.
2. LITERATURE REVIEW OF SUSTAINABLE
DEPLOYMENT OF ICT IN HIGHER EDUCATION

It has been described an activity theory when studying an
integrative ICT from socio-cultural and pedagogical
perspectives [9]. It was argued that such understanding is
critical to education research where the object of its inquiry is
not just knowledge, but ‘useable knowledge’. It has been
argued that no tool is good or bad in itself; its effectiveness
depends on configuration of the events, activities and contents
in addition to the interpersonal processes of the usage context
[10]. As ICT enters the socio-cultural setting of education
environment, learning can be translated into many ways than
earlier thought [11]. It was argued in [12] that for both digital
(word-processing package, computer simulation etc) and non-
digital (hand writing, hands-on laboratory etc) tools in
ensuring resourceful learners in a learning environment.

It was examined in [13] the integration of ICT and students in
enhancing thinking and autonomous learning using
observations, focus group and face-to-face interviews. The
authors conceded that time constraints, limited knowledge and
experience of the teachers working environment as proposal
hindrances. Such findings are generically peculiar to those of
the DE. Electronic Business Systems (EBS) is playing crucial
roles in the global business enterprise and hence the need for
resource re-direction into critical business areas to keep up
with economic and market trends [14]. EBS framework for
seamless integration of internal processes, suppliers and
customers includes Supply Chain Management (SCM),
Enterprise Resource Planning (ERP), and Enterprise
Application Integration (EAI). It is dishearten to note that
competent EBS professionals are hard to come by and hence
the need for enhanced training in ICT’s; e-marketing; e-
business programming; and specialist networking to bridge
the ever widening gaps between industry and academia in the DE.

Multimedia techniques are fostering scientific understanding
by presenting students with multilevel scientific thoughts. It
has been positioned the performance of university students
studying sciences using ICT by analysing the students’
characteristics and achievements [15]. It was concluded that
the ICT applications in multimedia environment facilitate
required basic scientific-knowledge and improved performance
while promoting positive attitude towards learning. Various authors in [16] investigated the perceived
barriers to adopting ICT in Omani tertiary DE institution and
suggested lack of institutional support, disbelief of ICT
benefits, lack of confidence, and lack of time as inherent
barriers - group differences based on gender, academic rank,
and academic field were generally not found to pose a
significant barriers. Undoubtedly, academics in DE are
expected to perceive at least moderate degrees of barriers in
applying ICT to their teaching practices, it is however
paramount to provide improved institutional support, training,
and allowing time for academics to learn and upgrade their
ICT knowledge and skills in the deployment of ICT in the HE
of DE.

In the work of [17], a description of an exploratory study of
ICT deployment in Greece was conducted. The author argued
that teacher expectations were positively associated with
students’ ability and perceptions to learning. The study does
not support the notion that boys have more positive ICT self-
efficacy and value beliefs than girls but boys’ and girls’ beliefs
are differentially affected by parents, teachers, and ICT
instructional framework. In the work of [18], a mobile
learning system for students in which they can physically face
the target in addition to personal guidance and supplementary
materials which help students improve achievements and
favourable attitudes toward mobile learning system was
developed. Authors in [19] positioned that ICT in education is
an innovative modifications resulting in efficiency. The
authors argued for the need for decision makers to improve the
‘betterment factors’ (i.e. self regulation, learning, justice,
evaluation and innovative thoughts) for teaching and learning
enhancement.

In [20], articulation of a web-based automated tool to
overcome the conceptual limits of multiple-choice tests was
developed. A description of managerial model (Ordered
Logistical Regression Analysis) for ICT adoption based on
objective (economic) and managerial (firms level factors)
components using a survey of 500 businesses in Latvia in
2008 was developed [21]. The authors argued that perceived
efficiency gains, technology absorption capacity and cultural
factors enhance ICT adoption. In the work of [22], a
deployment of Delphi techniques in describing the critical
success factors that influence the reception of e-learning
systems in the DE was undertaken. Technology awareness,
motivation, and changing learners’ behaviour are thought to be
the suggested prerequisites for successful e-learning
implementations. Important factors influencing e-learning
success in the DE includes enhanced basic-technology
knowledge and skills, improved learning content, computer
training; motivation, institutional support amongst others. The
next section describes the rationale and conceptual framework
for the deployment of ICT in teaching and learning
environment of HE in DE with specific focus on Nigeria – an
emerging West African economy.

3. RATIONALES AND CONCEPTUAL FRAMEWORK
FOR THE DEPLOYMENT OF ICT IN HIGHER
EDUCATION LEARNING ENVIRONMENT –
FOCUSING ON EMERGING NIGERIAN ECONOMY

It is important to adopt a sustainable rationale for deployment
of ICT in the HE environment in the DE [2]. Regrettably,
many institutions in the developing Nigerian economy has
invested heavily in the use of ICT, sadly, its intended benefits
are yet to be realised. Undoubtedly, there is a systemic failing
in the project life cycle of ICT deployment in the HE of
emerging Nigerian economy. Such failings are noted in
requirements gathering, sourcing, procuring and acquiring the
proposed technologies which often results in users’
abandonment.
This paper reiterates that suitable teaching and learning methods that enhance quality of experiential learning should not be passive as currently prevalent. A holistic approach is required in acquiring sustainable ICT framework that contributes positively to teaching and learning in an inherently complex and dynamic environment of Nigerian education environment. Stakeholders have a singular responsibility to develop a course that interest learners (students) and keep them engaged as part of students learning and development in an integrative environment. Figure 1 describes a rational conception of sustainable teaching and learning methods as originally proposed in [2]. It argues that the generic conception of teaching and learning focuses on impacting information. It however postulates that sustainable teaching and learning goes beyond ‘impacting of information’ to other crucial learning and developmental issues such as ‘transmission of knowledge and attitude to knowledge’, ‘facilitation of understanding’, ‘changing perception’ and ‘learning support’. Synthesising information is paramount for learners during academic development and resumption of their life-long learning. The manner by which information is impacted in academic settings of emerging Nigerian economy need significant improvement and ICT would enhance the rigour and quality of information that is impacted during lectures, tutorials, seminars, workshops and other learning sessions.

The quality of knowledge transmission is driven by strategic leverage of the information types, teaching methods and the associated learning support available at the concerned institution. It is also important to understand the positive (reinforcing) causal relationship between ‘impacting information’ and ‘transmitting attitude to change’. It is the position of this paper that if ‘attitude to knowledge’ is to be improved in Nigeria HE academic settings, the methods, tools (ICT) and procedures for impacting information need to be significantly redress and improved. Educational planners in Nigeria need to improve the quality of information, teaching methods and learning supports available to the students.

ICT will play an important role in transmitting learners’ attitude to knowledge in the Nigerian HE settings. Learners need an attitudinal change to their ill-conceived perception of knowledge and the need to challenge the frontiers of knowledge; simulation software and other modelling techniques would aid students learning of complex systems in a forward looking and dynamic learning environment. Knowledge transmission, learning support, facilitation of understanding and change perceptions are other conceptions where ICT are crucial in a learning process. It is however important to argue for strategic policy support that underpinned efficiency and efficacy of teaching and learning. Adopting a holistic approach to teaching and learning would enable decision makers to make informed judgement in respect of sustainable policy framework of pedagogic development in HE of DE.

**Figure 1 Sustainable Conception of Teaching Methods (Source: [2] Olaniyi and Ademola, 2013)**

Dissemination of knowledge to students is the major reason for the deployment of ICT in modern learning environment. Students’ development that improves their capabilities to use idea and information is critical in the Nigerian economy. Furthermore, students’ ability to generate and test ideas as taught and rigorously discussed in the lectures and tutorials environment are needed for their career development. If students in the emerging Nigerian economy are to compete with their global counterparts, effort must be made to help develop their ability to plan and manage their learning using modern ICT in an integrative teaching and learning environment.
Aspect of the need for students’ personal development cannot be over emphasised in the emerging Nigerian economy. Given the complex dynamics of the job market and increasing demand by employers to recruit and retain multi-tasking candidates, it is imperative to equip students with additional ICT skills, tools and techniques that would enable them a competitive advantage in the global job market.

4. FACILITATING PERSONAL DEVELOPMENT AND SUPPORTIVE LEARNING ENVIRONMENT

The primary purpose of a lecture in HE settings is to serve as an avenue for ‘subject-matter overview and stimulation of interest’ rather than a platform for ‘facts dissemination’. The time limit for a typical undergraduate course should not exceed fifty-minute followed by in-class exercise.

For tutorials, the main objective is to serve as an avenue for clarity of objectives (learning outcomes) and reinforcement of the lecture themes in a ‘less-structured environment’. The outcome of tutorials is to acquire some of the ‘personal transferable skills’; e.g. in presentation and group work. Academia must master the art of ‘personal development’ that is impacted on the students. This would include the use of action plan, learning log, group projects, self-help groups, time management exercises, proactive examination techniques, constructive feedback, learning contracts, role play, open learning computer packages, peer and self assessment etc.

The ingredients of quality teaching and learning in an ICT enabled environment start by stating the objective(s)/learning outcome of the session in clear and unambiguous terms. Learning objectives are an integral part of the Unit/Module Guide that are given to students at the beginning of the academic sessions and reiterated in all lecture summaries. Notably, Academic Accrediting Bodies in Nigeria do not provide adequate guidance in the development of learning outcomes, objectives, assessment criteria etc and hence leave the Academic Planning Directorate of various institutions to do the same. The use of clear overhead acetates and lecture slides with the aid of ICT will enabled better experiential learning and development.

Academic management ought to provide, support, assess and monitor the appropriate use of ICT for quality teaching and learning. The need for paced delivery to enhance students learning and development should be advocated amongst academic staff – the standard rule of thumb is that the larger the class and/or the more difficult the material, the slower the pace. Handouts should be developed with the aid of appropriate ICT for complex diagrams, difficult or critical text. Question and Answer Sessions should be undertaken at agreed times and places after the lectures. Academic staff should be encouraged to engage the students in ‘question and answer sessions’ to evaluate their grasps of the subject matter.
Figure 2 below describes the proposed generic framework for a holistic and supportive learning environment as proposed. The atmosphere of learning must be stimulating, calm, reassuring and personable. The use of ICT in creating a welcoming atmosphere of learning should be paramount in many Nigerian academic institutions. Academia must be encouraged of the relevance atmosphere for sustainable learning and development. Students must be taught and motivated to study on how to share their intellectual properties, develop proactively networking abilities using appropriate technologies. Resource adequacy is a dilemma that is confronting HE institutions in the emerging Nigeria economy. It ranges from adequacy of teaching and learning materials, laboratory equipments, up-to-date text books, appropriate development of ICT etc. It is hope that with the appropriate deployment of ICT, many of the resource shortcomings can be minimised. The use of ICT will play significant roles in simulating complex laboratory experiment on personal computers in engineering, science, biological, social and management, medicine and health sciences and legal studies.

The use of ICT is not a passive process on the part of academia - lecturers and other instructional staff must be able/well prepared, enthusiastic, trusted and patient. The issue in respect of ‘trust and patience’ is alarming in Nigeria HE sector – there are clear mismatch between attainment of discipline/morality and the need to ensure ‘trust’ in academic environment. Given the differing socio-cultural and economic settings in Nigeria with an increasing influx of students from other developed economies into Nigerian academic settings, it is imperative to state that ‘home discipline’ differs from ‘academic discipline’ and that morality in academic settings is a process and various students differs in its uptakes – academia must accept this as a reality.

Proactive academias need to recognise that learners are drawn from various background and exposures. Hence, patience are crucial in enabling supportive learning environment in all academic institutions of higher learning. Assessment is an area of concern in many academic institutions of higher learning in Nigeria. There is a need of clear guidance in the use of summative and formative assessment. In many academic instances; assessors are at the liberty of setting assessments at will (including late nights, weekends, religious dates etc) without diligent adherence to the learning contracts. Sadly, many of such assessors have been glorified by management as heroes while committing what is openly described as academic fraud in the developed nations.

The issue in respect of students’ feedback has become an important element in many academic settings. Students’ feedback must be honest, constructive and supportive – instances of lack of feedback have been witnessed in many of the summative assessment across Nigerian higher education institutions. Assessors have equally reported lack of interest by students on the feedback given – this is evidenced by many of the paperwork that often litters the classrooms after assessment feedback. Honest, constructive and supportive feedback will be retained by students for their future academic and professional usage. Students and industry input to curriculum development is gaining ground in the developed nations’ HEs. Student and industry involvement in the Nigerian HE sector is negligible – many academic is of the opinion that there should be a permanent curtain between assessment framework and students participation! Academic institutions need to recognise the importance of end users (students, and industry) in the development of their products (academic qualifications) and services (supportive learning environment). The need for feedback support is a paramount aspect of learning and development; and the ICT usage play a significant role in ensuring the same. Backup support services would include study-skils centre, welfare advice, counselling, career and dyslexia support.

Although many institutions boast of counselling students, however the nature of the counselling are mainly medical or spiritual while failing on many other aspects of counselling services. Study skills centre should form part of the Learning Resource Centre where students are given an opportunity to develop their skills and knowledge during the course of their experiential learning in the HE academic settings of DE. Career and dyslexia support lacks significantly in Nigeria HE settings. Many academic institutions do not see it as moral responsibility to make sure that their students compete favourably in the job market and in further education. This paper calls for the need to provide adequate career development support for learners.

5. CONCLUSIONS OF DEPLOYMENT OF ICT IN NIGERIAN HE SETTINGS

Proactive deployment of ICT in the Nigerian HE academic settings will depend on larger social cultural environment context as no tool is good or bad in itself. Constructive utilisation of ICT will facilitate improved students’ knowledge and enhances positive learning attitude. Positively integrated ICT environment would enable prompt gaining of professional knowledge and facilitates opportunity to receive remedial instruction. Provision of proactive institutional support, technical training, and time to faculty members in their knowledge and skills in ICT usage is urgently needed. E-learning would be an effective tool for delivering pedagogic materials; improved technology awareness, motivation, and changing learners’ behaviour and as some of the ‘success factors’. Identifying the success factors in learning and teaching would enable focusing on pedagogic programmes that promotes self-regulation, self-learning, self-justice, self-evaluation and innovative thoughts.

If Nigerian graduating students are to compete with their global counterparts, effort must be made to develop their ICT capabilities. Regrettably, many institutions in Nigeria have invested heavily in the use of ICT but its benefits are yet to be fully manifested. Various methodological approaches should be adopted for knowledge dissemination (i.e. worksheet, self-
directed private study, ICT produced handouts, e-books, video and audio tapes, internet and intranet, open learning materials, skill development in library and learning resource centres). Personal development and creation of supportive learning environment with the aid of ICT are needed in the Nigerian education sector. Issue of concern would include the atmosphere, resources adequacy (ICT, e-books, laboratory etc), lecturers (able, enthusiastic, trusted and patient), appropriate assessment and feedback, students and industry input into pedagogic development, availability of backup support services etc. Teaching and learning methods should not be a passive process and hence the need for systemic and holistic methodology. Future work will include amongst others the comparison study of ICT uptake and its effectiveness in government and private Nigerian HE institutions.

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Adoption of Accounting Information Systems in an Organization in South Africa

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ABSTRACT
A number of beneficial changes were made, including the implementation of major new business systems replacing the old accounting systems. This study has been designed to achieve the objective of assessing the level of perception of three factors, investigation of the social factors influencing the use of accounting information systems, investigation of the organizational factors influencing the use of AIS, and determining the extent to which AIS is used by accounting firm to achieve their intended purposes in South Africa. To attain this, a survey of 150 questionnaires was sent out and 104 were returned. The paired sample T-test in SPSS was used to determine the statistical significance between the social factors and organizational factors and other variables. Based on the result of the statistical analysis, it can be deduced that the use of AIS is relatively accepted within accounting firm, this is as a result of the ‘change’ that comes with the use of such application. The study has a lot of implications on creation of usage frameworks and the improvement of economy of South Africa.

Keywords- information communication technology; professional practice; in an accounting organization in South Africa

African Journal of Computing & ICT Reference Format:

1. INTRODUCTION

The importance of AIS in the economy of a nation has been recognized worldwide, especially in the contribution to the economic management of South Africa, where the contribution of AIS towards growth, job creation and social progress is highly valued. The role played by accounting firms has been enhanced by the development of AIS, which has contributed to the professional values added to these organisations [1]. In fact, automated AIS employed by software experts to process accounting information systems with a good support of financial statements have reduced the human error factor, compared to non-automated systems [2]. AIS also provide information on actual budgets of the organisation that will help the company’s management to plan and control business operations but an appropriate framework that determine the usage and impact of AIS is yet to be determined.

Good management of resources and better control of costs, budgeting and forecasting encourage the wellbeing of AIS to continually generate profits. AIS played a crucial role that contributed to value-added aspects by providing internally-generated input from financial statements. [3]believed that viable strategic plans must have a basis in the history of the organisation, the current assets and capabilities of the organisation, and the trends in the operation of the organization.

1.1 Information Systems in General
An information system is an organized means of collecting, entering and processing data and storing, managing, controlling and reporting information so that an organisation can achieve its objectives and goals [3]. This definition of information systems shows that an information system has the following components;
Goals and Objectives – an information system is designed to accomplish more goals and objectives. For example, an information system was designed to collect and process data about employees to help the manager prepare payroll reports. Inputs - Data must be entered into the information system before it is processed, as data are the facts that are being collected and processed by the information systems. Data are meaningless and useless if they are not processed, therefore they must be processed and transformed into a meaningful, organized and useful form that is called information. Output - Output is the meaningful and useful information produced by the information systems. For example, the weekly payroll report produced by the information systems is an output.

Data storage - In addition to the external data entry into the information systems, there should be internally-stored data used for processing. Processors - In order to produce useful and meaningful information, data must be processed by companies by using computers. Instructions and procedures - An information system produces data by way of the following instruction and procedures. In a computerized information system, software includes procedures and instructions that direct the computer to process the data. Users are people who use the information produced by the system and who interact with the systems. For example, the manager who uses financial statements that are produced by an accounting information system is the user of the information system. Control Measures - In order to make the information system produce correct and error-free information, necessary measures should be taken to protect and control the information system. Thus, any system that includes the above components is known as an information system, source [4].

1.2 Accounting Information System (AIS)
Accounting is the service function that seeks to provide the users with quantitative information. On the other hand, AIS is an information system that is designed to make the accomplishment of accounting functions possible. AIS processes data and transactions to provide users with the information they need to plan, control and operate their businesses [3]. An accounting information system is a computerized system using computers designed to collect data, enter, process, store, and report data and information. The acceptance and improvements in the technology have facilitated an information system which started in the early 1950s when the first business computers become available and is still in progress [5]. Large mainframe computers have been replaced by small and fast personal computers at lower costs. As a result, accounting information systems that were previously performed manually are now performed by computers in most companies [6].

Companies can now capture, process, store and transmit data with the help of computers. Whereas data collection and processing were performed manually in historical systems, on-line collection and processing of data were performed by computerized systems [7]. In manual accounting work, systems were very slow and tedious, which led to errors and mistakes [8]. Fortunately, improvements in technology have enabled companies to collect process and retrieve data quickly. In this case, the function of manual systems that were explained in the preceding section can be explained for computerized systems as follows: source from [8].

Data input function - In manual accounting work, accountants carry out their work through the sourcing of documents and later post all the account entries to the ledger accounts by use of a pen. On the other hand, in computerized AIS, after data are captured, they should be converted into a readable form [7]. In most computerized AIS, source data automation devices that capture data at the time and place of their origin are used. For example, the bar code scanner used in retail stores can record the sale transaction, just as the scanning device reads the code located on the products [9]. In addition, a Master File is used to store data about entities in a database in a computerized AIS. Master files have replaced the subsidiary ledgers that are used in manual systems. For example, records in an account receivable Master File includes Customer Names, Customer Account Numbers, Addresses and Balance due.

Master files are frequently updated automatically as transactions are taking place. For example, as sales are made or receivables are collected, accounts receivable master files are changed. In addition to the accounts receivable master file, other master files are kept for all other balance sheets and income statement items such as accounts payable, fixed assets and expenses [5]. Data processing – In computerized systems, records are updated by using primary keys that uniquely identify each record. For example, when a sales transaction takes place, the relevant customer file should be updated, in order to find the customer’s master file. Customer account numbers can be used as the primary key, because every customer has a unique customer account. In other words, it is not possible for two or more customers to have a common customer account number.

1.3 How AIS Updates a Customer’s File
As seen above, when a credit sale is made to a customer, the computer searches for the relevant customer in the accounts receivable file via the customer’s account number, thereby ensuring that it will not go to the wrong customer, because every customer has his or her own unique account number. When the desired customer is found, the amount in the current balance column is updated automatically, [3]. Information output - After the data are entered into the computer output process, information output is produced to
meet the needs of the users. Information is presented in three forms: a document, a report and a response to a query. Documents are records of transactions a company has in data such as invoices [6]. This document can be printed out using printers and, in addition, they can be stored as electronic images in the computer database. Today, electronic communication systems enable companies to transmit financial reports to the users electronically; this, of course, eliminates paperwork and reduces costs. In a manual accounting system, transactions are first recorded in a journal and then they are posted to a necessary ledger account [10]. At the end of each accounting period, financial statements are prepared by using the ending balance sheets and ledger accounts. In a computerized AIS, all the information is gathered in relation to tables, in which case financial statements can be prepared at any time by entering the necessary command into the computer [11].

1.4 Software Tools in the Accounting Information Systems

Accountants must be familiar with the software tools because they help the user perform the accounting functions more effectively and efficiently [7]. Accounting software - The software contains the basics of accounting functions such as input, processing and output [12]. There are two classifications of accounting software: low-end and high-end. The low-end is all-in-one software, which means that all of the functions of the accounting system are performed within different software. Therefore, low-end software is used for a small company. On the other hand, in high-end software, each accounting function comes in a separate module. Each module checks for data correctness, processes it, updates all relevant accounts and finally produces outputs such as document and reports [5].

Income tax - The tax laws are frequently changing, which makes it exceedingly tedious to deal with. Therefore, manual tax preparation is becoming more and more difficult and time-consuming. Fortunately, tax preparation software is currently available for companies. Therefore, instead of processing tax manually, the companies can just use computers and software to perform the functions. As a result of this, manual tax is tedious and complex to calculate, while a computer with the use of software prepares the taxes in a correct and meaningful way in a very short period of time. Audit - IT has also influenced computerization in the auditing profession: if auditors perform the function manually, it takes time to detect the frauds, mistakes and errors in the final computing. However, audit software packages are currently available for the auditing profession [11]. For example, trial balance software enables auditors to input the work in the trial balance correctly, handle all types of adjusting entries, and automatically compute the adjusted trial balance. In addition, a software package can access the customer’s file, select a statistical sample of the accounts, and print a working paper sheet. Auditors are able to use personal computers to reduce their costs significantly.

Word processing - Word processing is computer-assisted creation, editing, correcting, manipulation, storage and printing of textual data [3]. Accountants use word processing software to prepare reports, billings, memos and financial statements. Graphics software - Graphics can be prepared using graphics software, so that graphics can be printed on paper or displayed on slides, transparencies and photos. Many auditors and managerial accountants use the graphic software to graph the data in financial statements and reports. Electronic data interchange (EDI) - Electronic data interchange enables companies to communicate with each other electronically. Therefore, EDI enables companies to exchange documents with each other. For example, a computerized network enables the purchaser and the supplier to exchange purchase orders and invoice electronically in the form of images.

Electronic funds transfer (EFT) - Companies can now connect to banks through EFT. This system enables companies to make payments and collections electronically. In this case, when a company wants to pay for accounts payable to a supplier, it can do so via EFT [3]. Whenever a company makes a sale; the transaction is immediately charged to the customer’s bank account and simultaneously credited to the company’s account. In addition, all relevant accounts such as accounts receivable and cash are updated immediately by the computerised systems.

2. THEORETICAL FRAMEWORK AND BACKGROUND

A review of the literature on AIS and the advantage of AIS were discussed in the previous study, in order to establish the theoretical framework of the research model and to derive the hypotheses that can explain accountant behaviour towards the role of AIS in an organisation’s setting. This study have examines some theories in the domain of the information systems environment, and explored social factors and organisational behaviour and the technology acceptance model (TAM) variables. In the past, technology acceptance model (TAM) represents an important theoretical contribution towards the understanding of AIS [13]. The focus on the theory-based model of TAM by [13] explains computer usage behaviour towards the role of accounting information systems.

The goals of TAM also provided an explanation of the determinants of computer acceptance that are generally capable of explaining user behaviour across a broad range of end-user computer technology and user populations. Predicting human behaviour and suggests how users come to accept and use a technology and proposes that when a person is adopting a new technology, a number of factors such as the perceived usefulness, perceived ease of use, attitude towards use and behaviour intention can influence their decision about how and when he or she will use it.
Also [14] implies TAM framework, as a theory from social psychology, explicitly shows the social, cultural, individual and organisational factors that influence the behaviour. Davis developed TAM framework, while under contract to IBM Canada Limited to evaluate the market potential for a variety of the then-emerging PC-based applications in the area of multimedia, image processing, and pen-based computer in order to guide investment in a new development. [13] study of social influence was motivated by his interest in understanding the change brought about in individual attitude by external input, in such as information communicated to easy them. Specifically, his research attempted to understand whether the change in attitude resulting from external stimuli was a temporary superficial change or a more lasting change that became integrated in the person’s value systems.

He suggested that change in attitude and action is produced by social influence. His study employs a theory-based model to investigate and examine the social, individual, organisational and critical success factors that might explain accountants’ behaviour and role of AIS ([15]). These theories are in the AIS domain because they enable researchers to gain a useful insight into the reactions of people towards computer technology and factors affecting their reactions [13]. A brief discussion of each of the TAM variables was presented for this study. Perceived Usefulness: [13] define PU as the user probability that using a specific application system will increase his or her job performance within an organisational context. Perceived Ease of Use: Davis defines PEOU as the degree to which an individual believes that using a particular system would be free of physical and mental effort [16]. While PEOU relates to the assessment of the intrinsic characteristic of IT such as ease of use, ease of learning, flexibility and clarity of IT interface, PU on the other hand is a response to user assessment of the extrinsic, ie. Task-oriented outcome: how IT helps the user achieve task-related objectives, such as task efficiency and effectiveness. These two beliefs can create a favorable disposition or intention towards using the AIS.

Behaviour Intention: according to the TRA, an individual behaviour intention (BI) is a function of two basic determinants: one is a personal factor in nature and the other reflects the social influences. The former refers to an individual’s positive or negative evaluation of performing the behaviour. This is termed as attitude towards the behaviour. The latter reflects an individual’s perception of the social pressure put on him or her to perform or not to perform the behaviour in question. These are termed subjective norms. In other words, BI is determined by an individual perception of personal factors such as attitude towards the behaviour and subjective norms, which are the social pressure on the behaviour in question [17].

Attitudes towards use: TAM is based on the TRA attitude paradigm which specifies how the behaviour-relevant component of attitudes can be measured. It distinguishes between belief and attitudes and specifically how external stimuli such as objective features of the attitudes to the object are casually linked to belief, attitudes and behaviour. In TAM, an attitude towards usage is referred to as the evaluative effect of positive or negative feeling of individual in performing a particular behaviour [18].

2.1 The important of TAM in the research study
Since its original development, TAM has been the focus of considerable academic attention ([15]). TAM had received, adapted and extended by numerous researchers. These adaptations have variously explored TAM’s constructs and variables ([16]), issue of social influence, the temporal dimension of IT adoption behaviour, the degree of voluntary attitudes in IT adoption and usage ([13]), usage self-measurement bias and the case of object-oriented systems development . Furthermore, the theoretical importance of TAM as a determinant of user behaviour is revealed by various kinds of research studies including the adoption of innovations, the cost-benefit paradigm, expectancy theory and self-efficacy theory. An overview of scholar research studies ([19]) on IS acceptance and usage suggests that TAM has emerged as one of the most influential models in this stream of research, including e-commerce and the adoption of internet technology.

TAM with its original emphasis on system design characteristics represented an essential theoretical contribution in understanding IS usage and acceptance behavior. For instance, Davis [19] originally examined an email system and file-editor used at the time at IBM Canada and found the PEOU and PU to be significantly correlated with self-reported use of the system. Moreover, evidence of the research community’s growing acceptance of TAM is more or less reflected in the fact that the Institute for Scientific Information’s social science citation index recently listed 335 journal citations since 1999 of the initial research paper published by [19]. More than a decade after its initial publication, TAM continues to play a significant role in social science research studies [19].

Nevertheless, TAM has been replicated and tested extensively to provide empirical evidence on the relationship that exists between PU and PEOU. The result of the study has confirmed the validity and reliability of the Davis instrument, and supports its use with different populations of users and different software choices. TAM uses multiple-item scales to operationalize ATU, PU and PEOU in order to measure these constructs more reliably than would be possible with a single-item scale ([19]). The Cronbach Alpha reliability of TAM scales has been found to exceed 0.9 across numerous fields [19]. In addition, TAM item scales exhibit a high degree of discriminate, convergent and monological validity ([19]).
The importance of these psychometric properties and the high proportion of variance in TAM for studying IS adoption is shown by ([19]. However, there is potential bias in TAM. One of the major biases is that TAM assumes that when someone forms an intention to act, that the person will be free to act without limitation ([19]. However, in the real world, there will be many constraints such as limited ability, time limit and individual freedom to act [19]. TAM with its original emphasis on the system design characteristic does not account for social norms, subconscious habits and facilitating condition of the organisational environment in the adoption and utilization of new IS including AIS.

Further, most of the existing studies on TAM were conducted in North American countries. When TAM is tested in the other countries such as Switzerland and Japan, the results vary on TAM’s predictive power, culture, social norms, habit and facilitation in individual IS, including AIS adoption. [19] had observed that the omission of a subjective norm from TAM represented an important area that needed further research. They had noted that the theoretical basis of TRA makes it difficult to distinguish whether usage behaviour is caused by the influence of the referent on one’s intent or by one’s own attitude. For instance, [16] observed that the subject may want to do what referent: X thinks he or she should do, not because of X’s influence, but because the act is consistent with the subject’s own [attitude]. [13] not only underscores the importance of social norms that can explain behaviour in the adoption and use of IS in the real world application of TAM, but states that they failed to recognize the importance of habit and other facilitating conditions suggested above to have an important influence on behaviour. [16] encourages future research to consider the role of additional [external variables] within TAM. In other words, his study highlighted the growing importance of developing knowledge from TAM. This study employs TAM variables and incorporates selected variables such as social factors, and organization factors. The theoretical foundation and research model have explained the role of AIS and behaviour towards the adoption AIS.

2.3 Research model and Hypothesis
The technology acceptance model (TAM) was used in this study, for it does predict ability in the role of accounting information systems usage. The relationship between Social factors, Organizational factors, perceived usefulness, (PU), perceived ease of use (PEOU), attitudes towards usage (ATU), behavioral intention (BI) and accounting information systems (AIS). Technology is specified in the TAM adoption and it reflects in the organization structures. Informed by the empirical evidence shown below, is the modified model showing the Social factors, has direct influence in organizational factors. Together with perceived usefulness has direct influence on attitudes towards use, similarly perceived ease of use has direct influence attitude towards use, while behavioral intention is posited to affect (AIS). Empirically evidence was conducted in justifying TAM variables and other factors, the below was conceptualize model that was tested with the prove of hypotheses.

Figure; A conceptual model for Accounting Information system usage
Informed by the theoretical frameworks, the following hypotheses were tested, in order to achieve the aim and objectives of this work:

**Hypothesis 1:**

\[ H_0: \text{There is no positive relationship between social factors and organisational factors in the use of AIS} \]

\[ H_1: \text{There is a positive relationship between social factors and organisational factors in the use of AIS} \]

**Hypothesis 2:**

\[ H_0: \text{There is no positive influence between social factors and perceived usefulness of AIS} \]

\[ H_1: \text{There is a positive influence between social factors and perceived usefulness of AIS} \]

**Hypothesis 3:**

\[ H_0: \text{There is a positive relationship between organisational factors and perceived ease of use of AIS} \]

\[ H_1: \text{There is no positive relationship between organisational factors and perceived ease of use of AIS} \]

- Perceived ease of use ensure that there would be no error or omission in usage of AIS
- Using AIS in turn is influence by perceived ease of use

### 3. METHODOLOGY OF THE STUDY

#### Sample size

A total 150 respondents have been surveyed from different types of financial institution on random sampling. 140 employees are majorities, who familiar with use of AIS. They engaging in using AIS and this have make AIS to played a vital role in their industry.

#### Data collection

The study is mainly based on primary data. A structured survey questionnaire has been used to carry out the research. While the user of (AIS) were interested, and fully participated to filling the questionnaire provided.

#### Unit of analysis

Unit of analysis was conducted and targeted a set of people in an organization, mainly usage of AIS software, and accountants

#### Data analysis

Data have been analyzed by using Statistical Package for the Social Science (SPSS) was used to perform correlation on the result from the questionnaire. The correlation analyses were tailored towards achieving the set objectives.
Result
The descriptive statistics of the Social factors, organisational factors, and TAM variables are shown in the table Table 1; Summary of Descriptive analysis Correlation

<table>
<thead>
<tr>
<th>Factors</th>
<th>PU</th>
<th>PEOU</th>
<th>ATU</th>
<th>IN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization</td>
<td>1.000</td>
<td>.589**</td>
<td>.464**</td>
<td>.291**</td>
</tr>
<tr>
<td></td>
<td>.000</td>
<td>1.000</td>
<td>104</td>
<td>104</td>
</tr>
<tr>
<td></td>
<td>.589**</td>
<td>1.000</td>
<td>.381**</td>
<td>.382**</td>
</tr>
<tr>
<td>Social Factors</td>
<td>.000</td>
<td>104</td>
<td>104</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>.464**</td>
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<td>1.000</td>
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<td></td>
<td>.000</td>
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<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>Intention of Use</td>
<td>.291**</td>
<td>.382**</td>
<td>.113</td>
<td>1.000</td>
</tr>
<tr>
<td></td>
<td>.003</td>
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<td>.255</td>
<td>.104</td>
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</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).

The above table 1; indicate TAM construct has determine the role of AIS, shows correlation between the organisational factors, social factors and intention of use of AIS, the correlation coefficient indicates a positive trend of 0.589, while determine 0.464 in Social Factors which is significant at the 0.01 level at 2-tailed. A positive relationship also exists based on the result and framework. Between the organisational factors and the intention of use of AIS with correlation coefficient of 0.291 in, significant at 0.03 levels at 2-tailed. In addition, correlation coefficients of 0.382 in which indicate a positive relationship, also exist between the social factors and the intention to use AIS, significant at 0.01 level of 2-tailed test. Therefore implies that there is a strong relationship in TAM variables to easily adopted (AIS). This indicates that between the social factors and the organisational factors there is a co-orderly relationship that leads to intention to use AIS.
Table 2: Correlation Analysis between Social factors and Organisational factors

<table>
<thead>
<tr>
<th>Factors</th>
<th>Organisational Factors</th>
<th>Social Factors</th>
<th>Correlation Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organisational factors</td>
<td>1.000</td>
<td>.589**</td>
<td>.464**</td>
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<td>.589**</td>
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<td>Social Factors</td>
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</table>

**. Correlation is significant at the 0.01 level (2-tailed).

As shown in table 2, the result of the correlation analysis indicate that there is a positive relationship between organisational factors and social factors with a correlation coefficient of 0.589 and 0.464, indicating a positive relationship between organisational factors and general consideration of the use of AIS in the organization. This is significant at 0.01 level of 2 tailed analyses.

Table 3: Correlation co-efficient

<table>
<thead>
<tr>
<th>Correlation co-efficient</th>
<th>Co-efficient</th>
<th>Intention of use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sig. (2-tailed)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td>.381**</td>
<td>.382**</td>
</tr>
<tr>
<td>000</td>
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<td>000</td>
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<tr>
<td>104</td>
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<td>104</td>
</tr>
</tbody>
</table>

Social Factors Correlation Co-efficient

| .381**                  | 1.000       | .133             |
| 000                     | .255        | .255             |
| 104                     | 104         | 104              |

Intention of use Correlation Co-efficient Sig (2-tailed)

| .382**                  | .133        | 1.000            |
| 000                     | .255        | .255             |
| 104                     | 104         | 104              |
As shown in table 3, the figure consistent with factors, showing Social factors demonstrated a significant influence on Intention of use with (.381) similarly; Intention of use demonstrated a significant influence on Social influence with (.382). A correlation of the two factors shows significant at the.000 level and while the coefficient support the level of 104. In summary, the respondents were mostly female between the ages of 18 to 25 years, their highest educational level was a diploma and their current position in the organisation they work for is accountant manager. The qualitative analysis conducted revealed that the majority of the respondent have been privileged to personally use the computer for about 1 to 4 years, during which their use of AIS was considered to be equivalent to their use of computers and they have been aware of AIS ever since.

They make use of AIS more than four times a month on average. The respondents have used two different types of AIS packages/ Software. According to the perceived usefulness of AIS, the majority of the respondents strongly agreed that their use of AIS would improve how their data is kept, facilitate the growth of their organisation, enable them to process accounting work quickly, improve the process of publishing work and that overall AIS was very useful. The respondents also strongly agreed that AIS was easy to use, as it was easy to learn to operate the system. It was equally easy to operate AIS within the work schedule, it made work easy and it was also capable of making the publication of accounting work easy. Teaming the different aspects of AIS together was equally strongly agreed to be easy and, finally, their interaction with AIS was clear and understandable. Considering the facilitating condition of the respondents, the entire group of respondents had undergone a training section at some point in time concerning the usage of AIS. They were trained within five or more days and the majority of them agreed that the AIS training they received was satisfactory in terms of its quality.

A larger percentage of the respondents agreed that they were satisfied with the duration of their training on AIS. Most of the respondents agreed they were also satisfied with the pace of the training and the competence of their trainers. A little above average of the respondents can operate AIS with confidence. According to the majority of the respondents it could be concluded that AIS is always available, reliable and effective, thus there was a strong agreement to this effect. AIS was agreed upon to be flexible and also easy to use, but on the overall satisfaction rate, 50% agreed to this. There is a strong agreement that information required from AIS is always reliable. It was also agreed that the information required from AIS has been found to be accurate, timely, precise, adequate and meaningful. From the information extracted from the 104 respondents, they strongly agreed that they usually get help from IT support personnel in the organisation when difficulties are encountered during the usage of AIS.

Aside from this, help can also be assessed easily from the Institute of Chartered Accountants, the AIS manual and from colleagues. The support services provided by AIS head office staff were agreed to be always adequate, relevant, provided within an acceptable time frame, provided with a positive attitude and overall was regarded as satisfactory. Considering the organisational factors, it was agreed that the encouragement of AIS usage comes from the support from circuit office, availability of computers in the organisation, follow-ups made after the implementation of the system, encouragement from the head office and finally commitment from the Institute of Chartered Accountants supporting AIS. Socially, respondents agreed that their use of AIS had been influenced by their colleagues, circuit office officials, head of department, accountant, head office management, head office AIS staff and subordinates. The use of AIS was generally agreed upon by the organisation of the respondents to be productive, rational, efficient and effective. There arose a strong agreement that AIS’s introduction was aimed at centralizing the control by the Institute of Chartered Accountants. It was agreed that its introduction improves organisational administration, the work of accountants, the administrative and management skills of organisation personnel and equally so makes the work of organisation personnel easier.

4. CONCLUSION

From the results of the statistical analysis, it can be deduced that the use of AIS is relatively accepted within accounting firms, which is largely as a result of the ‘change’ that comes with the use of such application. The use of AIS which is a computer- based application brings a new trend of change from the conventional way of accounting to a computerized way which most people are not prepared for or find very difficult to adapt to. It is seen that its usage is majorly influenced by the institution. It was also found out that the majorities of recent users are within the diploma level of education and have minimal experience with the use of computers. This therefore creates a level of difficulty for effective usage of the applications available. The use of AIS is seen to have improved the productivity and delivery of the users’ work, although this was not quantified in this study. In addition, this study found out that all three factors influencing the AIS process were found to have a direct effect on attitude, although no direct effect of this process on behavioral intentions were observed. Hence, this emphasis on innovation adoption and diffusion initiatives should be focused on developing user attitudes that are conducive to effective utilization and acceptance behaviour.
5. RECOMMENDATION

For proper and effective usage of AIS, there must be an increased awareness of the usage and of AIS to facilitate its wide adoption. Therefore, higher levels of formal education should be encouraged, alongside workshops, training and retraining of users for adequate improvement. In addition, further studies should be conducted to quantify the impact of AIS on accounting firms, in order to be able to establish its full potential.

REFERENCE


Memetic Algorithm With Population Management (MA|PM) For Multi-Objective Network Design

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ABSTRACT
A Memetic Algorithm with Population Management (MA|PM) is employed to solve Multi-objective Network Design Problem. The algorithm was tested with three randomly generated networks of varying sizes. Results obtained were compared with the results obtained when MA was used. Overall, it was observed that MA|PM outperformed MA in terms of efficiency (computation time) for the three test problems. In addition, the results’ quality of MA|PM is superior to that of MA for 10-node network problem while it is inferior to that of MA for 36-node network problem. The results’ qualities of MA|PM and MA rank the same for 21-node network problem. The implication of these results is that MA|PM is always more efficient that MA regardless of problem size. However, the impact of population management on the effectiveness of MA is inversely proportional to the size of the problem.

Keywords: Memetic Algorithm, Population Management, efficiency.

1. INTRODUCTION
Population diversity is an important issue that should be considered in the design of an effective MA [1, 2]. If the population diversity is ill-managed, the algorithm will converge prematurely to poor local optima. This is particularly true when a small population is used by the MA.

MA|PM was proposed in [2] as a variant of classical MA to mitigate some of its drawbacks such as premature or slow convergence and a lack of strategy to control the diversity of a small population of individuals. Population management controls the diversity of a small population of high-quality solutions. It uses an input function that determines whether an offspring solution is added to the population or not. In a typical MA|PM, the input function takes cognizance of the following two factors:

(i) the quality of the solution, and
(ii) the diversity of the population after adding a solution, i.e. the contribution that the solution makes to the diversity of the population; this is measured as the “distance” of the solution to the population.

A Memetic Algorithm with Population Management (MA|PM) is structured much like a standard MA, but differs in the use of population management. Its main distinguishing features are:

(i) a small population (typically 10 to 30 solutions),
(ii) population management to control the diversity of the population

In [3], Zarei et al proposed an Adaptive Memetic Algorithm with Population Management (AMAPM) for designing HIV multidrug therapies. The authors claimed that the optimal solution given by the AMAPM is very satisfactory. They also submitted that numerical comparisons show that the AMAPM outperforms three other standard methods for the class of problems considered. Pagacz et al [4] designed an MA with advanced crossover operators, local improvement methods, and two population management techniques for solving a generalized minimum vertex-biconnected network problem (GMVBCNP).
Their numerical experiments clearly indicate that better results are obtained when the two management techniques are used, but more computation time is required. Park and Ryu [5] developed a Dual-population GA (DPGA). DPGA is a type of multipopulation GA (MPGA) that uses an additional population as a reservoir of diversity. Their empirical results on various classes of problems reveal that DPGA quite often outperforms both the standard GA and other GAs with additional diversity preservation mechanisms. A self-adaptation mechanism based on the competition of preference characteristic in mating to control the diversity of population in GA is proposed in [6]. The authors observed that the adaptive method is comparable to traditional GA with the best parameter setting.

MA|PM has not been extensively investigated for real life problems. Aside the work in [3] and [4], there is scarcely any other paper in literature that applied it to problems of practical significance. This paper therefore considers application of MA|PM for solving network design problem. To allow for comparison between MA|PM and the basic MA, the MA in [7] was equally used.

2. PROBLEM FORMULATION

We consider a multi-objective network design problem of the form:

Minimize $y = f(x) = (f_1(x), f_2(x))$ (1)

Subject to: $LFLOW_{ij} \leq CAP_{ij}$ (2)

Where:
- $x = (x_1, x_2, \ldots, x_n) \in X$ is the decision vector
- $y = (f_1, f_2) \in F$ is the objective vector
- $f_1(x)$ is the cost function of the configuration $x$
- $f_2(x)$ is the average delay on all the links in the configuration $x$

$LFLOW_{ij}$ refers to the traffic flowing along link $(i, j)$

$CAP_{ij}$ is the capacity of link $(i, j)$

$R(x)$ is the reliability of the configuration $x$

$R_0$ is the minimum acceptable reliability ($R_0 = 0.95$)

The reliability calculation is done via Monte Carlo simulations.

Other network design parameters used are the followings:
- $N$ denotes the total number of nodes in the network
- $D_{ij}$ denotes the physical distance between every pair of nodes $i$ and $j$
- $C_{ij}$ represents the cost of the link between nodes $i$ and $j$
- $C_{i}$ is the cost of network equipment at node $i$

$P_{ij}$ is selection status of link $(i, j)$: $P_{ij} = 1$ if link $(i, j)$ is selected, else $P_{ij} = 0$

$L$ = maximum distance for which the signal is sustained without amplification (We fix $L = 15$km)

$A$ = cost of each amplifier unit (#6.00)

Poisson process was used to model the traffic delay.

The objective functions; network cost and average delay are approximated by the following formulation.

\[ \text{Network Cost: } NetCost = \text{NodeCost} + \text{LinkCost} + \text{AmpCost} \]

Where:
- $\text{NodeCost} = \sum_i c_i$ (5)
- $\text{LinkCost} = \sum_i \sum_j C_{ij}$ (6)
- $\text{AmpCost} = \frac{\sum_i \sum_j D_{ij} \times A}{L}$ (7)

\[ \text{i) Average Delay: } AvDelay = \frac{\sum_i \sum_j \left[ \text{DELAY}_{ij} \times LFLOW_{ij} \right]}{\sum_i \sum_j LFLOW_{ij}} \]

\[ \text{ii) } \text{DELAY}_{ij} = \begin{cases} 1 & \text{if there is no link between nodes } i \text{ and } j \\ \infty & \text{if the network cannot handle the traffic load with the existing links’ capacities and routing policy.} \end{cases} \]

Monte Carlo Simulation is used to estimate network reliability. The network is simulated $t$ times, given the design and the links’ reliabilities. The method is outlined below.

initialize $i = 0$, $c = 0$

Step C0: while $i < t$ Repeat.

Step C1: Randomly generate network $(a)$: $i = i + 1$.\[ \text{Step C2: Check to see if the network forms a spanning tree (a): if YES, increment } c \text{ by 1 and go to Step C0 (b): if NO, go to Step C0} \]

Step C3: $R(x) = c / t$.

Breadth First Search (BFS) is used for routing. The metric used for this purpose is the length of the link. The following assumptions were made in the problem formulation.

The location of each network node is given

Each $C_{ij}$ is fixed and known

Each link is bidirectional i.e. a path can be traversed in either direction. There is no redundant link in the network.
3. ALGORITHM DESIGN AND IMPLEMENTATION DETAILS

3.1 MA|PM DESIGN

1: initialize population \( P \)
2: set population diversity parameter \( \Delta \)
3: repeat
4: select: \( p_1 \) and \( p_2 \) from \( P \)
5: crossover: \( p_1 \times p_2 \rightarrow o_1 , o_2 \)
6: local search: on \( o_1 \) and \( o_2 \)
7: for each offspring \( o \) do
8: if \( d_p(o) \geq \Delta \) then
9: remove solution: \( P \leftarrow P \setminus b \)
10: add solution: \( P \leftarrow P \cup o \)
11: end if
12: end for
13: update diversity parameter \( \Delta \)
14: until stopping criterion is met

3.2 IMPLEMENTATION DETAILS

This section presents relevant details concerning the implementation of MA|PM

3.2.1 Encoding Scheme

The chosen encoding scheme is such that every chromosome codes a possible network, which corresponds to an individual in a set of feasible solutions of the problem. This set of feasible solutions constitutes a population. The chromosome is represented by a constant length integer string representation. The chromosome consists of two parts, the first part contains details of NE’s at the nodes and the second part consists of details of the links. For example, if there are \( H \) types of nodes, then \( \log_2 H \) bits are required to encode a node. Therefore the first part of the chromosome consists of \( N \log_2 H \) bits, where \( N \) is the number of nodes in the network. If a link exists between nodes 1 and 2 then the first bit position in the link part is set to 1. Hence the second part of the chromosome consists of \( \frac{N(N-1)}{2} \) bits.

3.2.2 Initial Population

The two algorithms start by creating an initial population. There are two ways of generating initial population namely heuristic process and random process. A random process of generating initial population is adopted.

3.2.3 Fitness Evaluation

Fitness of a chromosome is evaluated based on principle of Pareto ranking. Pareto-rank of each individual is equal to one more than the number of individuals dominating it. All non-dominated individuals are assigned rank one. Network cost and average delay are used to evaluate the rank of an individual chromosome using the principle of Pareto dominance. The fitness of an individual is given by:

\[
Fitness = \frac{1}{\text{Rank}^2}
\] (10)

3.2.4 Selection

Roulette Wheel Selection Process is used. In roulette wheel, individuals are selected with a probability that is directly proportional to their fitness values i.e. an individual’s selection corresponds to a portion of a roulette wheel. The probabilities of selecting a parent can be seen as spinning a roulette wheel with the size of the segment for each parent being proportional to its fitness. Obviously, those with the largest fitness (i.e. largest segment sizes) have more probability of being chosen. The fittest individual occupies the largest segment, whereas the least fit have correspondingly smaller segment within the roulette wheel. The circumference of the roulette wheel is the sum of all fitness values of the individuals. The proportional roulette wheel algorithm procedure is depicted by the algorithm below. Let \( f_1, f_2, \ldots, f_n \) be fitness values of individuals 1, 2, \ldots, \( n \). Then the selection probability, \( P_i \), for an individual \( i \), is given as

\[
P_i = \frac{f_i}{\sum_{j=1}^{n} f_j}
\] (11)

The template of the roulette wheel selection procedure is shown below.

Procedure: Roulette Wheel Selection

while population size < pop_size do
generate pop_size random number \( r \)
calculate cumulative fitness, total fitness \( \langle P_i \rangle \) and sum of proportional fitness (sum)
Spin the wheel pop_size times
if sum < \( r \) then
select the first chromosome
else
select the jth chromosome
Endif
Endwhile
return chromosomes with fitness values proportional to the size of the selected wheel section
End Procedure
3.2.5 Crossover

3.2.6 Local Search

The local search technique used is the hill climbing search algorithm. It is essentially an iteration that continuously proceeds in the direction of increasing quality value. The algorithm is as shown below:

\[
\text{While (termination condition is not satisfied) do} \\
\quad \text{New solution} \leftarrow \text{neighbours(Best solution)}; \\
\quad \text{If new solution is better than actual solution then} \\
\quad \quad \text{Best solution} \leftarrow \text{actual solution} \\
\text{End if} \\
\text{End while}
\]

Distance measure: The proposed MA|PM uses a distance measure, \( d \) that determines for each pair of solutions their relative distance (or similarity) in the solution space. Then, by extension, the distance of a solution \( o \) to population \( P \) is expressed as:

\[
d_P = \min_{s \in P} d(o, s)
\]

For problems of which the solutions are most naturally represented as a binary string, the Hamming distance seems to be the only distance measure to use. For problems represented as real valued vectors, Euclidean, Manhattan, or Chebychev distance metrics can be used. Hamming distance [2] is used in our implementation. The distance of a given solution \( s_k \) to the population can be calculated as follows:

\[
d_P(s_k) = \min_{s_i \in P} d(s_k, s_i)
\]

(13)

Input function and diversity parameter \( \Delta \)

It is obvious that a solution that has a small distance to another solution already in the population, will not contribute much to the diversity of a population. Therefore, a solution is not added to the population if its distance to the population is below a certain threshold \( \Delta \). We call \( \Delta \) the diversity parameter. It is initialized to 1, 3, and 5 for 10-node network, 21-node network and 36-node network respectively and then incremented by 1 at each iteration.

4. COMPUTATIONAL RESULTS AND DISCUSSION

This section presents the results obtained when MA|PM and MA were applied to solve three instances of multi-objective network design problem. Comparative analyses of MA and MA|PM results are as well discussed. To enhance easy referencing and comprehensive analysis, results are coupled accordingly. All computations were performed on a HP 630 NOTEBOOK PC with the following configuration: 2.13GHz Processor Speed, 3.0GB RAM and 64 BIT OS.
### 4.1 MA Results versus MA|PM Results

#### Table 1: MA and MA|PM Results of Run 1 for 10-Node Network Design Problem

<table>
<thead>
<tr>
<th>No of Gen</th>
<th>C/Ratio</th>
<th>Cost</th>
<th>Delay</th>
<th>Comp. Time</th>
<th>No of Gen</th>
<th>C/Ratio</th>
<th>Cost</th>
<th>Delay</th>
<th>Comp. Time</th>
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#### Table 2: MA and MA|PM Results of Run 2 for 10-Node Network Design Problem

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#### Table 3: MA and MA|PM Results of Run 3 for 10-Node Network Design Problem

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#### Table 4: MA and MA|PM Results of Run 1 for 21-Node Network Design Problem

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<th>Cost</th>
<th>Delay</th>
<th>Comp. Time</th>
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#### Table 5: MA and MA|PM Results of Run 2 for 21-Node Network Design Problem

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<th>Cost</th>
<th>Delay</th>
<th>Comp. Time</th>
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#### Table 6: MA and MA|PM Results of Run 3 for 21-Node Network Design Problem

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</table>
### Table 7: MA and MA|PM Results of Run 1 for 36-Node Network Design Problem

|          | MA       |          |          |          | MA|PM     |          |          |          |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| No of Gen|          | C/Ratio  | Cost     | Delay    | Comp. Time | No of Gen|          | C/Ratio  | Cost     | Delay    | Comp. Time |
|          | 5        | 97       | 1259     | 0.06     | 3987      | 5        | 90       | 1259.0   | 0.06     | 1598          |
|          | 10       | 100      | 1167.4   | 0.05     | 5673      | 10       | 98       | 1267.1   | 0.05     | 2890          |
|          | 15       | 100      | 1167.4   | 0.05     | 9210      | 15       | 100      | 1247.4   | 0.05     | 4673          |
|          | 20       | 100      | 1167.4   | 0.05     | 14900     | 20       | 100      | 1247.5   | 0.05     | 5897          |

### Table 8: MA and MA|PM Results of Run 2 for 36-Node Network Design Problem

|          | MA       |          |          |          | MA|PM     |          |          |          |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| No of Gen|          | C/Ratio  | Cost     | Delay    | Comp. Time | No of Gen|          | C/Ratio  | Cost     | Delay    | Comp. Time |
|          | 5        | 97       | 1167.4   | 0.06     | 3598      | 5        | 97       | 1219.8   | 0.06     | 1543          |
|          | 10       | 100      | 1167.4   | 0.05     | 5890      | 10       | 100      | 1267.4   | 0.07     | 2673          |
|          | 15       | 100      | 1167.4   | 0.05     | 9673      | 15       | 100      | 1259.4   | 0.06     | 4062          |
|          | 20       | 100      | 1167.4   | 0.05     | 15897     | 20       | 100      | 1237.4   | 0.05     | 5537          |

### Table 9: MA and MA|PM Results of Run 3 for 36-Node Network Design Problem

|          | MA       |          |          |          | MA|PM     |          |          |          |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| No of Gen|          | C/Ratio  | Cost     | Delay    | Comp. Time | No of Gen|          | C/Ratio  | Cost     | Delay    | Comp. Time |
|          | 5        | 97       | 1259     | 0.06     | 3987      | 5        | 97       | 1350.4   | 0.06     | 1298          |
|          | 10       | 100      | 1167.4   | 0.05     | 5673      | 10       | 100      | 1263.4   | 0.07     | 2490          |
|          | 15       | 100      | 1167.4   | 0.05     | 9210      | 15       | 100      | 1220.4   | 0.07     | 4673          |
|          | 20       | 100      | 1167.4   | 0.05     | 14900     | 20       | 100      | 1220.4   | 0.05     | 5597          |

### 4.2 Comparative Analysis of MA Results and MA|PM Results

Results show that MA|PM is always more effective and more efficient than MA in the case of 10-node network design problem while MA|PM is as effective as MA and more efficient than MA in the case of 21-node network. In the case of 36-node network however, MA|PM is less effective than MA though more efficient than MA. In general, population management enhances the efficiency of MA for the three instances of the design problem. However, the impact of population management on MA’s effectiveness is a function of the network’s size.

### 5. CONCLUSION

Population management resulted in increased efficiency of MA for the three test problems. However, population management’s impact on MA effectiveness is inversely proportional to the size of the network. That is for 10-node network, it improves results’ quality, for 21-node network; it neither improves nor degrades quality, for 36-node network; it degrades quality. Our results do not totally agree with the results in [4] because MA|PM results are better than MA results for 10-node network problem only and these better results were obtained using less computational efforts (computing time). The discrepancy may be due to the fact that mutation was not implemented in our own MA|PM. Also our own problem domain/nature is different from that in [4].
REFERENCES


APPENDIX – TEST DATA

10-NODE NETWORK

Node Details (NodeType, C_i) = { (0,12),(0,78),(10,33),(0,53),(0,42),(0,13),(10,9),(11,23),(10,57),(10,25) }

Link Details (D_{ij}, C_{ij}, CAP_{ij}, LFLOW_{ij}) = { (28,47,60,46),(20,43,90,72),(28,12,54,28),(62,39,61,46),(42,23,24,9) }

11-NODE NETWORK

Node Details = { (0,12),(0,78),(10,33),(0,53),(0,42),(0,13),(10,9),(11,23),(10,57),(10,25) }

Link Details = { (29,20,87,74),(14,15,75,43),(13,47,50,35),(41,16,69,52),(32,25,72,54),(43,42,89,63),(31,71,25) }

21-NODE NETWORK

Node Details = { (0,12),(0,78),(10,33),(0,53),(0,42),(0,13),(10,9),(11,23),(10,57),(10,25),(0,53),(0,55),(0,11) }

Link Details = { (29,20,87,74),(14,15,75,43),(0,12,81,18) }

36-NODE NETWORK

Node Details = { (10,52),(0,69),(0,67),(10,35),(0,77),(10,62),(0,77),(0,62),(10,15),(0,57),(10,25) }

Link Details = { (8,32,89,20),(43,48,83,9),(31,21,65),(48,37,36,5),(10,19,86,24),(30,21,15,15),(17,37,33,6),(1,41,58,26) }

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Authors’ Brief

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A Shuffled Frog-Leaping Algorithm for Optimal Software Project Planning

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ABSTRACT
In recent time, software project management has received considerable attention from researchers in the field of Search Based Software Engineering (SBSE). This paper presents an approach to Search Based Software Project Planning based on Shuffled Frog-Leaping Algorithm (SFLA). Our approach seeks to optimize work package scheduling with a view to achieving early overall completion time. To evaluate the algorithm, it is tested on a set of randomly generated problems and its results are compared with those of Genetic Algorithm (GA). Results indicate that SFLA is significantly superior to GA.

Keywords: Shuffled Frog-Leaping Algorithm, work package, software project planning, Search Based Software Engineering, Design structure matrix

1. INTRODUCTION
Software engineering projects cannot be completed on schedule and within budget unless good software project management techniques are enforced. However, a thorough planning of the progress of a project is crucial for effective management of the project. Planning a large scale software (or another type of) project involves Work Packages (WPs). A work package defines not just the work product but also the staffing requirements, duration, resources, name of the responsible individual, and acceptance criteria for the work product [2]. The work packages are usually obtained from a Work Breakdown Structure. Given a fixed number of WPs for a fixed number of projects, there exists an optimal WPs assignment to time-slots such that the project completion time is minimized. WP ordering, one can find an optimal staff distribution into teams. This is an NP-hard problem problem for which heuristic methods have proved to be effective and popular among other methods.

Barreto et al [3] applied constraint satisfaction to staff software projects. However, their goal differs from ours in that they aimed at allocating maintenance requests to the most qualified team in terms of skills, to the cheapest team, or to the team having the highest productivity. Bertolino et al [4] employed performance engineering technique, based on the use of queuing models and UML performance profiles, to assist project managers in making decisions related to organization of teams and tasks.
Karova et al [5] presented implementation of GA for Project Planning and Project Scheduling Problem. Their algorithm was tested on a set of randomly generated problems and their results show that GA can be used by project manager to better simulate realistic situations and reorder the WPs and delay the project deadline, if the need arises.

SFLA is a memetic meta-heuristic that is based on evolution of memes carried by interactive individuals and a global exchange of information among the frog population [6]. It combines the strengths of Memetic Algorithm (MA) and the social behaviour-based Particle Swarm Optimization (PSO) Algorithm. In SFLA, the population consists of frogs (solutions) that is partitioned into subsets referred to as memeplexes. The different memeplexes are considered different cultures of frogs, each performing a local search [7]. Within each memeplex, the individual frogs hold ideas, that can be influenced by the ideas of other frogs, and evolve through a process of memetic evolution. After a defined number of memetic evolution steps, ideas are passed among memeplexes in a shuffling process [8]. The local search and the shuffling processes are repeated until a specified convergence criterion is satisfied.

In this paper, we implemented SFLA and tested it on a set of randomly generated problems of software project planning. We make two primary contributions in this paper: (1) SFLA is applied to solve Software Project Planning Problem, and to the best of our knowledge, this is the first paper in the SBSE literature to employ SFLA. (2) The results of the application of SFLA in comparison with GA are reported. The obtained results provide evidence to support the claim that SFLA is superior to GA.
2. PROBLEM STATEMENT

Planning a large scale software project involves a set of activities called Work Packages (WPs), and an allocation of programmers to teams and teams to work packages [9]. Given a fixed number of Work Packages, there exists an optimal WP ordering and optimal people distribution into teams. Such resource allocation problems are instances of the ‘bin packing problem’, which belong to the class of Non-deterministic Polynomial-time hard (NP-hard) problems. In this paper, we focus on finding an optimal WP scheduling: Given a project that consists of a set WP's =\{wp_1, wp_2, \ldots, wp_n\} of tasks to be performed, a set of dependency constraints DEPS = \{(wp_i, wp_j), \ldots (wp_i, wp_j)\}, such that 0 < i ≤ n and 0 < j ≤ n and j ≠ i of dependencies between tasks, where wp requires wp to be completed first. We seek an optimal ordering of tasks in the sequence in which they should be completed without violating dependency constraints such that the overall project completion time is minimized.

3. PROBLEM MODELLING

The problem is modelled with a Design Matrix Structure (DSM), an efficient method which shows the relationships between the activities in a project. It can be represented as an n x n multi-dimensional array representing tasks and precedence rule. The diagonal elements represent the tasks and off diagonal elements specify the precedence relationships. Using a scheduling problem consisting of two software projects, each containing 5 WPs which represent the tasks involved in the development of the projects, the corresponding DSM can be represented as shown in Figure 1.

![Figure 1: DSM model of project scheduling problem.](image)

From above figure, the DSM indicates that WP1 precedes WP5, WP2 precedes WP3, WP3 precedes WP5, WP6 precedes WP8 and WP9, and WP8 precedes WP10. The WPs are ordered according to the precedence rule modeled by the above DSM. For example the orderings below shows correct (a) and incorrect (b) schedules:

![Figure 2: Correct and incorrect WP orderings.](image)

4. SFLA DESIGN

In general, SFLA works as follows; First, an initial population of F frogs is created randomly. Afterwards, the frogs are sorted in a descending order according to their fitness. Then, the entire population is divided into memeplexes, within each memeplex the frogs with the best and the worst fitness are identified as X_b and X_w respectively. Also, the frog with the global best fitness is identified as X_g. Then, a process is applied to improve only the frog with the worst fitness (not all frogs) in each cycle.

Accordingly, the position of the frog with the worst fitness is adjusted as follows [10]:

\[ D_i = \text{rand} \times (X_b - X_w) \]  

\[ X_{\text{new}} = X_w + D_i \quad \text{subject to} \quad D_{\text{max}} \leq D_i \leq D_{\text{max}} \]  

\[ \text{rand} \] is a random number between 0 and 1, and \( D_{\text{max}} \) is the maximum allowed change in a frog’s position. If this process produces a better solution, it is replaced for the worst frog. Otherwise, the calculations in equations (1) and (2) are repeated but with respect to the global best frog (i.e. \( X_b \) is...
replaced with $X_g$). If no improvement is possible, then a new solution is randomly generated to replace the worst frog. Hence, the calculations continue for a specific number of iterations [8]. The main parameters of SFLA are: population size $F$; number of memeplexes $m$; and number of shuffling iterations in each memeplex $q$.

### 4.1 SFLA For Optimal Project Planning

The SFLA approach in solving project planning and scheduling problems combines the local search within each memeplex and global information interchange from parallel local searches among all memeplexes to move towards a global solution using population-based model of frogs which represents feasible solutions (correct WP orderings).

#### 4.2 Individual Frog Representation

The position vector of each individual frog represents a feasible solution of WPs schedules. Each frog is encoded as an $n$-sized array; the value of each meme (element of the array) indicates the position of the WP in the incoming ordered sequence and the index value represents the WP itself. The population is a set of $F$ frogs ($F$ WP ordered lists). The frog schema is shown in figure 3.1

![Frog Schema](image)

**Figure 3:** The frog schema.

#### 4.3 Fitness Function

The fitness $f$ of a frog is based on the constraints penalties. It is calculated as the sum of penalty points present in each frog with respect to the precedence rule predefined. Using the above DSM structure and the frog schema, the fitness values of two frogs A and B is given below:

Frog A:

<table>
<thead>
<tr>
<th>Pos 1</th>
<th>Pos 2</th>
<th>Pos 3</th>
<th>Pos 4</th>
<th>Pos 5</th>
<th>Pos 6</th>
<th>Pos 7</th>
<th>Pos 8</th>
<th>Pos 9</th>
<th>Pos 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>wp1</td>
<td>wp2</td>
<td>wp3</td>
<td>wp4</td>
<td>wp5</td>
<td>wp6</td>
<td>wp7</td>
<td>wp8</td>
<td>wp9</td>
<td>wp10</td>
</tr>
</tbody>
</table>

Frog B:

<table>
<thead>
<tr>
<th>Pos 1</th>
<th>Pos 2</th>
<th>Pos 3</th>
<th>Pos 4</th>
<th>Pos 5</th>
<th>Pos 6</th>
<th>Pos 7</th>
<th>Pos 8</th>
<th>Pos 9</th>
<th>Pos 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>wp1</td>
<td>wp2</td>
<td>wp3</td>
<td>wp4</td>
<td>wp5</td>
<td>wp6</td>
<td>wp7</td>
<td>wp8</td>
<td>wp9</td>
<td>wp10</td>
</tr>
</tbody>
</table>

\[ f(A) = 0 \text{ (no violation of precedence rule)} \]

\[ f(B) = 3 \text{ (three violations of precedence rule)} \]

The lower the value of $f$ the fitter the frog since the fitness is calculated based on penalties.
4.4 Formation Of Memeplex
Memeplexes are constructed by partitioning the initial population of frogs. The entire population is divided into \( m \) memeplexes, each containing \( n \) frogs. In this process, the first frog goes to the first memeplex, the second frog goes to the second memeplex, frog \( m \) goes to the \( m \)th memeplex, and frog \( m+1 \) goes back to the first memeplex and so on as shown in Figure 4.

![Figure 4: Formation of Memeplexes](Image)

4.5 Local Exploration
This is the part of the algorithm where the frog with worst performance in each memeplex is improved and updated. Within each memeplex, the worst performance frog is updated according to the following simple rule:

The new frog \( X_{\text{new}} \) is obtained by randomly selecting a subsequence in \( X_w \) to replace the corresponding position in \( X_w \), while keeping the other positions in \( X_w \) unchanged or if violating the precedence constraints, just randomly relocate the remaining positions to form a new feasible solution. The idea is illustrated in Figure 5. If the fitness of \( X_{\text{new}} \) is better than that of \( X_w \), then replace \( X_v \) with \( X_{\text{new}} \), otherwise replace \( X_b \) with the global best \( X_g \) and carry out the same operation as the above to generate another new feasible solution \( X'_{\text{new}} \). If its fitness is better than that of \( X_{\text{new}} \), then replace \( X_w \) with this new \( X_{\text{new}} \), otherwise randomly generate a new feasible solution to replace \( X_w \), where:

\[ X_{\text{new}} = \text{new updated frog}, \quad X_w = \text{worst frog}, \quad X_b = \text{best frog and} \quad X_g = \text{global best frog} \]

![Figure 5: Update \( X_{\text{new}} \) in a Submemeplex](Image)

This operation is performed for a specific number of iteration. The number of iteration \( q \) here determines the time spent for local meme transference and in turn the efficiency of the local search. Intuitively we chose \( q \) to be dependent on the problem size with the value \( q = 2n \), where \( n \) is the number of frogs in a memeplex.
4.6 Convergence
The convergence criterion we used is given by the formula:

\[ |f(1) - f(F)| < \epsilon \]

Where \( f \) represents the fitness and \( \epsilon \) is the convergence tolerance. In order to ensure high convergence rate the value of \( \epsilon \) is set to 1. The solution converges when at least 90% of the frogs in the population have a fitness value 0.

5. COMPUTATIONAL EXPERIMENTS, RESULTS AND DISCUSSION

The algorithm is coded in JAVA and executed on HP 655 pavilion laptop with Windows 7 operating system, AMD E2-1800 APU 1.7 GHz CPU and 4.00 GB RAM.

The proposed SFLA is tested on randomly generated problems with 10, 20, 30, and 50 WPs respectively. The number of memeplex is set to 5 and number of iterations per memeplex is \( 2n \) where \( n \) is the number of frogs in a memeplex. To avoid any misinterpretation of the optimization results related to the choice of any particular initial parameters, all results are obtained by averaging over 20 independent runs. The fitness value is given by the sum of penalty points and in each test the population size is varied as (30, 50, 80 and 100). The SFLA results and GA results extracted from [5] are presented in Table 1.

From the table of results, it is clear that SFLA is superior to GA. For GA, the best results are obtained when WP = 30. However, for SFLA the best results are obtained when WP = 50, in fact, the larger the size of WP the better the result. The implication of these results is that, apart from the fact that SFLA is more effective than GA, it has an added advantage of being able to handle projects with larger size of WPs. For both SFLA and GA, the optimal value (optimal schedule) is obtained when the population size is 80.

Table 1: SFLA results versus GA results

<table>
<thead>
<tr>
<th>Population size N</th>
<th>WP's</th>
<th>Fitness SFLA</th>
<th>Fitness GA [1]</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>10</td>
<td>14.80</td>
<td>16.1</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>8.30</td>
<td>10.00</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>3.35</td>
<td>3.50</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>2.85</td>
<td>4.00</td>
</tr>
<tr>
<td>50</td>
<td>10</td>
<td>13.10</td>
<td>15.75</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>7.30</td>
<td>9.80</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>2.65</td>
<td>2.80</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>2.35</td>
<td>3.40</td>
</tr>
<tr>
<td>80</td>
<td>10</td>
<td>12.15</td>
<td>15.55</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>7.23</td>
<td>9.85</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>2.45</td>
<td>2.60</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>2.30</td>
<td>3.05</td>
</tr>
<tr>
<td>100</td>
<td>10</td>
<td>12.95</td>
<td>15.90</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>8.22</td>
<td>9.60</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>3.03</td>
<td>3.05</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>2.75</td>
<td>4.25</td>
</tr>
</tbody>
</table>

6. CONCLUSION
The problem of assigning optimal WP to timeslots with a view to minimizing project completion time has been solved using SFLA. Experimental results show that the proposed SFLA is effective in finding optimal solution. Comparison of SFLA results with GA results reveals that SFLA outperforms GA. Results also show that while the best performance of GA occurs when WP = 30, the performance of SFLA improves as WP increases. In the future, the application of SFLA to multi-objective version of the problem will be considered as an extension of this study.
REFERENCES


APPENDIX: PSEUDOCODE FOR SFLA

Begin;
Generate random population of P frogs;
For each individual i in P: calculate fitness (i);
Sort the population P in descending order of their fitness;
Divide P into m memeplexes;
For each memeplex;
    Determine the best and worst frogs;
    Improve the worst frog position
Repeat for a specific number of iterations;
End;
Combine the evolved memeplexes;
Sort the population P in descending order of their fitness;
Check if termination criterion is satisfied;
End;

Authors’ Brief

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Design and Implementation of Artificial Neural Network System
for Stock Exchange Prediction

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ABSTRACT
Stock prediction with artificial neural network (ANN) techniques is one of the most important issues in finance being investigated by researchers across the globe. ANN techniques can be used extensively in the financial markets to help investors make qualitative decision. In this methodology a multilayer perception (M.L.P) neural network model is used to determine and explore the relationship between some variables as independent factors and the level of stock price index as a dependent element in the stock market under study over time. The results show that the neural network models can get better outcomes compared with statistical and parametric models like as multiple regression and other traditional statistical techniques. This study and test also show that useful predictions can be made without the use of extensive market data or knowledge, and in the data mining process, neural networks and some non algorithmic models can explore high level orders in complex time series which hide in the market structure and need very huge calculations in normal conditions. Our study was including of a relatively extensive range of indexes stock market prices in Iran. We've made two different predictions in Tehran Stock Exchange (TSE), and by help ANN and a new method of data mining, indexes stock market prices with about 1% error level, we predict.

Keywords - Stock Prediction, Artificial Neural Networks, Stock Market Indexes

1. INTRODUCTION
Stock market forecasters focus on developing approach-es to successfully forecast/ predict index values or stock prices, aiming at high profits using well defined trading strategies. The central idea to successful stock market prediction is achieving best results using minimum required input data and the least complex stock market model. Investors in stock market primarily traded stocks based on intuition before the advent of computers. The continuous growth level of investing and trading necessitate a search for better tools to accurately predict the market in order to increase profits and reduce losses. Statistics, technical analysis, fundamental analysis, time series analysis, chaos theory and linear regression are some of the techniques that have been adopted to predict the market direction [14].

Artificial neural network (ANN) technique is one of data mining techniques that is gaining increasing acceptance in the business area due to its ability to learn and detect relationships among nonlinear variables. Also, it allows deeper analysis of large sets of data, especially those that have the tendency to fluctuate within a short of period of time. This makes ANN a candidate for stock market prediction. Many research efforts have been made to improve the predictive accuracy and computational efficiency of share values [17]. Financial forecasting is of considerable practical interest and due to artificial neural networks’ ability to mine valuable information from a mass history of data; its applications to financial forecasting have been very popular over the last few years [15, 4, and 9].
Neural networks have been criticized and their wide spread successful application likely hindered because of the black box nature of their solutions, excessive training times, difficulty in obtaining and later replicating a stable solution, the danger of overfitting, tedious software, and the large number of parameters that must be experimentally selected to generate a good forecast. Table 1 lists the most common parameters that a researcher must choose when designing a neural network forecasting model. It excludes the many different proprietary features offered by neural network software vendors and ignores some more advanced topics. The large numbers of ways to organize a neural network account for its powerful function approximation capabilities.

The cost of such flexibility in modeling time series data is that the researcher must select the right combination of parameters. As a result of the large number of parameters and the relatively recent introduction of neural networks to finance, deciding on the appropriate network paradigm still involves much trial and error. Therefore, the objective of this paper is to provide an overview of a step by step methodology to design a neural network for forecasting economic time series data.

First, the architecture of a backpropagation (BP) neural network is briefly discussed. The BP network is used to illustrate the design steps since it is capable of solving a wide variety of problems and it is the most common type of neural network in time series forecasting. This is followed by an explanation of an eight-step procedure for designing a neural network including a discussion of tradeoffs in parameter selection, some common pitfalls, and points of disagreement among practitioners.

Research on Iranian studies for business excellence in TSE, like FadaiNejad [5], and Abdoh Tabrizi and Jouhari [2] and Namazi and Shoustarian [11] to be inefficient than the mature markets. In fact, even the stock price movements of U.S [6] and Japan [3] have been shown to conform only the weak from of the efficient market hypothesis.

In this paper, taking the output of the neural network, it has been implemented using MATLAB software.

<table>
<thead>
<tr>
<th>Table 1. Common Parameters in Designing Back Propagation ANN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data preprocessing</td>
</tr>
<tr>
<td>Frequency of data-daily, weekly, monthly, quarterly type</td>
</tr>
<tr>
<td>Method of data sampling</td>
</tr>
<tr>
<td>Method of data scaling- maximum/minimum, mean/standard deviation</td>
</tr>
<tr>
<td>Training</td>
</tr>
<tr>
<td>Learning rate per layer momentum term training tolerance</td>
</tr>
<tr>
<td>epoch size</td>
</tr>
<tr>
<td>Learning rate limit</td>
</tr>
<tr>
<td>Maximum number of runs</td>
</tr>
<tr>
<td>Number of times to randomize weights</td>
</tr>
<tr>
<td>Size of training, testing, and validation sets</td>
</tr>
<tr>
<td>Topology</td>
</tr>
<tr>
<td>Number of input neurons number of hidden layers</td>
</tr>
<tr>
<td>Number of hidden neurons in each layer number of output neurons</td>
</tr>
<tr>
<td>Transfer functions for each neuron error function</td>
</tr>
</tbody>
</table>

2. BACKPROPAGATION NEURAL NETWORKS

Backpropagation (BP) neural networks consist of a collection of inputs and processing units known as either neurons or nodes (Fig 1). The neurons in each layer are fully interconnected by connection strengths called weights which, along with the network architecture, store the knowledge of a trained network [13]. In addition to the processing neurons, there is a bias neuron connected to each processing unit in the hidden and output layers. The bias neuron has a value of positive one and serves a similar purpose as the intercept in regression models. The neurons and bias terms are arranged in layers. Input layer, one or more hidden layers and an output layer. The number of hidden layers and neurons within each layer can vary depending on the size and nature of the data set. ANNs are similar to linear and non-linear least squares regression and can be viewed as an alternative statistical approach to solving the least squares problem [10].
The number of input neurons is equal to the number of independent variables while the output neuron(s) represent the dependent variable(s). Linear regression models may be viewed as a feed-forward ANN with no hidden layers and one output neuron with a linear transfer function. The weights connecting the input neurons to the single output neuron are analogous to the coefficients in a linear least squares regression. Networks with one hidden layer resemble nonlinear regression models. The weights represent regression curve parameters.

**BP networks** are a class of feed-forward ANNs with supervised learning rules. Feed-forward refers to the direction of information flow from the input to the output layer. Inputs are passed through the neural network once to determine the output. Supervised learning is the process of comparing each of the network's forecasts with the known correct answer and adjusting the weights based on the resulting forecast error to minimize the error function.

**3. ERROR BACK PROPAGATION ALGORITHM**

The propagation error method is of methods with the supervisor. This means that the input samples are labeled and their expected output of each has been known before. The network output is compared with the ideal output and the network error is calculated.

In this algorithm, the first assumption is that network weights are chosen randomly. Network output is calculated at each step and in terms rate its differences with optimal output, the weights are correct. Until finally, this error can be Minimized. The error back propagation algorithm, the function of each nerve stimulation as a weighted sum of inputs to the neuron is considered. Thus, assuming that w corresponding weights between input layer and the layer is next, Can write:

\[
A_j(x, \bar{w}) = \sum_{i=0}^{n} x_i w_{ji}
\]  

(3)

Can be seen clearly that, the output function nerve stimulation only inputs and corresponding weights depend on. Assuming that the output function is sigmoid, \( j \)th nerve output can be written the following:

\[
O_j(x, \bar{w}) = sgm \left( A_j(x, \bar{w}) \right) = \frac{1}{1+e^{-A_j(x, \bar{w})}}
\]  

(4)

For training network and weigh improve to achieve a significant error, there are so many ways. One of the most famous of these methods is the error back propagation algorithm, which is described below.

In this algorithm, the first assumption is that network weights are chosen randomly. Network output is calculated at each step and in terms rate its differences with optimal output, the weights are correct. Until finally, this error can be Minimized. The error back propagation algorithm, the function of each nerve stimulation as a weighted sum of inputs to the neuron is considered. Thus, assuming that w corresponding weights between input layer and the layer is next, Can write:

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\]  

(4)

**Figure 1:** Layer Perceptron Networks With \( n \) Neurons in Each Layer
With accuracy in relation 4 we find that weights can be changed to change the output.

As mentioned before that the purpose of the training process to achieve optimal output (or ear optimal) is. Therefore for each neuron must first define the error function, the error of the difference between the actual network output and expected output is obtained as follows:

\[ E_j(x, w, d_j) = (O_j(x, w) - d_j)^2 \]  

(5)

4. ANN DESIGN FOR PREDICTION IN T.S.E

Action choice of index actual to predict the behavior of stock index and the designed model Prediction System is very difficult.

4.1 Application of Trained Model in an Actual Setting

The TEPIX is calculated on the basis of Iranian stocks. It is capitalization – weighted by Laspiers relation. Tehran Stock Exchange from March 1990 attempted to calculate and publish their price index name is TEPIX, this total time index included 52 companies that listed companies were. This index indicates that total market value than the base year (or 1991) is several times [11]. Main index are wide application in country macroeconomic and investment market investors and is calculated using relation 6.

Besides, the T.S.E is considered a young and speculative market, where some investors tend to look at price movements, rather than the fundamental analysis. Due to the high returns in emerging markets, investors are attracted to enhance their performance and diversify their portfolios. In this paper, a combined method includes technical analysis and fundamental analysis applied to predict the behavior of stock price index. Neural networks are trained to approximate the market values which may reflect the thinking and behavior of some stock market traders. Forecasting of stock indices is to find the nonlinear dynamic regularities between stock prices and historical indices together with trading volumes time series.

Due to the nonlinear interaction among these variables, it is very difficult to find the regularities but the regularities do exist. This research is aimed to find the hidden relationship between these indicators and future TEPIX through a neural network model. Different factors are used as the inputs to a neural network and the index of stock price is used to supervise the training process, in order to discover implicit rules governing the price movement of TEPIX. Finally, the trained neural network is used to predict the future levels of TEPIX. The technical analysis method is used commonly to forecast the TEPIX, buying and selling point, turning point, and the highest, lowest point, etc. Neural network could be used to recognize the patterns of the chart and the value of index. There are two principal phases in neural network analysis! “Learning” and “predicting”. During the learning, or training, phase the network “learns” by adjusting the weights between its nodes. The input data must be presented to the network many times. Data are split into two files. The first is used to train the network and the second file (the recall set) is used as a test of the networks predictive ability. During the training phase the network weights are saved at many intervals and tested to see how well the network can predict outcomes using weights it has learned up to that point. Following thousands of iterations, convergence occurs and the best weights for each element of the network can be derived.

\[ \text{TEPIX}_t = \frac{\sum_{i=1}^{n} P_{i,t} q_{i,t}}{D_t} \times 100 \]  

(6)

Where:

- \( P_i \) = price of \( i \)th company at time \( t \)
- \( q_i \) = number of shares outstanding \( i \)th company at time \( t \)
- \( D_t \) = the base value at time \( t \) when equal source was \( \sum P_{i,t} q_{i,t} \)
- \( P_{o,i} \) = Price Company \( i \)th at the time of source
- \( q_{o,i} \) = number of shares outstanding company \( i \)th at the time of source
- \( n \) = number of companies eligible index

4.2 Steps in Designing an ANN Forecasting Model

A method of designing an ANN forecasting model into distinct steps is used here. The eight-step design methodology presented in Table 2 draws on the steps outlined by Deboeck [7], Masters [16], Blum [1], and Nelson and Illingworth.

The procedure is usually not a single-pass one, but may require visiting previous steps especially between training and variable selection.

---

1 Tehran Stock Exchange
Step 1: Variable selection
Step 2: Data collection
Step 3: Data preprocessing
Step 4: Training, testing, and validation sets
Step 5: Neural network paradigms
Step 6: Evaluation criteria
Step 7: Neural network training
Step 8: Implementation

<table>
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<th>Step</th>
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<td>1</td>
<td>Variable selection</td>
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<td>Data collection</td>
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**4.3 Variable Selection & Data Collection & Data Preprocessing**

Success in designing a neural network depends on a clear understanding of the problem [10]. Knowing which input variables are important in the market being forecasted is critical. This is easier said than done because the very reason for relying on a neural network is for its powerful ability to detect complex nonlinear relationships among a number of different variables. However, economic theory can help in choosing variables which are likely important predictors. At this point in the design process, the concern is about the raw data from which a variety of indicators will be developed. These indicators will form the actual inputs to the neural network. When using basic data as an input in an ANN four issues must be kept in mind.

First, the method of calculating the fundamental indicator should be consistent over the time series. Second, the data should not have been retroactively revised after its initial publication as is commonly done in databases since the revised numbers are not available in actual forecasting. Third, the data must be appropriately logged as inputs in the neural network since fundamental information is not available as quickly as market quotations. Fourth, the researcher should be confident that the source will continue to publish the particular fundamental information or other identical sources are available. The daily data from 2009 to 2012 are used for the first trial. The Figure shows the graph of the TEPIX represented as logarithmic return in \((I_t - I_t/L_t)\) for the defined period, where \(I_t\) is the index value noisy which markets forecasting very difficult. The inputs to the neural network models are:

- Gold coin average change 2 weeks ago.
- Gold coin average change 1 week ago.
- U.S. Dollar exchange 2 weeks ago.
- U.S. Dollar exchange 1 week ago.
- Euro exchange 2 weeks ago.
- Euro exchange 1 week ago.
- Market value of Iran Mercantile Exchange (IME) 2 weeks ago.
- Market Value of Iran Mercantile Exchange (IME) 1 week ago.
- T.S.E volume change 2 weeks ago.
- T.S.E volume change 1 week ago.
- Moving average of TEPIX 2 weeks ago.
- Moving average of TEPIX 1 week ago.

The output of the neural network is stock price index, which shows the price level of the market. We've done two types of forecasts in the Tehran Stock Exchange. In the first phase, we have predicted Main index during the recent 100 days, Due to data 550 days before that. In the second phase, this was stage original and useful of our project, each of the eight sub-indexes. We forecast for the next business day in the stock market. We estimate Main index (the main and most important stock index) model based on eight indexes the past 500 days:

1. First market index, Due to data 550 days before that
2. Second market index, Due to data 550 days before that
3. Financial index, Due to data 550 days before that
4. Industry index, Due to data 550 days before that
5. Weighted average of the top fifty companies, Due to data 550 days before that
6. Simple average of the top fifty companies, Due to data 550 days before that
7. Price index and cash returns, Due to data 550 days before that
8. Free float index, Due to data 550 days before that.

In general, the stock price data have bias due to difference in name and spans. Normalization can be used to reduce the range of the data set to values appropriate for input to the activation function being used. The normalization and scaling formula 7 is:

\[
y = \frac{2x - (\text{max} + \text{min})}{\text{max} - \text{min}}
\]  

(7)

Where
- \(x\) is the data before normalizing.
- \(y\) is the data after normalizing.

Stock price index is normalized in the same scale. The outputs of the neural network will be rescaled back to the original value according to the same formula.
4.4 Training, Testing And Validation Sets & Neural Network Paradigms
Common practice is to divide the time series into three distinct sets called the training, testing, and validation (out-of-sample) sets. The training set is the largest set and is used by the neural network to learn the patterns present in the data. The testing set, ranging in size from 10% to 30% of the training set, is used to evaluate the generalization ability of a supposedly trained network. The researcher would select the network(s) which perform best on the testing set. A final check on the performance of the trained network is made using the validation set. The size of the validation set chosen must strike a balance between obtaining a sufficient sample size to evaluate a trained network and having enough remaining observations for both training and testing. The validation set should consist of the most recent contiguous observations. Care must be taken not to use the validation set as a testing set by repeatedly performing a series of train, test and validation steps and adjusting the input variables based on the network’s performance on the validation set.

4.5 Architectures Of ANN
Determine the number of layers, the number of inputs, outputs and the number of hidden layers and number of neurons in each layers of an ANN is the most important design issues. There are several approaches or rules of thumb for choosing the number of neurons in hidden layer(s) while designing an ANN topology. The ones retrieved from literature are:

\[
\frac{(i + o)}{2}, \text{ as defined by Man-Chung et al (2000)} \\
2i + 1, \text{ as defined by Azoff (1994)} \\
\frac{2}{3} (i+o), \text{ as defined in the Neural Ware Software Manual} \\
\frac{1}{3} (i+o), \text{ as defined in the Neural Ware Software Manual} \\
2i + 1, \text{ as defined by Heaton (2005)} \\
\frac{1}{3} (i+o), \text{ as defined by Freisleben (1992)} \\
\frac{1}{3} (i+o), \text{ as defined by Freisleben (1992)} \\
\sum (i), \text{ as defined by Gencay (1998)}
\]

Where \(i\) the number of inputs, \(o\) is the number of outputs and \(k\) is the number of hidden layer. We used these relations in the construction of neural networks predictor.

4.6 Evaluation Criteria & Neural Network Training & Implementation
The most common error function minimized in neural networks is the sum of squared errors. Other error functions offered by software vendors include least absolute deviations, least fourth powers, asymmetric least squares, and percentage differences. These error functions may not be the final evaluation criteria since other common forecasting evaluation methods such as the mean absolute percent-age error (MAPE) are typically not minimized in neural networks.

Training a neural network to learn patterns in the data involves iteratively presenting it with examples of the correct known answers. The objective of training is to find the set of weights between the neurons that determine the global minimum of the error function. Unless the model is overfitted, this set of weights should provide good generalization. The BP network uses a gradient descent training algorithm which adjusts the weights to move down the steepest slope of the error surface. One method to determine a reasonable value for the maximum number of runs is to plot the mean correlation, sum of squared errors, or other appropriate error measure for each iteration or at predetermined intervals up to the point where improvement is negligible (usually up to a maximum of 10,000 iterations).

Each iteration can be easily plotted if the neural network software creates a statistics file or, if this is not the case, the mean correlation can be recorded at intervals of 100 or 200 from the computer monitor. After plotting the mean correlation for a number of randomly selected starting weights, the researcher can choose the maximum number of runs based on the point where the mean correlation stops increasing quickly and flattens. The implementation step is listed as the last one, but in fact requires careful consideration prior to collecting data. Data availability, evaluation criteria, and training times are all shaped by the environment in which the neural network will be deployed. Most neural network software vendors provide the means by which trained networks can be implemented either in the neural network program itself or as an executable file. If not, a trained network can be easily created in a spreadsheet by knowing its architecture, transfer functions, and weights. Care should be taken that all data transformations, scaling, and other parameters remain the same from testing to actual use.

An advantage of neural networks is their ability to adapt to changing market conditions through periodic retraining. Once deployed, a neural network’s performance will degrade over time unless retraining takes place. However, even with periodic retraining, there is no guarantee that network performance can be maintained as the independent variables selected may have become less important.

5. RESULTS
Statistics characteristics of TEPIX series are analyzed first before applying it to neural network models. Table 3 shows means, maximum, minimum, Variance, standard deviation, skewness, and kurtosis.
Table 3. Statistics results of TEPIX

<table>
<thead>
<tr>
<th>min</th>
<th>mean</th>
<th>max</th>
<th>stdev</th>
<th>var</th>
<th>skew</th>
<th>kurt</th>
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</thead>
<tbody>
<tr>
<td>170</td>
<td>1983.27</td>
<td>1980.5</td>
<td>180.002</td>
<td>29653.07</td>
<td>1.00159</td>
<td>1.0283</td>
</tr>
</tbody>
</table>

Accordance table 4, we found that the most ideal ANN architecture, for our issue, structure 8-7-1 is, with fault $\alpha=0.5802$ ability to extract each of indexes based on other indexes for every day. This neural network has nearest reply to actual data with minimum error after 171 replications. We used the training functions and transfer function for this ANN), following the: TRAINGDM\(^2\), TRAINGDA\(^3\), TRAINGDX\(^4\) and transfer function LOGSIG\(^5\).

![Figure 2: Performance of Model 7](image)

Figure 2: Performance of Model 7

Fig 2 illustrates the training phase of the model 7 for Index II. That shows this model has a high performance, because almost all 3 graphs train, validation and test, movements are quite smoothly and at epoch 171th collide together. This means that minimize the prediction error. Fig 3 shows regression over 99%. In this case, we can trust to the output values of the neural network.

5. CONCLUSION

We forecasts values for each indexes from 04/27/2013 to 08/09/2013, were compared with actual values on the same day in the Table 4 and have brought them each rate errors. Our review shows that this issue is the in months year that symmetrical is the religious months of Muharram and Ramazan, TSE indexes, compared to other months, the movements are more different. According to Table IV, it should be emphasized that the ANN models showed significant performance in predicting the direction of stock price movement. Thus, we can say that the ANN is useful prediction tools for this topic.

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1. Gradient Descent with Momentum back-propagation
2. Gradient Descent with Adaptive learning back-propagation
3. Gradient Descent with momentum and adaptive learning back-propagation
4. Log-Sigmoid transfer function
Table 4. ANNs Is Built For Prediction 8 Indexes

<table>
<thead>
<tr>
<th>Neurons of hidden layer</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>17</th>
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<tbody>
<tr>
<td>Index I</td>
<td>3.2562</td>
<td>2.2078</td>
<td>1.2519</td>
<td>2.5901</td>
</tr>
<tr>
<td>Index II</td>
<td>3.2580</td>
<td>2.2614</td>
<td>0.5802</td>
<td>1.8960</td>
</tr>
<tr>
<td>Index III</td>
<td>1.2303</td>
<td>3.6520</td>
<td>2.5712</td>
<td>2.2501</td>
</tr>
<tr>
<td>Index IV</td>
<td>2.1489</td>
<td>2.1050</td>
<td>3.4268</td>
<td>1.9637</td>
</tr>
<tr>
<td>Index V</td>
<td>1.28091</td>
<td>1.9073</td>
<td>3.1057</td>
<td>2.3088</td>
</tr>
<tr>
<td>Index VI</td>
<td>1.9630</td>
<td>1.8124</td>
<td>2.1140</td>
<td>1.9543</td>
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<tr>
<td>Index VII</td>
<td>2.0051</td>
<td>1.7966</td>
<td>2.8409</td>
<td>1.1982</td>
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<tr>
<td>Index VIII</td>
<td>1.7419</td>
<td>2.0040</td>
<td>4.8620</td>
<td>3.0012</td>
</tr>
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REFERENCES


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