
Design of a Presentation Layer for Semantic Net Data Analysis

Iniakpokeikiye P. Thompson[1], Bunakiye R. Japheth[2], Erho A. Joseph[3], Juliana I. Consul[4], Evans F. Osaisai[5]

[1,2,3] Department of Computer Science,
Niger Delta University,
Wilberforce Island, Bayelsa State,
Nigeria.
[4, 5] Department of Mathematics,
Niger Delta University,
Wilberforce Island, Bayelsa State,
Nigeria.

Email: [1]iniakpothompson@ndu.edu.ng, [2]bunakiye.japheth@ndu.edu.ng, [3]joseph.erho@mail.ndu.edu.ng, [4]ji.consul@ndu.edu.ng, [5]ef.osaisai@ndu.edu.ng

---

ABSTRACT

Semantic Web has become a huge area of research with several directions, this paper is a step towards a dynamic platform design that can perform better services for the Semantic Web. Our platform provides more consistency, easy manipulation and interpretation as well as a presentation environment (User Interface) called the Semantic Net Data Analysis Presentation Environment (SNDAPE). It also suits Big Data analysis in a way that results are valid, consistent and intuitive, because businesses hold these very important since they form the foundation for better decision making. The platform designed provides end-users increased ability to self-manage data from varied resource. It also gives the everyday Semantic Web user; easy ways of extracting knowledge from the web of data. Java is used as the programming language for the implementation of the design through the object-oriented approach to system design.

Keywords: *Semantic Web Data, User Interface, Data Analysis, End-user Utility, Consistency Provision*

African Journal of Computing & ICT Reference Format

Iniakpokeikiye P. Thompson, Bunakiye R. Japheth, Erho A. Joseph, Juliana I. Consul, Evans F. Osaisai (2021), Design of a Presentation Layer for Semantic Net Data Analysis

Afr. J. Comp. & ICT, Vol. 14, No. 1, pp. 20 –.25

---

1. INTRODUCTION

The biggest obstacle amongst others identified in Big Data development and analytics is the variety of web-based information where they are made up of structured, semi-structured, totally unstructured (e.g., video, audio) and numeric data [8]. The Semantic Web has to provide more consistency, easy manipulation and interpretation as well as presentation (User Interface) to suit its Big Data analysis requirements in a way that is valid, consistent and intuitive. Validity, Consistency and Intuitiveness are key features that businesses hold very important because these three helps them make better decisions and cut cost. The paper is focused on the design of a presentation layer for Semantic Net Data analysis by improving validity, consistency and intuitiveness of analyzed data. Presentation layer in terms of the Open Systems Interconnection (OSI) Model is concerned with the structure and meaning of the data that is exchanged between two systems with functions such translation, encryption and compression of data.

Similar to this, but with specific application in the Semantic Web environment, our idea is to design a Semantic Net Data analysis presentation environment that will be able to translate or serialise inputed data to a semantic web format as well as extract the semantics and visualize same. Semantic Web has become a huge area of research. It comprises of Semantic Web underlying Technologies, LOD, Semantic Web authoring tools and techniques, the presentation otherwise called the user interface. The User Interface (UI) has to be developed in other to provide a suitable environment for the ever-growing data analysis of the semantic web. Big Data is a general term to define datasets whose size exceeds the processing capacity of traditional database systems [3]. Though it is not yet a commonly agreed definition; Big Data is generally made up of three V's: volume, velocity, and variety [7]. Volume is about the size of the data not minding the source. It could be in tera, peta, or exabytes. Velocity means the rate at which data is streamed and the ways by which such data can be accessed and stored in near real-time as well as handling the increasing amount. The Last, variety deals with the heterogeneity of data in the big data space at every level.

The best interest of the semantic web is that of Variety of Data, because technologies for the semantic web are tailored towards the aggregation of data from different varying sources and formats [1]. Ivan [6] defined Semantic Web as "A collection of standard technologies to realize a Web of Data". It allows applications to directly exploit data. The purpose of Semantic Web is to be able to link to data independently of their presentation and also use such in any way the user dim fit (e.g. present it, mine it e.t.c). The data in a semantic web should also be accessible for processing and interpretation by programs, software agents, scripts etc. [2].

.

2. RELATED WORK

The Web has been made up of documents; as such it is named Web of Documents which is primarily made up of interlinked documents, sometimes links also exist within parts of each document. The degree of structure is fairly low and implicit semantics of content that is designed for human consumption [10]. While recently, the new web is now a collection of data which is why it is called Web of Data; a description of things and a link between them. Request Description Framework (RDF) provides a model that specifies how data items can be made available to the World Wide Web [15]. Data items in this context are called resources. These resources are identified using web Uniform Resource Identifier (URI) represented in Subject, Predicate, and Object form summarily called Triples. The subject holds a URI or an empty node called blank node. The Object holds a URI or string literal while the Predicate is what tells the relationship or link between the Subject and Object, this is integrated as URI [1]. When Triple are grouped into sets, each set is called an RDF graph.

An RDF graph is physically seen as directed node-arc graph where every single triple is made up of a node-arc-node link [15]. The model notation of RDF graphs is defined such that every statement has a node representing the Subject, another for the Object and also an arc representing the predicate that connects the Subject and the Predicate. The same way any document expressed in HTML can have a connection to any other with same expression; an information defined using RDF can easily be connected to any other information expressed in RDF [9]. Though, with respect to HTML, a linked resource must be a whole document, with RDF, any information defined as a resource can be linked together without recourse to whether it is a document or not. The Semantic Web integrates or brings together not only resources that are built or represented using RDF but also those entities which can be mapped to RDF [15]. Numerous RDF serialization formats exist that can be used to write statements in RDF. They are, but not limited to rdf-xml (RDF/XML), n-triples (N-Triples), turtle (Turtle), n3 (Notation3), trix (TriX) and trig (TriG) [5].

Ontology has been defined in many areas, many of which contradict one another especially in the field of Artificial Intelligence (AI) [8]. Two of the widely accepted definitions are; ontology is an explicit specification of the structure of a domain and it is also defined as the conceptualization of a domain; this basically includes the model of the domain with possible restrictions [16]. Each group of single objects of classes defined with the use of ontology becomes a knowledgebase. The conceptualization only describes the knowledge derivable from the domain rather than the specific state of things within the domain [16]. The implication of this is that conceptualization does not change, or rarely change. Ontology is therefore a specification of this conceptualization. The specification of the conceptualization is done using a particular modeling language and particular terms [16]. Ontology development in practical terms, involve: defining classes for the ontology, organizing the classes in a subclass–super class order, creating slots and defining allowed values for the slots, as well as entering input into the slots for instances. Thereafter, knowledgebase creation is done if desired, where individual class instances are defined, filling in specific slot value information and additional slot restrictions [8].

Though there exists no "correct" way or methodology for developing ontologies, in [8], an iterative approach to ontology development is described with emphasis on some fundamental rules in ontology design to include: (1) The best solution almost always is dependent on the application that is to be developed and the anticipated extensions. (2) Ontology development is necessarily an iterative process. (3) Concepts in the ontology should be close to objects (physical or logical) and relationships in the area of interest. These are most likely to be nouns (objects) or verbs (relationships) in sentences that describe the domain. Ontology provides a general or shared understanding of data, services and processes and therefore made a significant impact in the semantic integration of databases [18]. The general term used to call the language for the specification of the conceptualization is Web Ontology Language (OWL). This language is an extension of the RDF capabilities in the specification of things, terms and concepts.

The essence of developing an Ontology whether with Semantic web Ontology Data or others is for the purpose of knowledge discovery [11]. Several knowledge discovery approaches exist; in [11] these approaches are categorized into three: Using Semantic Web based approaches: In this category Semantic Web technologies and Linked Open Data (LOD) are employed to support the process of knowledge discovery. Initial survey was done on the categories presented above by [13] but later concentrated more on the second category. More recent studies on the second category were done by [12] and [2] while an overview of the challenges and opportunities of the other category was given by [14] but there has been no recent discuss on the first category, i.e. using Semantic Web based approaches. A survey on Semantic Web Data mining was therefore carried out by [11]. In their work, knowledge discovery process model was used as presented by [4], which is given below to show how Linked Open Data can be used at various stages for building content-based recommender systems as a consequence of a broad survey on the usage of Semantic Web and Linked Open Data to support and improve data mining and knowledge discovery.

3. METHODOLOGY, RESULTS AND DISCUSSION

The research methodology used is water fall system analysis and design methodology, in following through this methodology. Two major activities are captured in following through this methodology, they include; Operational Requirements and Priority as well as Captured Sequences

3.1 Operational Requirements and Priorities

System Analysis in our case is the feasibility study and planning for the development of the semantic net application and the presentation layer for the creation of the network to be used for deduction and meaning inference. The core priority is evaluation and analysis of the existing system with core interest in the interacting links in the specification and definition of the operational requirements. The outcome of the evaluation and analysis of the existing system brings us to our next and ultimate priority in this paper; to develop a new and improved system. In other to clearly identify areas of improvement for our system, it will be very important to understand the way that the present system works and functions [17]. Some high-level details will be presented so that the deficiency of the present system can be clearly identified and the area of improvement clearly mapped out in the process of building the improved system.

The present analytical architecture of the linked web data starts from the nodal concept from where the data or information is generated. The information is profiled based on one and only one (1) set of data at a time for each node and then the next stage captures them. In the next stage, the functional properties and the non-functional data properties are processed. On the functional property point, input is captured by the system and is made up of the rules of inference and the data behaviours derived from the functional property processed. The fine-tuned behaviour is still further re-injected into the system which after some iteration produces the output. The output is made up of system suggested results and percentage rating of the suggestions [12]. Given the output, users can take decisions. This is shown in Figure 1. On the point of iteration, activity can be zero or one set (0.1) based on whether there is significant change in the iteration value. Activity can be zero if there is no change but can be one if there is change.

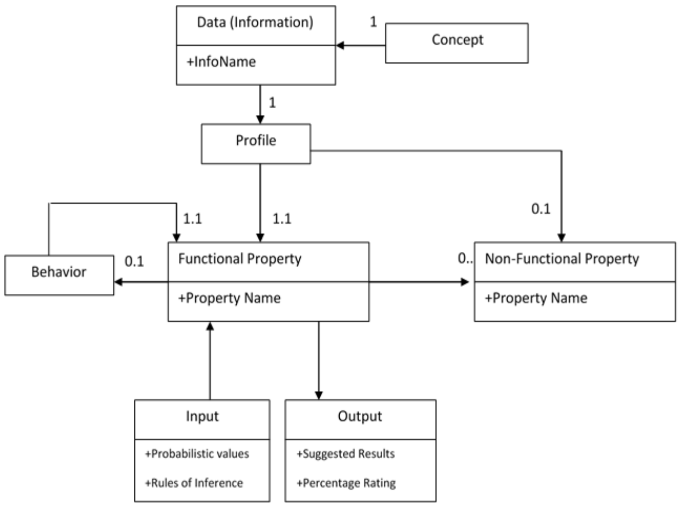

Figure 1 Evaluation and Interacting Links of Semantic Operational Requirements

The dynamic platform metamodel as shown in Figure 2 is an extension of the existing system discussed in Figure 1. Subsequently the validity, consistency and reliability that are features of the proposed system is derived from the last section of the proposed architecture where a semantic annotation using the Ontology and semantic concept (the validation parameter) is processed and injected into the system. This injection is to ensure that these parameters are used in processing the network [8].

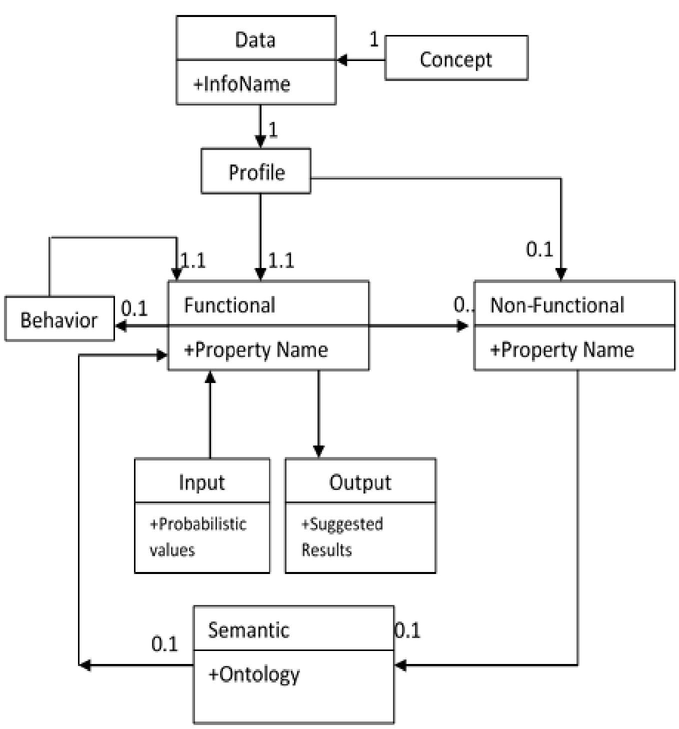

Figure 2 Analytical System with Semantic Annotation

3.2 Captured Sequences

The goals are to reveal the functionality of each of the layers of the system so that the detail will start to be visible. Every layer is made up of parts that take charge several services, they also decide on the way services are generated, run and monitor services as they run as well as providing and aiding several other tasks such as management tasks, creation and publishing of semantically defined services [6]. The layers identified as shown in figure 3 include the presentation layer, the middleware layer, the service layer and the realization layer.

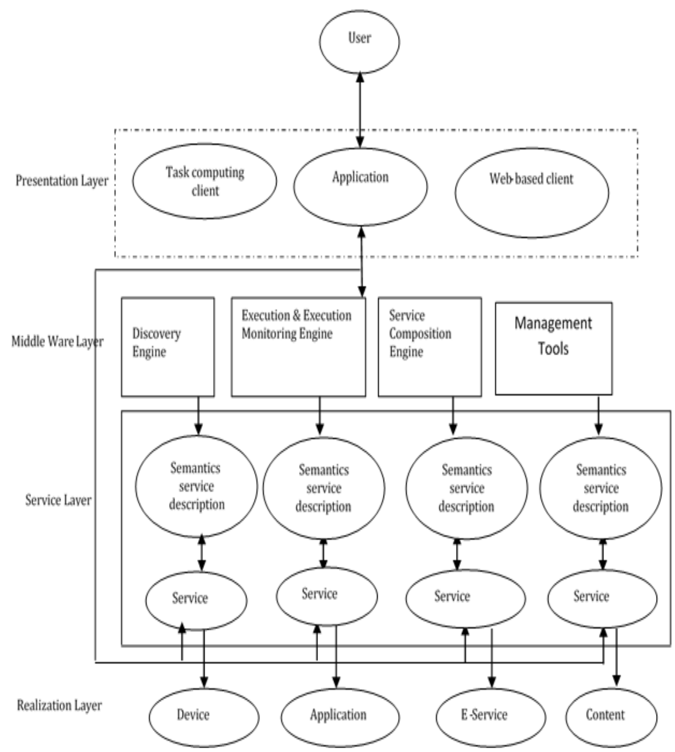

Figure 3 System Layer design

Presentation Layer: This layer provides the user an interface or a medium of communication with the system where by making an individual task on the system temporary with the capacity of carrying out functions in real time. Custom or user specific tasks can be implemented at the presentation layer since the components of the middleware layer provides well defined service API's in any development environment that can invoke web services. Task computing defines a semantic service discovery mechanism (SSDM) which uses the underlying service discovery mechanisms offered by the middleware layer (e.g., UPnP SSDM) to discover semantically described services.

Middleware Layer: The Middleware layer takes charge of the discovery of new services, deciding how services can be created, running and monitoring as well as providing support by managing several activities which include definition and publishing of semantic services.

Service Layer: The above-mentioned services are provided as computational services in a way that interfaces are used to access (execute) this functionality. Each service has an association with the least semantic description, which sometimes may be created on-the-fly as services might be created dynamically. In the area of task computing, services are the abstractions of the details and complexities of the underlying sources of functionality which are semantically described and serve as the source of executing their tasks.

Realization Layer: This layer is at the base of the other layers; it is the eco-system of devices, applications, e-services, and valid user content available to him.

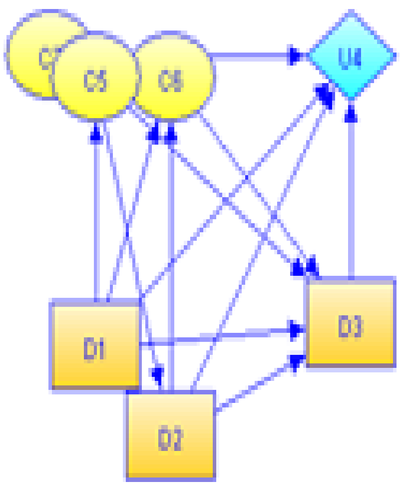

Figure 4 Semantic Net with three nodes and three decision variables

When the Semantic Net is run as shown in figure 5, it generates the values and the output in a table of all three nodes. The tables show defect percentages and suggestion to buy the car or no test [4].

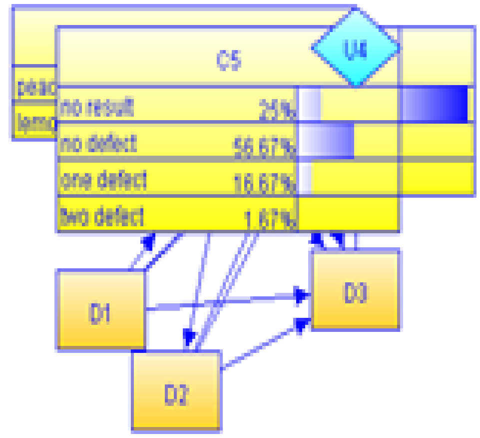

Figure 5 Executed Semantic Net

In figure 6 the executed Semantic Net output is further expanded to show various outcomes based on the nodes used when testing the system [17]. On the right hand of the system the graph of the percentages is clearly displayed suggesting that there is No defect on the car and conclusion is to buy

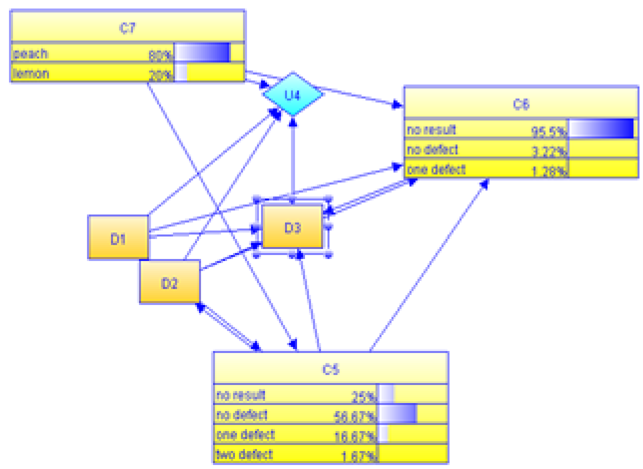

Figure 6 Expanded View of Executed Semantic Net

4. CONCLUSION AND FUTURE WORK

The purpose of task computing approach is such that non-experts can have an environment to create user customized complex tasks using information-rich, device-rich, and service-rich Semantic Network devices. Users, through the End User Programming tools (EUP-tools) are able to perform this task. With these tools, they can also be able to generate new applications or scripts that fit their intentions and use same to perform such tasks. These applications, though developed with such EUP-tools are native applications which provide a suitable user interface that is able to call scripts put together by non-expert users. E.g., as a result of users interacting with the EUP-tools, an application front-end is chosen among a pool of possible front-end and installed by the phone's installer. When this application is later launched, it invokes the generated scripts from the EUP-tools and which contain specific functionality composed by the user. The EUP-tools might sometimes use task-oriented script templates to facilitate more meaningful final task compositions. While guiding the user to compose the scripts, the EUP-tools use user-level discovery of service and service discovery and "action/event" description the semantic web adaption layer provides.

The semantic adaptation layer is the layer that handles semantic translations of the user defined concepts to what is made available by the system. This layer therefore, contains the end-user semantic actions and events which are in two roles. They describe how low-level actions and events (e.g., distributed based on Simple Object Access Protocol (SOAP) or local based on local file contents or local application functionality) are tied to the concepts defined by the user and which are provided to end-users. More specifically, they describe how the end-user service discovery and scripting semantic adaptation libraries should translate core distributed middleware functionality or local resources to user-perceived concepts. For example, a user-level action may be "upload video to media server".

REFERENCES

[1] Bizer, Cyganiak, and Heath (2007). How to publish Linked
Data on the Web. Retrieved June 14, 2009, from http://www4.wiwiss.fu-erlin.de/bizer/pub/LinkedDataTutorial/

[2] D. Dou, H. Wang and H. Liu, "Semantic data mining: A survey of ontology-based approaches," *Proceedings of the 2015 IEEE 9th International Conference on Semantic Computing (IEEE ICSC 2015)*, 2015, pp. 244-251, doi: 10.1109/ICOSC.2015.7050814.

[3] Jean-Pierre Dijcks (2011). Oracle Oracle White Paper—Big Data for the Enterprise.

[4] Usama M. Fayyad, Gregory Piatetsky-Shapiro, Padhraic Smyth and Ramasamy Uthurusamy. (1996). Advances in knowledge disc overy and data mining, in: American Association for Artificial Intelligence. American Association for Artificial Intelligence.

[5] GitHub. (2014). RDF Format. GitHub. Retrieved July 9, 2016, from https://github.com/thinkaurelius/faunus/wiki/RDF-Format

[6] Ivan Herman. (2009). Introduction to the Semantic Web (tutorial). Semantic Technology Conference San Jose, California, USA.

[7] IBM. (2013). What is big data? - Bringing big data to the enterprise. Retrieved from http://www-01.ibm.com/software/data/bigdata/

[8] Natalya Noy, and Deborah McGuinness. (2015). Ontology Development. Stanford University.

[9] Neuman Ek, Miller E, and Wilbanks, J. (2004). What the semantic web could do for the life sciences. Journal of Drug Discovery Today: Biosilico, Aventis Pharmaceutics, Bridgewater, NJ 08807, USA; W3C, Room 32-G515, 32 Vassar St, CSAIL-MIT, Cambridge, MA 02139, USA number {6}, volume {2}, pages {228-236}, {2004}, doi = {10.1016/S1741-8364(04)02420-5},

[10] Oktie Hassanzadeh. (2011). Introduction to Semantic Web Technologies & Linked Data. University of Toronto March 2011Microsoft PowerPoint - web-of-data-intro.ppt (toronto.edu)

[11] P. Ristoski, H. Paulheim / Web Semantics: Science, Services and Agents on the World Wide Web 36 (2016) 1–22http://dx.doi.org/10.1016/j.websem.2016.01.001 1570-8268/© 2016 Elsevier B.V. All rights reserved.

[12] Sivakumar, J. and Ravichandran, K. S. (2013). A Review on Semantic-Based Web Mining and its Applications. International Journal of Engineering and Technology. 5. 186-192.

[13] Stumme, G., Hotho, A., & Berendt, B. (2006). Semantic Web Mining: State of the art and future directions. *J. Web Semant., 4*, 124-143.

[14] Tresp V., Bundschus M., Rettinger A., Huang Y. (2008) Towards Machine Learning on the Semantic Web. In: da Costa P.C.G. et al. (eds) Uncertainty Reasoning for the Semantic Web I. URSW 2006, URSW 2007, URSW 2005. Lecture Notes in Computer Science, vol 5327. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-540-89765-1_17

[15] W3C. (2015). Linked Data. Retrieved July 9, 2016, from https://www.w3.org/standards/semanticweb/data

[16] Obitko, Marek. (2008). Semantics in Industrial Distributed Systems. IFAC Proceedings Volumes. 41. 13880-13887. 10.3182/20080706-5-KR-1001.02350.

[17] Daniele Dell'Aglio, Thomas Eiter, Fredrik Heintz and Danh Le-Phuoc; Special issue on stream reasoning. Semantic Web 10 (2019) 453–455

[18] Jonathan Alan Smith. Reflecting on the Development of Interpretative Phenomenological Analysis and Its Contribution to Qualitative Research in Psychology January 2004 Qualitative Research in Psychology 1(1):39-54 DOI: 10.1191/1478088704qp004oa