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With the publication of the current volume, *African Journal of Computing & ICT* is shifting away from its publication partnership with IEEE Nigeria Computer Chapter. It can be recalled that since the first edition appeared in June 2008 up till Volume 8 (2015), this journal was published in partnership with the Chapter.

Due to the peculiarities of the transition in publication partnership, only four (4) papers appear in this edition, which is a combined edition.

The paper by Sadiat Adetoro Salau and Bamidele Oluwade studied the general perception of scientists and science educators on the prospects and challenges of using electronic publication (e-publication). It was shown, among others, that most of the academic staff are aware of the existence of e-publication, and they subscribe to it.

The paper by O. G. Igbinosa and Bamidele Oluwade was stimulated by the 2012 flood disaster which ravaged many states of Nigeria, especially Kogi State, and in particular, Lokoja, the capital city of the state. The state is a confluence state in which the two major rivers of Nigeria, River Niger and River Benue, meet. The paper examined general technical strategies for monitoring and preventing flood-related phenomena, from the perspective of the well-studied tsunami.

Performance evaluation of multilayer perceptron classifier using cross validation techniques is the focus of the paper by Tinuke Omolewa Oladele, Jadesola Adejoke Emmanuel and Samuel Adebisi. The experimental paper involved the use of the KDD’99 full dataset and reduced dataset, where the latter is obtained through feature selection. Using WEKA tool, it was shown among others that there is a drastic difference in the training time of the multilayer perceptron algorithm in favour of the reduced dataset.

And last, but not the least, the paper by Bamidele Oluwade and Sunday Atnadu Bawa carried out a comparative analysis of three digital libraries, namely the Library of Congress (USA), Alexandria Digital Library (USA) and National Virtual Library of Nigeria (Nigeria). The paper confirms that the Library of Congress is the leading library (in the world) based on several aggregate parameters.

The journal will like to appreciate members of the editorial board, authors, reviewers and readers.

You are welcome to Volume 9, Numbers 1 & 2 (combined edition), 2016!

Bamidele (‘Dele) Oluwade,
Editor-in-Chief,
Afr. J. Comp. & ICT,
ISSN 2006-1781
Perception on E-Publication by Scientists and Science Educators in a Nigerian University

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ABSTRACT
One of the essential activities of academic/research staff (including scientists) in a university is to communicate their findings for publication in scholarly media such as journals and conference proceedings. As a result of the ICT revolution, there has been an increasing shift from the conventional paper publication to electronic publication (e-publication). This research was thus carried out to assess the general perception of scientists and science educators of a typical Nigerian University on the prospects and challenges of using e-publication. The particular university considered is the Federal University of Technology, Minna, Niger State (FUTminna), in North Central Nigeria, where opinions were sampled from academic staff in the university’s School of Science and Science Education. The views of the staff were gathered using questionnaires and the analysis was done using some statistical tools such as mean, percentages, frequency tables and charts. The respondents considered the following challenges faced in embracing e-publication, and rated them in the order of importance: erratic power supply, copyright violation, web management, poor verification of manuscripts, access to computers, pass wording information and cost implications. The research showed, among others, that a vast majority of the staff subscribe to e-publication, with preference for e-journals. About half of the respondents are of the opinion that the cost of e-publication is moderate. Also, the vast majority believed that e-publication contained more updated information than print publication.

Keywords: E-publication, Scientists, Science educators, Nigerian University

African Journal of Computing & ICT Reference Format:

© Afr. J. Comp. ICT, 2016; ISSN 2006-1781
1. INTRODUCTION

Academic science researchers publish to establish their claims to discovery of specific methodologies and results. They also publish to gain other form of recognitions (such as promotion and tenure) that require evidence of publication. In addition, they publish in other to have independent certification of the results and to have those certified (refered) results archived in perpetuity. Furthermore, they publish to communicate with those who may be interested in their works, researchers in related fields, and researchers in less well-connected institutions and students who are just cutting their teeth in research scholarship [1].

If the academic researcher as author is focused in this way, the user of information has a broader horizon. Any source of information, whether a journal article, a newspaper story, a magazine, database, or a primary source document can be important. The easier the access to these sources, the more likely the source will be used. Electronic publishing becomes really significant due to improved access (which implies quicker publication), desktop access, improved search and retrieval tools, and perhaps relatively lower cost. A number of journals have, while retaining their peer review process, established electronic versions or even moved entirely to electronic publication [2, 3].

If publishers were looking only to satisfying the needs of the author (and the journal’s editor), electronic publishing would have gone nowhere in the past decade. Paper is a satisfactory medium for documenting results or establishing priority (assuming everyone is on the same level playing field), and is a good archival medium. On the other hand, instead of focusing more on the user (or on the buyer for the user, the library), academic electronic publishing has become indispensable to publishing. For academic publishers that are traditionally oriented towards their editors and authors, this means a complete change in approach.

The digital revolution is not only beneficial to the academic writers, but has also revolutionized the works of artists, photographers and other creative people. There are already thousands of books that have been published in digital format. Publishers have started looking at electronic publishing optimistically as it is playing pivotal role in modern world [1, 4, 5].

Several studies have been conducted on the perception of users of electronic information resources, particularly e-journals, with respect to functionality, availability, ease of use, problems, prospects and other factors. These studies were conducted on community members of higher institutions in different countries, especially academic staff. These include United Arab Emirates [6, 7], United Kingdom [8, 9], India [10, 11, 12, 13] and Ghana [14, 15]. Other countries include West Indies [16], Turkey [17], Malawi [18], Kenya [19], Malaysia [20] and Nigeria [5,21,22,23,24,25,26,27,28].

In the present paper, the authors carried out an assessment of the general perception of scientists and science educators of a typical Nigerian University of Technology with respect to the prospects and challenges of using electronic publication. The particular university considered is the Federal University of Technology, Minna, Niger State (FUTminna), in North Central Nigeria, where opinions were sampled from academic staff in the university’s School of Science and Science Education. The views of the staff were gathered using questionnaires and the analysis was done using some statistical tools such as mean, percentages, frequency tables and charts. The respondents considered the following challenges faced in embracing e-publication, and rated them in the order of importance: erratic power supply, copyright violation, web management, poor verification of manuscripts, access to computers, pass wording information and cost implications. The specific objectives of this paper include:

(i) To assess the level of awareness of the staff on electronic publications
(ii) To assess the cost implications of electronic publications from the perception of the academic staff
(iii) To identify the major challenges from the perspective of the staff militating against the effectiveness of electronic publications in terms of its usage

It has been observed that cost is a significance index in electronic resource publishing [29, 30]. Also, an earlier work focused on the relative performance of the internet network of FUTminna vis-à-vis the network of two other Nigerian federal universities, namely University of Lagos and University of Jos [31]. The connection between e-journals and the Internet is that the existence of e-journals, including the ability to access them is dependent on the Internet. Another work which focused on the Internet is [32] wherein some basic technical factors that are relevant to the provision of internet service in a typical
Nigerian university were identified. The importance of the Internet in modern day research is discussed in [33].

II. METHODOLOGY

The authors employed random sampling technique to eliminate bias and so every staff in the population has equal chance of being selected.

For this research study however, the data instruments used were questionnaire to collect the opinion of the respondents, fifty-two (52) in number, which in this case are the academic staff of the School of Science and Science Education, FUT Minna. The questions in the questionnaire focused on the opinions of respondents on the prospects and challenges of e-publication. There were options among which respondents were asked to pick choices. The questions relate to the following:

(a) Subscription rate of respondents.
(b) Subscription frequency of e-publication resources.
(c) Cost of e-publication.
(d) Availability of e-publications.
(e) Accessibility rate.
(f) Opinion on whether e-publication contain more updated information than print publication.
(g) Challenges militating against the effectiveness of e-publication.

In particular, six possible challenges were posed to the 52 respondents. These are:
(i) Web management i.e. technical problems relating to the server slow download time
(ii) Erratic power supply: This relates to the availability of constant or regular electric power supply.
(iii) Access to computers: Easy availability of computers respondents for internet-related usage.
(iv) Copyright violation i.e. ability to have access to copyright permission.
(v) Poor verification of manuscripts: This relates to the fact that there is usually minimal control over posting of publications.
(vi) Password Access i.e. lack of access to password for accessing e-publication.

Taking into consideration that the collected data was discrete, descriptive statistical applications were utilized which include percentages, mean and frequency tables. Pie-chart was utilized to illustrate the relative frequency distribution shown on the tables. The statistical results and subsequent interpretations are discussed subsequently.

III. RESULT

This section presents outcome of the analysis of the distributed questionnaires.

a. Subscription

Table 3.1 shows that 46 out of the 52 respondents, which represent 88.5%, subscribe to electronic publications, while 6 respondents, which represent 11.5%, do not subscribe to electronic publications.
b. E-Publication Resources

Table 3.2 shows that no staff subscribes to CD-ROM publications, 18 out of the 52 respondents, which represents 34.6%, subscribes to Electronic journals only, 10 of the respondents (19.2%) subscribes to Electronic Articles only, 6 of the respondents (11.5%) subscribes to Electronic Books only, while 12 out of the respondents (23.2%) subscribes to Electronic Journals, Articles, Books and CD-ROM publications.

c. Cost implications

Table 3.3 indicates that 19.2% of the respondents assess electronic publications as expensive, 50% which represents half of the respondents think the cost implications are moderate, 3.8% think subscribing to electronic publications is cheap, 15.4% view electronic publications subscription as cost effective, while 11.5% of the respondents didn’t give their assessment.

d. Availability of electronic publications

From Table 3.4, 53.8% of the respondents think electronic publications are available overtime for subscription while the remaining 46.2% disagree on its availability for subscription over time.

e. Accessibility Rate

As indicated in Table 3.5, 57.7% think that electronic publications are readily accessible, while 42.3% think they are not readily accessible.

f. Opinion on Whether E-Publication Contain More Updated Information than Print Publication

84.7% of the respondents agree that e-publications contain more updated information than print publications while 11.5% disagree. 3.8% of the respondents didn’t give their view.

g. What are the challenges militating against the effectiveness of electronic publications?

The following values were the rankings of the fifty-two respondents on each of the challenges of using electronic publications, where one (1) is the lowest rank of these challenges and four (4) is the highest rank, as shown in Table 3.1. With respect to this question, mean was used to deduce which of the challenges tends to the highest rank, and which would be considered as major challenges militating against the effectiveness of electronic publications.

Mean score of a challenge =

\[
\text{Sum of rankings of challenges} \\
\text{Sum of number of respondents}
\]

i.e. Mean = Sum of scores of respondents divided by the number of respondents

First challenge: Web management
Mean = 140/52 = 2.69
Second challenge: Erratic power supply
Mean = 156/52 = 3.00

Third challenge: Access to computers
Mean = 114/52 = 2.19

Fourth challenge: Copyright Violation
Mean = 154/52 = 2.96

Fifth challenge: Poor Verification of Manuscripts
Mean = 134/52 = 2.57

Sixth challenge: Pass Word Challenge
Mean = 110/52 = 2.11

IV. DISCUSSION

Based on the calculations in the last section, the average of the various means is 2.58. This implies intuitively that any of the challenges whose mean is less than 2.58 is not considered a major challenge. These include access to computers (with a mean of 2.19) and pass wording information (mean = 2.11). Poor verification of manuscripts is a challenge which may also be considered to be marginally insignificant because its mean (2.57) is almost the same as the average. This can be easily seen if the mean and average of the means are approximated to one decimal place. The remaining challenges, namely, web management, erratic power supply and copyright violation are considered as the basic challenges militating against the effectiveness of electronic publications from the respondents’ perspective.

The findings from this study indicated that most of the academic staff are aware of the existence of electronic publications and subscribe to them, although a certain percentage of them do not know about their existence and so not subscribe to them. Also, academic staff subscribe mostly to electronic journals and articles and rarely to electronic books.

It was equally observed from the perspective of the academic staff that electronic publications usually contain more updated information than print publications. The cost implications of assessing these publications are also moderate which makes it easy for an average academic staff to subscribe to them. Also observed was the view that electronic publications remain available overtime for subscription to the users than print publications.

V. CONCLUSION

This paper has examined the prospects and challenges of electronic publications (e-publication) from the perspective of scientists and science educators in a Nigerian University. E-publications are a viable means of transmitting knowledge in this era of information proliferation. They contain more updated information than print publications, and so are readily accessible, especially in the academia. Based on this, e-publications are a better alternative of secondary information source than the print publications. The latter, especially current ones, are not readily available in many institutions in developing nations. Despite the prospects of e-publications, there are challenges that tend to be a clog in the wheel of progress of their usage.
In particular, the findings reported in this paper show that the problem of the erratic power is the most challenging i.e. without constant electricity, accessibility becomes difficult. Closely followed is the problem of web management (technical problems with the server, slow download time etc), and then copyright violation. The issue of poor verification of manuscripts is only marginal as a challenge. Access to computers and the issue of ‘pass wording information’ are not serious intuitive challenges militating against the effectiveness of e-publications.

VI RECOMMENDATIONS AND INFERENCES

(a) The University library need to subscribe more to electronic publications to compensate for the inadequacies of the library stock, and also to increase accessibility and level of awareness, especially in the academia where these publications are needed in the day to day research work.

(b) With subscription of libraries to electronic publications, the cost implications of accessing these publications would be reduced drastically. This will reduce paper processing, shelving, re-shelving, binding, risk of damage and losses.

(c) Academic staff need to explore the alternative offered by electronic publishing with respect to their research papers.

(d) The internet services available in the university need to be improved and keep running at virtually all times to meet the varied times the lecturers (and other members of the university community) surf the internet. This would reduce traffic congestion and a host of other technical issues [32]. This is because apart from publications on CD-ROMs every other electronic publication requires good internet connectivity.

(e) Alternative source of power supply need to be provided to make up for the inadequacies of the erratic power supply, which seem to be the major challenge of assessing electronic publications in many developing nations, especially Nigeria.

(f) A copyright policy review to cover violators of online intellectual properties need to be put in place and strictly adhered to.

REFERENCES


http://digitalcommons.unl.edu/libphilprac/229
Table 3.1: Subscription Rate of Respondents

<table>
<thead>
<tr>
<th>Serial number</th>
<th>Items</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
</table>
| 1             | Yes   | 46        | 88.5%
| 2             | No    | 6         | 11.5%
| Total         |       | 52        | 100%

Table 3.2: E-Publication Resources

<table>
<thead>
<tr>
<th>Serial number</th>
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<th>%</th>
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<td>CD-ROM publications</td>
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<td>-</td>
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<td>E-Journals</td>
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<td>E-Articles</td>
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<td>19.2%</td>
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<td>E-Books</td>
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<td>5</td>
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<td>6</td>
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<tr>
<td>Total</td>
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Figure 1: Pie Chart Showing Subscription Frequency for E-Resources
Table 3.3: Cost Implications of E-Publication

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<td>Cheap</td>
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Figure 2: Pie Chart Showing Cost Implications of E-Publication

Table 3.4: Availability of E-Publication for Subscription over Time

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<td>Yes</td>
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<td>Total</td>
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Table 3.5: Accessibility Rate of E-Publication

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Table 3.6: Update of E-Publication over Print Publication

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Table 3.7: Challenges of E-Publication and the Responses/Scores of Respondents

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Vol. 9, No. 1 & 2(combined), 2016, pp. 1 - 11
ISSN 2006-1781
Sadiat Adetoro Salau & Bamidele Oluwade (2016), Perception on E-Publication by Scientists and Science Educators

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A Survey of Global ICT Strategies for Monitoring and Preventing the Occurrence of Flood-Related Disasters

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ABSTRACT
Natural disasters are not peculiar to any particular geographical location, zone or country on the earth surface. Since the development of agriculture, human societies have experienced climate changes which have often had profound effects on human cultures and societies. Single-year precipitation-driven floods, wildfires, severe storms, hurricanes, tsunami and other climate-related events, occasioned by global warming, can cause severe economic damage and loss of life. In 2012, the famous River Niger and River Benue in Nigeria over-flooded their banks as a result of intense rainfall and the activities of neighbouring country, especially the opening of the Lagdo dam located in Cameroun. This natural disaster affected several Nigerian states including Kogi, Oyo, Lagos, Anambra etc. Several lives, homes and industries were affected, including a professional school for the training of sailors in Lokoja, the capital of Kogi State. Government agencies such as the National Emergency Management Agency (NEMA) made spirited efforts to ameliorate the effects of the disaster, but it was obvious that they were hitherto not adequately prepared for the magnitude of the disaster. As a result, all the inhabitants of all the communities along the rivers’ coastal line were rendered homeless, in addition to severe effects on animals, birds and valuable property. Using the well-studied occurrence of Tsunami as a case study, this paper presents a mechanism for using Information and Communication Technology (ICT) to monitor and prevent the occurrence of flood related disasters, with particular reference to Nigeria. Tsunami typically results from series of water waves caused by the displacement of a large volume of a body of water like an ocean or a large lake. The major ICT preventive technologies that are highlighted are the alarm system and the bottom pressure sensor.

Keywords: Climate change, Tsunami, ICT, Natural disaster, Flood

African Journal of Computing & ICT Reference Format:

© Afr. J. Comp. ICT, 2016; ISSN 2006-1781
I. INTRODUCTION

Natural disasters are not peculiar to any geographical location, particular zone or country on the earth’s surface. Human societies have experienced climate change since the development of agriculture. These climate changes have often had profound effects on human cultures and societies. Climate change, according to the United Nations Framework Convention on Climate Change [1], is a change of climate which is attributed directly or indirectly to human activities that alter the composition of the global atmosphere, and which, in addition to natural climate variability, is observed over comparable time periods.

Regardless of their locations on the planet, all humans experience climate variability and change within their lifetimes [2]. The most familiar and predictable phenomena are the seasonal cycles, to which people adjust their clothing, outdoor activities, thermostats and agricultural practices. This inter-annual variation in climate is partly responsible for year-to-year variations in crop yields, road maintenance, wildlife hazards etc. Single-year precipitation-driven floods can cause severe economic damage, including loss of life. Similar damage and loss of life can also occur as a result of wildfires, severe storms, hurricanes, tsunami and other climate-related events.

Tsunami, a Japanese word meaning “harbor wave”, is used as the scientific term for a class of abnormal sea wave that can cause catastrophic damage when it hits a coastline [3, 4, 5, 6]. A tsunami is a series of water waves caused by the displacement of a large volume of a body of water, typically an ocean or a large lake. Earthquakes, volcanic eruptions, landslides, glacier carvings, meteorite impact, nuclear tests and other disturbances above or below water, all have the potential to generate tsunami [7]. The most frequent cause of tsunamis is an underwater earthquake. Tsunami waves do not resemble normal sea wave, because their wavelength is far longer. Although, the impact of tsunami is limited to coastal areas, but its destructive power can be enormous, beat human imaginations, and can affect entire ocean basins. It can as well destroy lives and drown loved ones, wash away property, cause mental effects (as the sound makes a person scared), and in some cases, may cause loss of sleep if heard at night and can equally wash away plants and livestock [6, 8, 9, 10]. Table 1 describes some of the notable tsunamis throughout the world [11].

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Two of the basic formulas for measuring the scales of Tsunami intensity or magnitude are as follows [7, 15, 16]

(i) Intensity Scales

The Soloviev-Imamura tsunami intensity scale defines the Tsunami intensity I as:

\[ I = 0.5 + \log_2 H_{av} \]  

where \( H_{av} \) is the average wave height along the nearest coast.

(ii) Magnitude Scales

On the tsunami magnitude scale \( M_t \) is defined as:

\[ M_t = a \log h + b \log R = D \]

where a, b and D are a constants, h is the maximum tsunami wave amplitude and R is the distance of tide gauge from the epicenter.

---
It is noteworthy that both authors of this paper physically witnessed the 2012 floods in Lokoja, Nigeria. One of the earlier floods in Nigeria is the Ogunpa flood disaster. This disaster occurred in Ibadan, Oyo State, in 1980, when the Ogunpa River overflowed its banks.

II. ICT AND CLIMATE CHANGE

Information and Communication Technology (ICT) plays major roles in the climatic change migration and adaptation. This is increasingly being recognized between the climate change technology transfer negotiations, because according to the World Development Report 2010 [17], the use of ICT is predicted to reduce the total green house gases by 15% in 2020.

Beyond climate change mitigation, ICT has a prominent role to play in realizing Nigeria’s vision 2020 mandate of building a large, diversified, sustainable and competitive economy that harnesses the energies and talents of its people and guarantee high standard of living and quality of life for its citizens.

Over time, the impact of ICT on sustainable development has often been underestimated by policy makers. The importance of this sector can be felt in the construction of ICT- enabled energy efficient buildings and electric appliances, manufacturing, logistics and power grids. Others include ICT- enabled business models, markets and lifestyles. It is clear that ICT, as both general purpose and specific technologies, are necessary in order to monitor, model, administer and disseminate climate change activities. ICT products are used for environmental monitoring such as monitoring of weather and climate change, deforestation using satellite imagery, environmental modeling and computer simulations of climate change. Other administrative uses include information sharing, environmental advocacy reduction, physical mail and paper use.

III. ICT STRATEGIES FOR PREVENTING THE OCCURRENCE OF TSUNAMI

ICT can be used as a measure to monitor and prevent tsunami, especially in Nigeria, in the following ways:

(a) Use of Tsunami Alarm System or Tsunami Warning System

The Tsunami Alarm System works everywhere in the world covered by the GSM network, provided one’s mobile telephone is logged into a GSM network in the city (or country) where one is staying. The main feature of the Tsunami alarm system is its ease-of-use. One does not have to install or activate anything on one’s mobile phone. All one needs do, is to subscribe to the tsunami alarm system on the website. That is, wherever one can use mobile phone for calls, one’s tsunami alarm system will also be able to receive tsunami warnings. It does not matter to which GSM network one is logged on to. The Tsunami Alarm System receives earthquakes and tsunami warning information from a multiplicity of seismic measuring stations (and tsunami warning stations) from different cities all over the whole country. A seismic measuring station is a station that consists of seismographs [2]. A seismograph is a device that measures and record seismic waves. Nigeria is a country that has a very fast growth rate in terms of information and telecommunications. Even in the remote areas of the country, the GSM network is usually just as well-developed as in highly developed communities such as Abuja and Lagos. When one travels in areas accessible to tourists, one should not encounter any problem with the reception of mobile phone signals.

As a subscriber, one can be sure that one’s tsunami alarm system does not miss any warning and that any tsunami will result into an alarm being sent to one’s mobile telephone as soon as possible.

When a tsunami alarm is sent to subscribers, it is particularly important that it does not go unnoticed. In this way, one becomes aware of the message on one’s display at anytime of the day or night and one will be able to ascertain when and where the tsunami is expected. The tsunami alarm system reliably ensures that subscribers and other people one may want to warn can apply life-saving measures several minutes before the arrival of a destructive tsunami [19].

(b) The use of a bottom pressure sensor.

When an earthquake strikes on the bed of an ocean, millions of tons of water are publicly pushed upwards or sinks dramatically downwards, thus generating a powerful wave. In deep water, the wave travels at extremely high rate of speed. The wave can be identified by a tsunami detector (tsunameter), which is anchored on the ocean floor and measures changes in water pressure when a tsunami passes above. Six of these instruments are deployed in the Pacific Ocean. When a tsunameter
detects a tsunami, it sends acoustic signals to a buoy (a device which floats on water) on the surface. The buoy converts the signals to radio waves and relays the data to an orbiting satellite, which then alerts several warning centres. Warnings can then be sent out to the endangered regions immediately. Figure 6 explains the mode or operation of a tsunami pressure sensor system [7].

Apart from the specific ICT-based use of tsunami alarm system and pressure sensor system, other general measures for monitoring tsunami include the construction of tsunami walls and getting signals via the (erratic) behavior of animals.

IV. DISCUSSION

In general, it has been observed that about 80% of tsunamis occur in the Pacific Ocean. As a rule, a tsunami is possible anywhere in which there is a large body of water such as a lake. Indian Ocean was one of the most severe in modern times, especially in terms of the number of people killed. Many persons were killed in 14 countries which border the Indian Ocean. Furthermore, the 2011 tsunami in Tohoku, Japan, as well as the 1960, 1964, and 2004 tsunamis are classic examples of what is technically referred to as tele-tsunami.

It is pertinent that peculiar alarm system be developed for disaster-prone areas and made easily affordable. Government of Nigeria, as a matter of necessity, should do all within its power to encourage an and provide the enabling environment for ICT experts/computer scientists, in collaboration with seismologists, oceanographers and other disciplines in the geographical, geological and disaster management agencies, to work together towards averting devastating disasters. And finally, advice from this group of experts and professionals should not be treated with levity. Professional associations - such as Institute of Electrical and Electronics Engineers (IEEE), Nigeria Computer Society (NCS) and Nigeria Society of Engineers (NSE) - have important roles to play. Relevant working groups within these associations need to be alive to their responsibilities in providing timely warnings and advice to the society.

V. CONCLUSION

The importance of timely disaster warning in mitigating negative impacts can never be underestimated. Prevention is not only better but cheaper and safer than cure. ICT can play a significant role in highlighting risk areas, vulnerabilities and potentially affected populations by producing geographically referenced analysis through a Geographic Information System (GIS). Ultimately, it is the authors’ hope that an appropriate (mathematical) model will be formulated for solving the peculiar floods in Nigeria, taking into consideration all the necessary variables. This is expected to lead to the development of electro-mechanical warning/alarm system for peculiar floods such as exist in Nigeria.

REFERENCES

Hazards and Earth System Sciences, 6 (6), pp. 1035 – 1051.


Table 1: Some of the Notable Global Tsunamis

<table>
<thead>
<tr>
<th>DATE</th>
<th>ORIGIN</th>
<th>DESCRIPTION/EFFECT</th>
<th>DEATH TOLL (ESTIMATED)</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 7, 1692</td>
<td>Puerto Rico trench, Caribbean</td>
<td>Port Royal, Jamaica was permanently submerged</td>
<td>2,000</td>
</tr>
<tr>
<td>1707</td>
<td>Tokaido-Nankaido, Japan</td>
<td>Tokaido-Nankaido and environs were affected</td>
<td>30,000</td>
</tr>
<tr>
<td>October 28, 1746</td>
<td>Lima, Peru</td>
<td>Lima and environs were affected</td>
<td>3,800</td>
</tr>
<tr>
<td>November 1, 1755</td>
<td>Atlantic Ocean</td>
<td>Lisbon was destroyed</td>
<td>60,000</td>
</tr>
<tr>
<td>February 20, 1835</td>
<td>Peru-Chile Trench</td>
<td>Concepcion, Chile, destroyed</td>
<td>Not known</td>
</tr>
<tr>
<td>December 23, 1854</td>
<td>Nankaido, Japan</td>
<td>Nankaido and environs were affected</td>
<td>3,000</td>
</tr>
<tr>
<td>August 8, 1868</td>
<td>Peru-Chile Trench</td>
<td>Ships washed several miles inland, town of Arica destroyed</td>
<td>10,000 to 15,000</td>
</tr>
<tr>
<td>August 27, 1883</td>
<td>Krakatau</td>
<td>Devastation in East Indies</td>
<td>36,000</td>
</tr>
<tr>
<td>June 15, 1896</td>
<td>Japan Trench</td>
<td>Swept the east coast of Japan, with waves of 100ft (30.5m) at Yoshimama</td>
<td>27,122</td>
</tr>
<tr>
<td>September 30, 1899</td>
<td>Banda Sea, Indonesia</td>
<td>Sea around Indonesia was affected</td>
<td>3,620</td>
</tr>
<tr>
<td>December 28, 1908</td>
<td>Sicily</td>
<td>East cost of Sicily, including Messina and toe of Italy, badly damaged</td>
<td>84,000</td>
</tr>
<tr>
<td>March 3, 1933</td>
<td>Japan Trench</td>
<td>9,000 houses and 8,000 ships destroyed in Sanriku district, Honshu</td>
<td>3,000</td>
</tr>
<tr>
<td>April 1, 1946</td>
<td>Aleutian Trench</td>
<td>Damage to Alaska and Hawaii</td>
<td>159</td>
</tr>
<tr>
<td>1958</td>
<td>Lituya Bay, Alaska, USA</td>
<td>This was caused by submarine landslides. The wave didn’t travel far on the bay, but it struck the land almost immediately</td>
<td>2</td>
</tr>
<tr>
<td>May 22, 1960</td>
<td>South central Chile</td>
<td>Coinciding with a week of earthquakes. Damage to Chile and Hawaii</td>
<td>1,500 (61 in Hawaii)</td>
</tr>
<tr>
<td>March 27, 1964</td>
<td>Anchorage, Alaska</td>
<td>Severe damage to south coast of Alaska</td>
<td>115</td>
</tr>
<tr>
<td>August 23, 1976</td>
<td>Celebes Sea</td>
<td>Southwest Philippines struck, devastating Alicia, Pagadian, Cotabato, and Davao</td>
<td>8,000</td>
</tr>
<tr>
<td>July 12, 1993</td>
<td>Japan Trench</td>
<td>Okushiri Island devastated</td>
<td>200</td>
</tr>
<tr>
<td>Date</td>
<td>Location</td>
<td>Affected Areas</td>
<td>Casualties</td>
</tr>
<tr>
<td>------------</td>
<td>-------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>July 17, 1998</td>
<td>Papua New Guinea, Bismarck Sea</td>
<td>Arop, Warapu, Sissano, and Malol, Papua New Guinea, devastated</td>
<td>2,200</td>
</tr>
<tr>
<td>December 26, 2004</td>
<td>Indian Ocean, near Sumatra, Indonesia</td>
<td>Coastal areas of Indonesia, Sri Lanka, India, Thailand, Somalia, Myanmar, Malaysia, and Maldives devastated</td>
<td>250,000</td>
</tr>
<tr>
<td>July 17, 2006</td>
<td>Indian Ocean, near Java, Indonesia</td>
<td>More than 5,000 people internally displaced in West Java province</td>
<td>668</td>
</tr>
<tr>
<td>2011</td>
<td>Tohoku, Japan</td>
<td>The tsunami crossed many oceans</td>
<td>Not known</td>
</tr>
</tbody>
</table>
Figure 1: 2011 Tsunami in Sendai, Japan [12]

Figure 2: 2004 Tsunami in Phuket, Thailand [13]
Figure 3: 2004 Tsunami in Thailand [14]

Figure 4: Simple tsunami alarm system [18]
- **Tsunami warning system**

![Complex tsunami alarm system](image1)

Figure 5: Complex tsunami alarm system [19]

![A pressure sensor system](image2)

Figure 6: A pressure sensor system [7]
Performance Evaluation of Multilayer Perceptron Classifier on the KDD’99 Full and Reduced Dataset using WEKA Tool

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ABSTRACT
This paper presents a survey of intrusion detection, its system and an improved classification algorithm seeking to remove the existing problem of data mining’s intrusion detection system. The improved classifier is based on using information gain attribute evaluation technique (entropy) for performing feature selection (removal of redundant attributes) and feeding the filtered dataset into a multilayer perceptron algorithm for classification. A 10-fold cross-validation technique is used for the performance evaluation of the Multilayer Perceptron classifier on the KDD cup 1999 dataset using WEKA (Waikato Environment for Knowledge Analysis) tool. The experiment shows that the feature selected dataset provides better results than the full dataset after classification is performed on both.

Keywords: Multilayer Perceptron (MLP), Intrusion Detection System (IDS), Information Gain Technique, Feature Selection

I. INTRODUCTION
In recent years, the growths of the internet have increased exponentially and have changed the computing world immensely. However, this outstanding achievement has it is vulnerable point. The highly connected computing world has also equipped the intruders and hackers with new facilities for their destructive purposes. The costs of temporary or permanent damages caused by unauthorized access of the intruders to computer systems have urged different organizations to increasingly implement intelligent systems capable of providing efficient security [1].

Intrusion Detection is a key technique in information security as it plays an important role in detecting attacks and secures the network system; it is a process of observing and analyzing the events arising in a computer or network system to identify all security
problems [2]. The capability of IDS to stop current attacks or prevent future attacks is limited. Typically, the measures that IDS can take against an attack include blocking ports, blocking source addresses, and disabling all communications over a specific cable segment.

Intrusion Detection Systems has gained acceptance, as a necessary addition to every organization’s security infrastructure. A network-based intrusion detection system, including system logs, file systems and disk resources, monitors the data passing through the network when the system is used to analyze network packets.

The ability of soft computing techniques for dealing with uncertain and partially true data makes them attractive to be applied in intrusion detection. Some studies have used soft computing techniques other than Artificial Neural networks (ANN) in intrusion detection. For Instance, genetic algorithms have been used along with decision trees to automatically generate rules for classifying network connections. However, ANNs are the most commonly used soft computing technique in IDSs [3].

The idea behind the application of soft computing techniques and particularly ANNs in implementing IDSs is to include an intelligent agent in the system that can disclose the latent patterns in abnormal and normal connection audit records and to generalize the patterns to new (and slightly different) connection records of the same class.

ANN (Artificial Neural Network) is an information processing system that is inspired by the way biological nervous systems, such as the brain, process information. It is composed of many highly interconnected processing elements (neurons) working with each other to solve specific problems. Each processing element (neuron) is basically a summing element followed by an activation function. The output of each neuron (after applying the weight parameter associated with the connection) is fed as the input to all the neurons in the next layer.

The data set used in this paper is the KDD’99 intrusion data set. This data set is based on a DARPA initiative and has been used by researchers for evaluation of various intrusion detection methodologies in the past. The data set consist of 41 discrete and continuous attributes and has 22 attack classes and 1 normal class, where each instance in the data set has been categorized as one class.

Classification algorithms have been traditionally used to design IDS. These algorithms use supervised learning techniques, where they are trained first. After training using a set of data instances, patterns are detected. The algorithms can detect unknown patterns, once sufficiently trained. Many classification algorithms use feature selection to determine attributes which are more relevant for the classification. Intrusion detection systems use gathered packet information and classification algorithms are applied to classify normal behavior from abnormal behavior. Multilayer perceptron (MLP) is one of the most commonly used neural network classification algorithms [4]. Feature selection is the most critical step in building intrusion detection model. During this step, the set of attributes or features that deemed to be the most effective attributes are extracted to construct suitable detection algorithm (detector).

Data mining can be used to build an IDS as data mining techniques can be dissimilated by their different model functions and representations, preference criteria, and algorithm [2]. There are several techniques used for Intrusion Detection, which include Data such as Summarization, Visualization, Classification, Clustering, Association, and Prediction. The objectives of the paper are to Examine and analyze MLP Classifier as used in IDS, Evaluate the enhanced-MLP classifier and MLP Classifier and Using Information gain technique as feature selection for enhancing MLP classifier for the identified weakness.

II. LITERATURE REVIEW

A. Intrusion Detection System

An Intrusion Detection System (IDS) is a software that automates the intrusion detection process and detects possible intrusions. It is stated by [5] that “Intrusion Detection Systems serve three essential security functions: they monitor, detect, and respond to unauthorized activity by company insiders and outsider intrusion”. An IDS is composed of three logical components; Sensors which generate security events; Console to monitor events and alerts and control the sensors; Central Engine that records events logged by the sensors in a database and uses a system of rules to generate alerts from security events received [6]. An intrusion detection system dynamically monitors the events taking place in a system and decides whether these events are symptomatic of an attack or constitute a legitimate use of the system [7].

Additionally, intrusion detection systems (IDSs) are categorized according to the kind of input information they analyze by [8]. This leads to the distinction between
host-based and network-based IDSs. Host-based IDSs analyze host-bound audit sources such as operating system audit trails, system logs, or application logs. Network-based IDSs analyze network packets that are captured on a network. The host-based IDS detect only the malicious packet which enters individual system while the network-based intrusion detection system detects the whole network and alerts the network administrator about the malicious activity. [8] further disclosed that ‘detection is of two types which are anomaly and signature detection. Anomaly detection checks the normal system activity like the network bandwidth, ports, protocols and device connection, if there be any abnormal activity in system or network it informs the administrator. However, signature detection monitors all network packets with a previously known attack that are called signatures.

In [9], their research work introduced a framework for intrusion detection in data mining which is used to detect an insecure network attack on computer systems. The authors said, “Intrusion detection system can be classified into three systems based on such” (i) misuse-based system, (ii) anomaly-based systems, and (iii) hybrid systems”. The first two systems share the same scope with others, while the hybrid system is a newly introduced classification by them which ‘was based on misuse and corruption of the detection system technology. Intrusion Detection system is a combination of hardware and software that detects intrusions in the network. IDS monitor all the events taking place in the network by gathering and analyzing information from various areas within the network. It identifies possible security breaches, which include attacks from within and outside the organization and hence can detect the signs of intrusions. The main objective of IDS is to alarm the system administrator whenever any suspicious activity is detected in the network.

B. Data Mining

Data Mining is an analytic process with great potential, designed to explore large amounts of data also known as “big data” and search for consistent patterns and/or systematic relationships between variables, and then to validate the findings by applying the detected patterns to form new subsets of data [10]. It is an interdisciplinary subfield of computer science, is the computational process of discovering patterns in large data sets involving methods at the intersection of artificial intelligence, machine learning, business intelligence, statistics, high-performance computing and database systems. The goal of data mining is a prediction that has the most direct business applications [10].

Data mining is the process of analyzing data from different perspectives and summarizing it into useful information the patterns, associations, or relationships among all data that can provide information. It has been referred to as a convenient way of extracting patterns which represent mining implicitly stored data in large datasets and focuses on the issues relating to feasibility, usefulness, effectiveness, and scalability [11]. Data mining has been applied successfully in different scenarios and activities ranging from scientific areas such as genomic data mining, medical diagnosis to business areas such as manufacturing, finance, and marketing. Data mining involves the use of several algorithms to classify and evaluate data, these algorithms range from classification algorithm, clustering and several others whose use is targeted towards evaluation and analysis of data and used in data security and completeness.

C. Feature Selection

Intrusion detection data have characteristics of higher dimension and large sample, which causes two problems during the process of machine learning: firstly, there are many noise and redundancy attribute in intrusion detection data set, which can affect the accuracy of classifiers; secondly, training and classification time of machine learning increase as data dimensions increase, which will decrease efficiency of classification [12]. The main idea of feature selection is to choose a subset of input variables by eliminating features with little or no predictive information. It can significantly improve the comprehensibility of the resulting classifier models and often builds a model that generalizes better to unseen points [13].

Feature selection can reduce both the data and computational complexity. Three feature selection methods are identified in this paper; The filter method uses measures such as information consistency or distance measures to compute the relevance of set of features, the wrapper method uses predictive accuracy of a classifier as a means to evaluate the felicity of a feature set and the Embedded method learn which features best contribute to the accuracy of the model while creating the model using feature selection methods such as regularization. Feature selection provides three main benefits, especially when constructing predictive models which are improved model interpretability, shorter training times and enhanced generalization by reducing over-fitting.

It is stated by [14] that in feature selection redundant features are generally found to be closely correlated with one or more other features. As a result, omitting them from the intrusion detection process does
not degrade classification accuracy. In fact, the accuracy may improve due to the resulting data reduction, and removal of noise and measurement errors associated with the omitted features. Therefore, choosing a good subset of features proves to be significant in improving the performance of the system. The paper presented two methods of feature selection; Information Gain, where features are filtered to create the most prominent feature subset before the start of the learning process and Gain ratio which is a modification of the information gain that solves the issue of bias towards features with a larger set of values, exhibited by information gain. The gain ratio should be Large when data is evenly spread and small when all data belong to one branch attribute. Gain ratio takes number and size of branches into account when choosing an attribute as It corrects the information gain by taking the intrinsic information of a split into account (i.e. how much information do we need to tell which branch an instance belongs to) where Intrinsic information is the entropy of the distribution of instances into branches.

Effective and versatile classification cannot be achieved by single classification algorithm; it is recommended that hybrid models comprising a feature selection stage be integrated [15]. The authors further stressed that one of the most efficient heuristics used for decision tree construction is the Separability of Split Value (SSV) criterion. Its basic advantage is that it can be applied to both continuous and discrete features in such a manner that the estimates of separability can be compared regardless of the substantial difference in types. It is known that extra features can increase computation time and can impact the accuracy of IDS, so feature selection is a very good measure of improvising on machine learning algorithm used for classification purposes.

**RELATED WORK**

Several authors had worked on intrusion detection system using classification algorithms and comparing their performances. Many had worked on feature selection (i.e. feature extraction leading to the usage of an important attribute for training and test the IDS) and classifying attacks type – training and test MLP for classifying attack type. An Improved MLP in IDS to protect the user was introduced by [16]. This algorithm can be easily scalable by allowing different format of data to apply into this algorithm IMLP (Improved Multi-layer Perceptron) for more reliable IDS solution. The implemented Improved MLP is just a step to improve the performance of the existing system. The applied improved MLP method which gives better time efficiency as compared to traditional MLP also provided a better detection rate. The researchers concluded that IMLP (Improved Multi-layer Perceptron) performed better as compared to traditional MLP in both the measures.

Feature selection for intrusion detection using the neural network and support vector machines was proposed by [17]. According to the authors experiment based on Support vector machine (SVM) and Neural network, a number of observations and conclusions were drawn from their results; that SVMs outperformed ANNs in the important respects of; scalability (SVMs can train with a larger number of patterns, while ANNs would take a long time to train or fail to converge at all when the number of patterns gets large), training time and running time (SVMs run an order of magnitude faster), prediction accuracy. An approach for anomaly detection using Distributed Time-Delay Artificial Neural Network (DTDNN) over KDD99dataset was proposed by [18]. He used training dataset consisting of 25000 patterns (5000 patterns for each class of DoS, U2R, R2L, Probe, Normal), and testing dataset consisting of 2500 patterns (500 patterns for each class). The results shows overall accuracy classification is 99.884% for Distributed Time-Delay and the percentage of successful classification for DoS (97.6 %), U2R (96.2%), R2L (95.8%), Probe (98.2%) from normal one (Normal (98.4%)).

In [19], Backpropagation neural network for intrusion detection was proposed. The emphasis is on detection of new attacks and low failure rate. The proposed model consists of data-collector, pre-processor, encoder and neural network classifier. First, the network is trained and then tested. Testing includes two phases Level 1 and Level 2. In level 1 sample data is used whereas in level 2 totally new dataset is used. The success rate for level 1 and level 2 testing is 95.6%, 73.9% whereas the failure rate is 4.4%, 26.1% respectively. In [20] a back-propagation approach to detect intrusion was also proposed. First, the input and its corresponding target are called a Training Pair is generated. Then the training pair is applied to the network. Detection rate and false alarm rate are the performance measure used for evaluation of the proposed method. The detection rate for DoS, Probe, U2R, R2L attack is below 80%. Poor detection of attackers if some hidden attackers are present is one of the issues.

Several issues come from the survey such as false detection, large training time, the detection precision of low frequent attacks, classification of attacks etc. To overcome the problem of a large amount of training time, it is necessary to use high-speed learning algorithm for IDS and to test its results with existing learning technique. In [20] the dimensionality of the dataset was reduced
using the information gain technique for reduction of the attributes in a dataset. Their study approached the influence of this feature selection technique on the classification of attack by the Multilayer Perceptron algorithm. The simulations showed that the dataset that has its attributes filtered has the lowest training time and, in most cases, had an improved accuracy compared to the full KDD’99 dataset when being classified by MLP.

III. METHODOLOGY

To uncover the impact of feature selection on multi-layer perceptron classifier for intrusion detection system which is the aim of this research, the KDD99 dataset is used in the evaluation of various algorithms. The steps involved in the building the experiment evaluation include:

- Environmental setup
- Data preprocessing
- Choosing of a data mining software
- Selection of classifier algorithms that will cover algorithms from Decision trees to ANNs.

In the preprocessing stage, the KDD99 dataset is split into various types of attacks and feature selection is done using information gain which is done using decision tree classifier algorithm. The ‘WEKA’ software is used to carry out the data mining and MLP algorithm is used for intrusion detection. Table 3 and Table 5 results having the performance comparison among the selected classifiers are presented. One is the results of the performance of the Multilayer perceptron algorithm using all features contained in the KDD dataset and the other for the performance of MLP using selected features having reduced the features through decision tree’s information gain.

A. Information Gain in Terms of Feature Selection

Information gain for a dataset \( D \) containing \( S_i \) tuples of class \( C_i \) for \( i = 1, \ldots, m \) is defined as:

\[
\text{Info} (D) = - \sum_{i=1}^{m} \frac{S_i}{S} \log_2 \left( \frac{S_i}{S} \right)
\]  

(1)

Where \( S_i \) is the total value of a feature \( X \) and \( S \) is the number of possible value a feature \( X \) can take.

Entropy of feature \( X \) with values \( \{x_1, x_2, \ldots, x_v\} \)

\[
E(X) = \sum_{j=1}^{v} \frac{s_j}{S} \text{Info} (D)
\]  

(2)

Information gained by branching on feature \( X \)

\[
\text{Gain} (X) = \text{Info} (D) - E(X)
\]  

(3)

This is used for calculation of information gain of all the attribute of the KDD99 dataset and the prominent ten features are used.

B. Multi-Layer Perceptron for Classification

The neural network gains the experience initially by training the system to correctly identify pre-selected examples of the problem. The most popular static network is the MLP as shown in figure 3. MLP is feed-forward neural networks trained with the standard backpropagation algorithm. They are supervised networks, so they require a desired response to be trained. They are widely used for pattern classification. With one or two hidden layers, they can approximate virtually any input-output map. ANN is the network of individual neurons as shown in figure 1. Each neuron in a neural network acts as an independent processing element. Each processing element (neuron) is fundamentally a summing element followed by an activation function. The most successful application of neural network is classification or categorization and pattern recognition. There are two types of learning Supervise and Unsupervised. Multilayer Perceptron is the well-known architecture of supervised learning. The MLP is employed for Pattern Recognition problems. The Algorithm for MLP is shown in figure 2.

C. SYSTEM ARCHITECTURE
D. Dataset
The dataset used in this study was the 10% of the KDD99 dataset. According to [21] KDD99 has been the most widely used data set for the evaluation of anomaly detection methods. This dataset is built based on the data captured in DARPA’98 IDS evaluation program (KDD, 1999). DARPA’98 is about 4 gigabytes of compressed raw (binary) TCP dump data of 7 weeks of network traffic. The two weeks of test data had about 2 million connection records.

E. Training MLP With All Features
The training dataset was used to train the MLP intrusion detection system for detection and correct classification of attacks and it is subsequently tested to see if learning algorithm can correctly classify the attacks. This training and testing process was carried out using 10-fold cross-validation technique.

F. Feature Selection Via Information Gain
Afterward feature reduction of the dataset was performed via information gain. This reduced the number of features that the MLP classifier used in making correct and accurate classification. The feature reduction/selection technique selected the best attributes from the original 41 features (plus the label feature) and the extracted attribute were not more than 10 features (plus the label feature).

G. Training MLP Classifier With The Selected Features
The features extracted were fed as input to the MLP classifier, and the training and testing of the classifier were done also using 10-fold cross-validation technique. Conclusively, the results derived from both separate operation were subjected to analysis and comparison.

IV. RESULTS
A. Performance Comparison
The performance of MLP on each dataset i.e. the full dataset (containing all the features) and the reduced dataset (containing 12 features plus label), were evaluated and measured via the following parameters: incorrectly classified instances (%), correctly classified instances (%), root mean squared error, relative absolute error, kappa statistics, root relative squared error and measured via the following parameters: TP (True Positive) rate, FP (False Positive) rate, Precision, Recall, F-Measure and TT (Training Time of the algorithm on each dataset), and AA (Average Accuracy = Total correctly classified instances/Total instances).

Where:
True positive rate: fraction of intrusions correctly detected
True negative rate (TNR): fraction of non-intrusions correctly diagnosed
False positive rate (FPR): fraction of non-intrusions incorrectly diagnosed (false alarm)
FPR = 1 - TNR

B. Results
The Tables 3, 4, 5 and 6 shows the performance of MLP based on the Full and reduced dataset and the table 7 is derived from all the previous tables result.

C. Attacks and the Normal Attributes Terms
1) Denial of Service (DoS) attack causes the computing power or memory of a victim machine too busy or too full to handle legitimate requests. DoS attacks are classified based on the services that an attacker renders unavailable to legitimate users like apache2, land, mail bomb, back, etc.
2) Normal connections are generated by simulated daily user behaviour such as downloading files, visiting web pages.
3) Remote to User (R2L) is an attack that a remote user gains access of a local user/account by sending packets to
a machine over a network communication, which include send-mail, and Xlock.
4) **User to Root (U2R)** is an attack that an intruder begins with the access of a normal user account and then becomes a root-user by exploiting various vulnerabilities of the system. Most common exploits of U2R attacks are regular buffer-oversflows, load-module, Fd-format, and fb-config.
5) **Probing (Probe)** is an attack that scans a network to gather information or find known Vulnerabilities. An intruder with a map of machines and services that are available on a network can use the information to look for exploits.

D. **Performance Evaluation Terms**
1) **Correctly and Incorrectly Classified Instance**: reveals the percentage of test instances that were correctly and incorrectly classified.
2) **Kappa Statistics**: Kappa is a chance-corrected measure of agreement between the classifications and the true classes. It’s calculated by taking the agreement expected by chance away from the observed agreement and diving by the maximum possible agreement. A value greater than 0 means that the classifier is doing better than chance.
3) **Mean Absolute Error, Root Mean Squared Error and Relative Absolute Error**: These errors are basically used in numeric prediction rather than classification. In numeric prediction, predictions aren’t just right or wrong, the error has a magnitude, and these measures reflect that.

E. **Performance Measurement Terms**
1) **True Positive (TP)**: is the number of detected attacks and it is indeed an attack.
2) **True Negative (TN)**: is the number of normal instance classified as normal.
3) **False Positive (FP)**: also known as false alarm is the number of detected attacks but which is indeed normal.
4) **False Negative (FN)**: is the number of normal instances classified as an attack.

5) **Precision** = \( \frac{TP}{TP + FP} \)

6) **Recall** = \( \frac{TP}{TP + FN} \)

7) **Training Time (TT)**: this is the time taken to build the model.

The performance evaluation of the two datasets, that is, the full and reduced dataset is given in Table 7 and the graphical representation of accuracies of both dataset is shown in figure 15.

From the above results, we can conclude that there is a positive improvement in the classification of various attacks by the multilayer perceptron algorithm except for remote to local classification which shows a demeaning result, but an obvious difference is seen in the user to root classification.

Figure 15 depicts the accuracy of the correctly classified instance of attack performed on the two separate datasets.

V. **DISCUSSIONS**

Deducing fact from the analysis, the empirical result revealed the effect of information gain (feature selection) technique on the performance of multilayer perceptron in the classification of various attack. Nevertheless, the effect of feature selection is clearly seen in the time taken to train the algorithm as there was a drastic difference in the training time of the algorithm with the two separate datasets.

VI. **CONCLUSION**

In this paper we studied the performance evaluation of multi-layer perceptron classifier on the KDD’99 full and reduced dataset using weka tool. The overall performance of the classification algorithm was improved using the filtered dataset except for the dataset that were small before the reduction was performed thereby making it smaller which gave in degrading results as compared to when it was classified using the full dataset such as probing and remote-to-local.

**REFERENCES**


Figure 4: Proposed System Architecture (WEKA)

Table 2: Parameters Full Meaning

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>MEANING</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOS</td>
<td>DENIAL OF SERVICE</td>
</tr>
<tr>
<td>R2L</td>
<td>ROOT TO USER</td>
</tr>
<tr>
<td>U2R</td>
<td>USER TO ROOT</td>
</tr>
<tr>
<td>TP</td>
<td>TRUE POSITIVE</td>
</tr>
<tr>
<td>TN</td>
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EXPERIMENTAL RESULT OF MULTILAYER PERCEPTRON ALGORITHM FOR CLASSIFICATION ON THE FULL DATASET USING WEKA TOOL

Figure 5a: MLP on Denial of Service (DOS)
Figure 5b: MLP on Denial of Service (DOS)
Figure 6a: MLP on NORMAL
Figure 6b: MLP on NORMAL
Figure 7a: MLP on PROBING
Figure 7b: MLP on PROBING
Figure 8a: MLP on R2L
<table>
<thead>
<tr>
<th>Class</th>
<th>TP Rate</th>
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**Figure 8b:** MLP on R2L
Figure 9a: MLP on U2R
Figure 9b: MLP on U2R

Figure 5a and 5b depict MLP on Denial of Service (DOS). Figure 6a and 6b depict MLP on Normal. Figure 7a and 7b depict MLP on Probing. Figure 8a and 8b depict MLP on R2L. Figure 9a and 9b depict MLP on UR2, as shown in Table 3 and 4.

Table 3: Performance Evaluation of MLP of the full dataset

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>DOS</th>
<th>NORMAL</th>
<th>PROBING</th>
<th>R2L</th>
<th>U2R</th>
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<tbody>
<tr>
<td>Correctly Classified Instances (%)</td>
<td>99.9983</td>
<td>100</td>
<td>99.1478</td>
<td>99.2007</td>
<td>84.6154</td>
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<tr>
<td>Incorrectly Classified Instances (%)</td>
<td>0.0062</td>
<td>0</td>
<td>0.8522</td>
<td>0.7993</td>
<td>15.3846</td>
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<tr>
<td>Kappa Statistics</td>
<td>0.9998</td>
<td>1</td>
<td>0.9877</td>
<td>0.9539</td>
<td>0.7355</td>
</tr>
<tr>
<td>Mean Absolute Error</td>
<td>0.0001</td>
<td>0.0001</td>
<td>0.0012</td>
<td>0.0017</td>
<td>0.0177</td>
</tr>
<tr>
<td>Root Mean Squared Error</td>
<td>0.0021</td>
<td>0.0002</td>
<td>0.0236</td>
<td>0.0254</td>
<td>0.1086</td>
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<tr>
<td>Relative Absolute Error</td>
<td>0.3297</td>
<td>353.0244</td>
<td>2.0025</td>
<td>9.8533</td>
<td>28.4466</td>
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<tr>
<td>Root Relative Squared Error</td>
<td>1.5411</td>
<td>355.3712</td>
<td>13.6347</td>
<td>28.9263</td>
<td>65.2344</td>
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</table>
Table 4: Performance measurement of MLP on the full dataset

<table>
<thead>
<tr>
<th>PARAMETERS</th>
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<tr>
<td>TP RATE</td>
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<td>0.991</td>
<td>0.992</td>
<td>0.846</td>
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<tr>
<td>FP RATE</td>
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<tr>
<td>PRECISION</td>
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<td>0.992</td>
<td>0.992</td>
<td>0.845</td>
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<tr>
<td>RECALL</td>
<td>1</td>
<td>1</td>
<td>0.991</td>
<td>0.992</td>
<td>0.846</td>
</tr>
<tr>
<td>F-MEASURE</td>
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<td>1</td>
<td>0.992</td>
<td>0.992</td>
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<tr>
<td>ROC AREA</td>
<td>1</td>
<td>0</td>
<td>0.999</td>
<td>0.997</td>
<td>0.908</td>
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<tr>
<td>Training Time</td>
<td>98919.32secs</td>
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EXPERIMENTAL RESULT OF MULTILAYER PERCEPTRON ALGORITHM FOR CLASSIFICATION ON THE REDUCED DATASET USING WEKA TOOL

Figure 10a: MLP on Denial of Service (DOS) (reduced dataset)
Figure 10b: MLP on Denial of Service (DOS) (reduced dataset)
Figure 11a: MLP on NORMAL (reduced dataset)
Figure 11b: MLP on NORMAL (reduced dataset)
Figure 12a: MLP on PROBING (reduced dataset)
Figure 12b: MLP on PROBING (reduced dataset)
Figure 13a: MLP on R2L (reduced dataset)
Figure 13b: MLP on R2L (reduced dataset)
Figure 14a: MLP on U2R (Reduced Dataset)
Figure 14b: MLP on U2R (reduced dataset)

Figure 10a and 10b depict MLP on Denial of Service (DOS) reduced dataset. Figure 11a and 11b depict MLP on Normal reduced dataset. Figure 12a and 12b depict MLP on Probing reduced dataset. Figure 13a and 13b depict MLP on R2L reduced dataset. Figure 14a and 14b MLP on UR2 reduced dataset, as shown in Table 5 and 6.

Table 5: Performance evaluation of MLP on the reduced dataset

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>DOS</th>
<th>NORMAL</th>
<th>PROBING</th>
<th>R2L</th>
<th>U2R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correctly Classified Instances (%)</td>
<td>99.9938</td>
<td>100</td>
<td>97.0782</td>
<td>97.6909</td>
<td>73.0749</td>
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<tr>
<td>Incorrectly Classified Instances (%)</td>
<td>0.0062</td>
<td>0</td>
<td>2.9218</td>
<td>2.3091</td>
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<tr>
<td>Kappa Statistics</td>
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<td>1</td>
<td>0.9577</td>
<td>0.8617</td>
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<tr>
<td>Mean Absolute Error</td>
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<td>0.0003</td>
<td>0.0054</td>
<td>0.0065</td>
<td>0.0423</td>
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</table>
Root Mean Squared Error 0.0021 0.007 0.0391 0.0396 0.1291
Relative Absolute Error 0.2974 1294.665 9.0433 38.4633 67.9958
Root Relative Squared Error 1.5502 1305.3079 22.5764 45.1331 77.5406

Table 6: Performance measurement of MLP on the reduced dataset

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<tr>
<th>PARAMETERS</th>
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<td>0.971</td>
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<td>0.999</td>
<td>0.981</td>
<td>0.89</td>
</tr>
<tr>
<td>Training Time</td>
<td>2057.11secs</td>
<td>131.5secs</td>
<td>26.55secs</td>
<td>10.66secs</td>
<td>10.98secs</td>
</tr>
</tbody>
</table>

Table 7: Performance evaluation of the two datasets

<table>
<thead>
<tr>
<th>CLASSIFIER</th>
<th>ATTACK TYPES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DOS</td>
</tr>
<tr>
<td>MLP</td>
<td>99.9983</td>
</tr>
<tr>
<td>(with full dataset)</td>
<td></td>
</tr>
<tr>
<td>MLP</td>
<td>99.9938</td>
</tr>
<tr>
<td>(with reduced dataset)</td>
<td></td>
</tr>
</tbody>
</table>
Figure 15: Graphical representation of accuracies of both dataset.
A Comparative Study of Three Digital Libraries and Its Implication for National Development

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ABSTRACT
The importance of digital libraries in this modern-day world is evident. These libraries provide easier access to library users. A digital library refers to a collection of organized electronic documents which are available on the Internet or on CD-ROM disks. In particular, a virtual library is a kind of digital library which provides portal to information that is available electronically elsewhere. In this paper, the differences and similarities in three digital libraries, located in two continents of the world (namely America and Africa) are identified. The specific libraries considered in America (USA) are the Library of Congress (LOC) (American memory online exhibit) and the Alexandria Digital Library (ADL), while the Nigerian Virtual Library (NVL) is the case study in Africa. A comparative analysis based on funding/support, architecture, content of collections and cost of access to resources was carried out. All the libraries are funded by the respective governments or their agencies. The study also shows that access to resources available in American memory online exhibit is free of charge. Access to resources available in ADL is not entirely free of charge, as registration is required for gaining access to some resources. Access to resources available on the NVL is also not free, as all users are to obtain their username and password from the authority. In the world ranking of libraries, LOC comes first while the ADL is next to LOC in ranking. Based on the findings in the paper, it is recommended that government and the public sector of Nigeria should create more awareness about the benefits of digital libraries. These benefits include speedy information retrieval in different electronic formats, reduction of mutilation and theft of library materials and sharing of resources between networked libraries. Affordable and easy access of modern information and communication technologies (computers, internet services) should also be provided for primary, secondary and tertiary institutions. These are the infrastructures on which digital libraries are designed.

Keywords: Digital Library, Library of Congress, Alexandria Digital Library, Nigerian Virtual Library, Architecture

African Journal of Computing & ICT Reference Format:

© Afr. J. Comp. ICT, 2016; ISSN 2006-1781
I. INTRODUCTION

There is no doubt that technology is greatly transforming libraries. The term “digital library” for example, is a relatively new term. Due to contrasting perspectives (research and practice), various definitions of the term now abound. It connotes different meanings to different communities viz. “electronic library”, “virtual library”, “universal library”, or “future library”. A digital library (DL) is viewed by some as an electronic database, and by others, as an institution that offers information services or service [1, 2].

The present paper promotes the view of a digital library as including electronic databases on the internet, the World Wide Web (WWW) and resources on compact disc read-only memory(s) (CD-ROMs) [3]. In this context the word “library” is a collection of full-text and bibliographic information sources rather than buildings that incorporate human services, such as electronic publishing, personal information management and distance education. Digital libraries have the potential of improving information retrieval and dissemination. A virtual library (VL) is a kind of digital library [4]. It provides portal to information which is available electronically elsewhere i.e. the library itself doesn’t hold any content. It only provides remote access to content which is available in libraries and other information sources, essentially online or via CD-ROM.

Many authors acknowledged that digital libraries, for example, the World Wide Web (WWW), hold more useful, up-to-date and relevant (to many subjects) information than most academic libraries and other categories of libraries have. Users whose computers are networked to a digital library from different locations, can access a single copy of an electronic journal. Copies of the same electronic journal can be downloaded in little or no time by users and the same electronic journal can be reformatted by users to suit individual reading needs, like making the font larger for those with limited sight, making the page fit a smaller screen etc. Also because readers get a screen display of the information contained in books, rather than carrying away the physical book, loss of books by theft, except for Compact disc-read only memory(s) CD-ROMs which are vulnerable, are much reduced.

It has been pointed out severally in the literature that digital libraries contain representations of original works, provides opportunities for students and scholars to conduct research from personal computers and workstations located in their homes, offices and laboratories, and at their own pace and convenience. It also promotes scholarly publishing. In [5, 6], basic design principles and architecture of digital libraries were presented.

The aim of the present paper is to compare (American memory online exhibit of) the United States Library of Congress (LOC) [7], Alexandria Digital Library (ADL), USA [8] and the National Virtual Library of Nigeria (NVLN) of the National Universities Commission of Nigeria [9]. The parameters used in the comparison are architecture, funding/support, cost of access and content of collections. Earlier preliminary study on the theme was carried out by the second author under the supervision of the first author [10].

The LOC was established by an Act of Congress in 1800 when President John Adams signed a bill providing for the transfer of seat of government from Philadelphia to the new capital city of Washington. Established with $5,000 appropriated by the legislation, the original library was housed in the new capitol until August 1814. In January 1815, congress accepted retired President Thomas Jefferson’s offer, appropriating $23,950 for his books, and the foundation was laid for a great national library. The Jeffersonian concept of universality, the belief that all subjects are important to the library of the American legislature, is the philosophy and rationale behind the comprehensive collecting policies of today’s Library of Congress.

The LOC has made digitized version of collection materials available online since 1994, concentrating on its most rare collections and those unavailable anywhere else. The digital library services are the gateway to a growing treasury of digitized photographs, manuscripts, maps, sound recordings, motion pictures and books. In addition, the LOC maintains and promotes the use of digital library standards and provides online research and reference services. The LOC classification system, which uses alphabetic identifiers, has more classes than the Dewey classification system which uses decimal numbers as identifiers.

The Alexandria Digital Library project has its headquarters on the campus of the University of California at Santa Barbara, and it is hosted by the Davidson library. ADL is a consortium of researchers, developers and educators spanning the academic, public and private sectors, exploring a
variety of problems related to distributed digital libraries for geographically referenced information. By ‘distributed’, it is meant that the library holdings may be spread across the internet, as well as on a single personal computer. By ‘Geographically referenced’ is meant all the library holdings are associated with one or more regions (footprints) on the surface of the earth.

The National Virtual Library of Nigeria project was established in 2001 by the National Universities Commission (NUC). Bout ten years later, the project was rejuvenated via a subscription to thousands of e-books and e-journals in several fields of study. The goal is to improve the quality of teaching, learning and research in Nigerian institutions [11]. The website of the library was previously [12], a site which is now totally irrelevant. The new site is [9]. Virtual libraries of some individual Nigerian universities are hosted through the NUC virtual library (NUCVL). Apart from the NUCVL, other independent virtual libraries exist in the Nigerian system. These include the VL of the National Information Technology Development Agency (NITDA) [13], the Virtual Library Service of the National Library of Nigeria [14] and the virtual library of the Nigerian Institute of International Affairs [15].

II. TYPICAL ARCHITECTURE OF DIGITAL LIBRARIES

In general, a digital library may have multi-tier architecture and different digital libraries may have different architectures. The basic criteria for the development of a digital library system include [5] user friendliness, platform independence, scalability, technical simplicity, multi-ser in orientation and robust. Others include low cost, openness/interoperability, modularity and multimedia enablement [5, 16]. Figure 2.1 shows the major system components of a digital library.

The basic components, as depicted in the figure are user interface, search system, handle system and repository. Two user interfaces (incorporating browsers) are used, namely end-user interface and interface for librarians and system administrators. A search system recognizes indexes and catalogs while handle systems are general purpose identifiers for internet resources. Repositories are components which store and manage digital objects and related information.

In terms of the architecture, digital libraries can be examined from the perspective of three levels, namely notional level, operational level and technical level [5]. The notional level (see Figure 2.2) involves the consideration of data and metadata. In particular, a metadata refers to a set of data which describes and provides information about other data. Operational level considers how information flow is managed through the system’s components while the technical level involves a consideration about the functional component.

Common categories of metadata include descriptive metadata (e.g. bibliographic information etc), structural metadata (information about formats and structures) and administrative metadata (such as rights, permissions and other information used to manage access).
2.1. LIBRARY OF CONGRESS

The architecture of the American memory online exhibit of the Library of Congress is in line with the general architecture shown in Figure 2.3. The constituents of this architecture include, among others, distributed libraries, web server, web cataloguing, external information system, digital audio and video capture and email system.

2.2. ALEXANDRIA DIGITAL LIBRARY

The Alexandria Digital Library (ADL) has a distributed service-based architecture with three basic layers. These are client, middleware and servers, as shown in Figure 2.4. It is both an online and offline based digital library.

There have been three distinct architectures associated with Alexandria digital library since the project’s inception in 1994 [8]. The first was the “Rapid Prototype” architecture which used a personal computer (PC) geographic information system (GIS) as the user interface for accessing Alexandria digital library catalogue database. The second was the “Web Prototype” architecture which replaced the GIS with a server presenting a user-interface of dynamically generated hypertext markup language (HTML) pages. Like the pages accessible over the internet.

The third Alexandria digital library architecture is a generalization of the web prototype with interfaces supporting multiple clients and servers.

ADL servers are responsible for maintaining collections of metadata i.e. data about another data. ADL can also be used as an online catalogue for digital geospatial information. As such, ADL servers are generalizations of traditional library catalogues.

ADL clients are responsible for presenting ADL service to users. These users may be interactive (e.g. human beings using a graphical user interface) or may be programs using Alexandria digital library as a data source. The ADL clients also support complex real-time user interactions (e.g. rollover help etc). The very important aspect of the ADL architecture is the middle layer which maps an assortment of heterogeneous collection servers into a few standard client interfaces for metadata queries, metadata retrieval and digital holding retrieval. These client interfaces are intended to be generic enough to support clienteles.

2.3 NATIONAL VIRTUAL LIBRARY OF NIGERIA

The Nigerian Virtual Library as an online-based digital library whose architecture follows the general architecture of virtual digital library shown in Figure 2.5.

The architecture consists of several agents, namely user interface agent (for authors and consumers), referee agent, publisher agent, quantity agent, directory agent and information retrieval agent. All these are linked to the broker agent.

III. FUNDING AND COST OF ACCESS

3.1 LIBRARY OF CONGRESS

3.1.1 FUNDING/SUPPORT
Source of funding/support is from the government of United States of America.

3.1.2 ACCESS
Access to resources is free of charge, irrespective of whether the user is registered or not. Access is also not dependent on whether or not a prospective user is a United States citizen. Resources in text and image formats can be viewed, copied and manufactured for research purposes, except audio and video resources which are only accessible in read only formats due to copyright laws. If a user is not satisfied with offerings of the American memory online exhibit or has not been able to find what has been searched, such a user can use the “ask a librarian” hyperlink by click of the mouse button on the website [7] and there will be response from a reference librarian at the library of congress via electronic mail.

3.2 ALEXANDRIA DIGITAL LIBRARY

3.2.1 FUNDING/SUPPORT
The Alexandria Digital Library Project is one of the six projects funded under the Digital Libraries Initiative (DLI). The DLI is a joint program of the United States National Science Foundation (NSF), the Defense Advanced Research Projects Agency (DARPA) and the National Aeronautics and Space Administration (NASA) [17].

The name Alexandria comes from the Library of Alexandria, Egypt which was considered the centre of all knowledge/learning. The project began in 1994. The library of Alexandria per se was founded by Ptolemy I Sorter, King of Egypt, in the city of Alexandria and was
expanded by his son Ptolemy II Philadelphus early in the 3rd century BC.

3.2.2 ACCESS
Access to resources is not entirely free. A user must be registered to access some resources while some can be accessed without registration.

A user has to be registered to access some resources like the annex in the temple of Serapis which is 43,000 volumes, while others like audio books can be downloaded for free. If a user is not satisfied with offerings of the Alexandria digital library or has not been able to find search, such a user can use the “ask a reference question” hyperlink by click of the mouse button on the website (www.alexandriadigitallibrary.com) and there will be a response from a reference librarian at library of Alexandria via electronic mail.

3.3 NATIONAL VIRTUAL LIBRARY OF NIGERIA

3.3.1 FUNDING/SUPPORT
The Nigerian Virtual Library is a project supported by the Education Trust Fund (ETF)/Tertiary Education Trust Fund (TETFUND) of the Federal Government of Nigeria. It is managed by the National Universities Commission (NUC).

3.3.2 ACCESS
Access is not free. Only registered users can have access to resources. All users of the NVLN must request for their usernames and passwords. Users can no longer create passwords or usernames online as the case used to be.

IV. CONTENTS OF COLLECTIONS

4.1 LIBRARY OF CONGRESS
The Library of Congress contains over 100 million items, including several million books in about 500 languages. There is online access to over 500,000 items from its collections in the format of maps, atlases, printed and recorded music, motion pictures and television programmes. The American Memory Online exhibit includes a number of early films, television commercials and other moving image materials available for online viewing. The exhibits are in two groups: the first group of titles represent early motion picture history. The second group of titles contain titles that are protected by copyright.

American memory online exhibit provides one of the largest bodies of non-commercial high-quality content on the internet. By providing these materials online, potential users who may never come to Washington can gain access to the treasuries of the nation’s library. Such online access also help preserve rare materials that maybe too fragile to handle. In order to offer extensive reference service to the nation, and the world, the Library of Congress provides online access to over 500,000 items from its pictorial collections. The reproductions have sufficient quality to meet general reference needs, and, in a few instances, museum-quality facsimiles are also created.

The images in the Gottscho-Schleisner collection [18] grew out of a special project to make preservation copies of deteriorating nitrate and diacetate negatives in LOC photographic collections (some colour transparencies were also copied at this time). The original negatives were copied onto larger cut film in the late 1980s. At the same time, in order to produce a reference service video disc, the library of congress produced an additional 35mm film copy of the negatives. The contractor, stokes imaging of Austin, Texas produced the analogue videodisc from the 35mm film in a two-way process. First, stokes created a set of interim digital images with the moderate spatial resolution of 560 x 420 pixels. This set of digital images was achieved. Second, the digital images were processed to create the analogue video frames.

The current set of larger images (the images requested by the action of clicking the thumbnail) is reprocessed versions of the archived 560 x 420 digital images. The black and white images have a tonal resolution of 8 bits per pixel (256 shades of gray), while the colour images have a tonal resolution of 24 bits per pixel (16 million shades). All have been compressed with joint photographic experts group (JPEG) algorithm. Uncompressed versions of images at the same resolution are held by the library.

The “inline” thumbnail images for the Gottscho-Schleisner collection are in Graphics interchange format (GIF) and have a tonal resolution of 8 bits per pixel. There are images displayed with the bibliographic records. It is an online based digital library.

The American memory online exhibit includes a number of early films, television commercials and other moving image materials available for online viewing. The exhibits are in two groups. The first group of titles represent early motion picture history. Majority of titles in group one are
public domain. The second group contains titles that are protected by copyright.

Some of the titles in group one include:

a) America at work, America at leisure: motion picture from 1894-1915 [19].
b) Origins of the American Animation, 1900-1921 [20].
c) Theodore Roosevelt: his life and times on film, 1898-1919 [21].

Some of the titles in group two include:

a) Fifty years of coca-cola television advertisements: highlights from motion picture archives at the library of congress between 1954 and 1999 [22].
b) September 11, 2001 documentary project [23].

4.2. ALEXANDRIA DIGITAL LIBRARY

The collections in the Alexandria digital library include over 500,000 rolls of Ancient Egyptian history, annex in the temple of Serapis contained in 43,000 volumes. The library stores several articles, photographs and web links. It contains videos, compact discs, electronic resources, fiction for children, classic literature, bibliography and autobiography, business and carriers, foreign languages and free digital books software.

Books like “once upon a time in the north” a novel by Philip Pullman in audio format which can be downloaded for free and “sins of the assassin” a novel by Robert Ferrigno in audio format which can also be downloaded for free. Videos, of fiction for children and classic literature, bibliographies, business and carrier guidance, foreign language tutoring and free digital book software can be accessed. Search results (information) retrieved on collections of Alexandria digital library available on the internet using the Encarta premium digital versatile disk (DVD) 2008 was: 155 articles, 6 photographs and 28 web links.

4.3 NATIONAL VIRTUAL LIBRARY OF NIGERIA

Structure of access to collections in Nigerian Virtual Library is via creation of an account online and a password scheme (username and password) which can be obtained from the university librarian of a Nigerian university. Collections are arranged categorically and alphabetically. The following are some examples: Agriculture/Veterinary Medicine, Arts/Humanities, Building and construction, Business/management studies, Education. etc.

Some of the Nigerian journals accessible are on the following topics: agriculture (e.g. agricultural economics, agricultural extension, agronomy (crop/soil) and fisheries), engineering (e.g. agricultural engineering), religion etc. The library stores several articles, photographs and web links.

V. DISCUSSION

The American memory online exhibit of the Library of Congress (LOC) is online based, so also is the National Virtual Library of Nigeria (NVLN). The Alexandria Digital Library (ADL), on the other hand, can run online and also on single desktop/laptop. However, the components on a single laptop are limited to only information available in the database. ADL has more of the ancient worlds in its collections. NVLN has substantial content relating to Africa and Nigeria in its collections. Access to resources on LOC is free of charge with download restrictions on audio and visual content due to copyright laws. Access to ADL is not entirely free as registration is required to access some resources. Access to the NVLN requires approval.

Scholarly and professional interest in digital libraries has grown rapidly throughout the 1990s [2]. As ongoing researches indicate [24], services provided by these libraries will continue to be improved upon. It is therefore important that Nigeria takes more steps to harness the opportunities that digital libraries offer. These include speedy information retrieval in different digital formats, reduction of information bulkiness leaving only the message part, reduction of mutilation and theft of library resources, and sharing of resources between networked libraries. The developed world has made headway in networked and digital library capabilities. The United States determination to harness the benefit of the digital libraries inspired the country to designing these libraries as “a national challenge application area” under the High Performance Computing and Communications Initiative (HPCC) and a key component of the National information infrastructure [2]. This has helped a lot in enhancing information services delivery. This example is worthy of emulation by Nigeria. Nigeria’s access to information is vital if Nigerians are to contribute in finding solutions to their own development problems.
In the library of the future, the virtual (digital) networked library, there are strong indications that collection and archiving will be less important, at each local library. With networked information, there is less need to store local copies, and there is a shift away from collections towards access. This might imply fewer libraries and less information in each library. Of course, other opportunities exist for a library to collect documents. Some suggest that collecting and publishing local unpublished information may be an important future role of libraries. Others see the library as the publisher of local research material, bypassing today’s publishers. However, this will not produce the same volume of documents as today. When libraries do not collect as much, there is less need for local archiving. The task of archiving will probably be assumed by regional and national archives or libraries in each country.

It is hoped that there will be increased awareness, funding and support of digital library projects in Nigeria by government and the private sector of Nigeria.

It is recommended that:
(i) There is need for more publications, such as books, theses and journals, published on digital libraries by Nigerian authors. This will showcase the benefits of digital libraries, which include speedy information retrieval in different electronic formats, reduction of mutilation and theft of library resources and sharing of resources between networked libraries.
(ii) The emerging digital libraries in Nigeria such as the National Virtual Library of Nigeria and MTN Virtual Library [25] should approach the presentation of knowledge contained in their collections by making available version of collections in English and indigenous languages, especially the three major languages in Nigeria, namely Igbo, Yoruba and Hausa.
(iii) It has been said that a building of good architectural touch will naturally attract people to come and pay a visit to it. This is a call for refurbishment of some of the dilapidated traditional library buildings in Nigeria, by government and the private sector. This has the potential of influencing users to always return to the library for research in what is perceived as a comfortable environment.
(iv) Digital libraries need to be integrated into traditional libraries to create hybrid libraries. This will mean that users no longer need to concern themselves with the location, format or access method. That is, users can get whatever information they need at any time in a prompt manner, contrary to the usual phenomenon in a traditional library. This will help to revive the book reading culture in Nigeria.

(v) The government of Nigeria need to make education a topmost priority of her development programmes by adequately allocating a substantial part of the national budget for education. Measures need to be put in place so that the allocation is judiciously spent. The government should also make available up-to-date educational and training facilities that will equip citizens to design, build, operate and maintain information and communication technologies (ICTs) infrastructure.

(vi) The government and the private sector of Nigeria should not only create awareness, but should also provide affordable and easy access to modern information and communications technology (computers, internet services) for primary, secondary and tertiary institutions. This is the infrastructure on which virtual/digital libraries are based.

VI CONCLUSION

This paper carried out an examination of the differences and similarities in three digital libraries, namely, the American memory online exhibit of the United States Library of Congress, the Alexandria Digital Library, USA and the National Virtual Library of Nigeria. The comparison was based on funding/support, architecture, content of collections and cost of access. In the normal ranking of libraries, LOC comes first, based on several factors such as content. In particular, LOC is globally acknowledged, for instance, due to its superior classification scheme, over the popular Dewey Decimal Classification Scheme. The latter uses call numbers for book and non-book materials across the world. LOC scheme uses alphabetic identifiers. Based on the overall findings in this paper, the ADL is next to LOC in ranking.
REFERENCES


[18] https://www.loc.gov/collections/gottscho-schleisner/about-this-collection


1997;
http://www.dlib.org/dlib/may97/ibm/05gladney.html

Figure 2.3: General Digital Library System Architecture [5]
Figure 2.4: Architecture of Alexandria Digital Library [5]
Figure 2.5: General Architecture of Virtual Digital Library [5]
Call for Papers

Papers for consideration for publication in African Journal of Computing & ICT, ISSN 2006 – 1781, are invited which contain substantial ideas that have the potential of aiding inventions or a technological breakthrough for general and specialized use. The Journal mainly publishes online editions, and print editions in restricted quantities. Four editions are normally published every year. Special editions are published as the need arises.

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In general, papers are solicited from all areas of computer science and information and communication technology, including but not limited to, the following themes:


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