

## DESIGN AND ANALYSIS OF A FORMAL COMPUTATIONAL ONTOLOGY MODEL FOR YORUBA NAMING CONVENTION

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**ABSTRACT:** Yorùbá Culture is at the risk of going into annihilation as its rich culture and custom are being lost due to inadequate knowledge preservation measures to safeguarding its learning, teaching and practice. Folktale is the commonest method used in transferring knowledge and information from one generation to another generation. However, this is not possible and reliable as vital information and data would be lost in the face of current globalisation and enculturation. This study was carried out in order to protect Yorùbá Cultural heritage with a focus on Yorùbá Naming practice. In order to safeguard and protect the knowledge contained in the cultural heritage from being endangered, the need to develop a knowledge management system for Yorùbá Naming is required. Data on Yorùbá names were obtained from documented text and knowledge about the naming convention was elicited from domain and ontology experts using a combined method of observation and consultations. Moreover, Formal Concept Analysis (FCA) method was used in building the binary relations, which was used in the computational design of the Yorùbá artefact. The design was implemented and validated using an Ontology Web Language (OWL) tool called Protégé. The ontology model represents the documentation of the elicited knowledge of the YCH domain. Finally, the formal digital artefact resulting from the analysis and design of an ontology model or framework serves as a useful software artefact for formalising the concept of naming in Yorùbá culture. This research is very vital (indispensable) so as to preserve the rich culture of learning names, which can be extended to different societies and clans.

**KEYWORDS:** Yorùbá Culture, Yorùbá Naming Convention, Ontology, Formal Concept Analysis, Ontology Web Language (OWL), Knowledge management, Computation artefacts.

### 1. INTRODUCTION

The concept of naming is something thought or imagined. Naming is a general principle that determines how people of a particular culture behave. Naming is a concept that helps in signifying or identifying something, someone and tangible things whether it is living or non-living things.

Indeed, names are words or phrases by which somebody or something is known, identified or distinguished from people or thing. The word name is used in the identification of personality ([Dav17]). Name is in like manner a word or set of words by which someone or something is known, tended to, or alluded to. In other words, the phrase name is frequently used interchangeably with the word noun. This is because some semantic experts have examined the connection that exists between names and the naming word it refers to ([Zab68], [Leh92], [LS94]). Moreover, individual frequently use the term name for what can be all equivocally called noun within the general classification of names ([MB14]).

Naming is an important activity or process that cannot be overemphasized as it produces concerns and issues over the identification, belief system and ownership in that they are a major aspect of every culture. Names are important to the people as well as the society who receives and gives the name, hence, the concept of naming is dependent on culture from which it originates. Within the field of language, these issues are essential given the fact that languages and culture of African origin, particularly Yoruba language, which is at the verge of going into extinction and under the threat of being dominated by other languages ([Dav17], [Ala15]).

Nevertheless, a naming convention is described as an agreed pattern or scheme or order of identifying things. A naming convention is a system describing the identity of a person ([Dav17]). Naming is considered as one of the significant properties of all languages and culture (Feu). Moreover, there are numerous naming systems in existence with respect to culture and discipline, which are unique and different. Again, there has been no widely accepted naming system in the society as they differ in intent as well as from culture to culture, which may allow useful information to be realised from the names based on consistency.

## 1.1. CONCEPT OF DOMAIN NAMING IN YORÙBÁ CULTURE

Name is also a means of communicating the intent of the mind. ([AA97]) defined name as a term by which things are known and communicated. In the same manner, the name is a word by which individual creature is known, recognised and addressed. In addition, ([Mph06]) emphasised that name is the most significant lexical item (object of interest) in the list of words of any language and culture. Again, ([AA97]) submitted that the linguistic items listed in the language have and perform the primary role of communication.

Semiotic describes the concept of meanings, while the linguistic aspect shows the essence of identification as a primary function of language itself and the anthropology suggests the socio-cultural aspect of names. Indeed, the naming system or taxonomy is fundamental as it helps to provide additional information about the use to which a name is put, help in ensuring effective communication among a geographically distributed people and formalise the language in such a way that it can be shared and used. In semiotics, the name is a representation for something in one respect or capacity as it talks about somebody (Nboh, 1990). It also stands for an object in a way that the bearer and the name are connected through the cognitive process in mind as described by the semiotic triangle of a name.

Generally, Scholars have presented there are two (2) approaches to which the meaning of names can be described. [Hof93] observed that names have descriptive meanings, which help to distinctly distinguish an individual from another in a society. However, the anthropology viewed the concept of naming words assigned to reveal the identity of a child once he is born and assign a name. It also helps to know our ethnic preference, indicates social relationship as well as self-representation. According to [Ony18], a name is more than a tag or label with which an individual can be identified. Hence, the concept of naming is dependent on the culture from which it originates.

Therefore, naming is an aspect of culture, and every culture has its own peculiar naming system. A lot of works have also shown that every society has a distinct naming system, which has unique beliefs underlying the process of naming. Africa as a continent has a rich and unique name and naming tradition with unique stories behind the several names they bear, which differs from that of other continents ([MS12]). From the moment a child is born the name that is given usually shows a reflection of several circumstances surrounding the birth of the baby. Nevertheless, African cultures

have various methods of naming. This ranges from the naming system of the Akan people that is based on weekdays, the Egyptians, Bantus, Nguni, Zulus, Yoruba and others.

Nigeria being a multicultural and multilingual society has three (3) major ethnic groups ([Aze13]). Yorùbá is one of the major languages spoken in Nigeria, others being Hausa and Igbo. The naming system in Nigerian Yorùbá culture has a connotative meaning in that they are deeper than the literal meaning it portrays.

Naming is an indispensable aspect of Yorùbá culture, which is usually done with pops and pageantry especially to mark the arrival of something or somebody important ([Ade72]; [Eku77]; [Aki80]). However, there exist some differences though with similarities in the way names are given. In fact, literature has shown that the Yorùbá people give names to their children in accordance with their belief system and religious inclinations be it Christian, Islamic and traditional influences. Additionally, ([Iko13]) affirmed that "in Yorùbá culture and tradition, Ifa is regarded as the custodian of the wisdom of the peoples' way of life, history, custom and values.

Yorùbá culture has been constantly and continuously explored by several researchers in the area of explicit representation of its embedded knowledge and information contained and now its computational representation for over 150 years ([Ojo13]). Similarly, in *Yorùbá* land, names are given based on situation, circumstance and state of affairs of the land or environment. In some cases, a new name is considered to take care of the new and arising situation. However, the *Yorùbás* do not give names heedlessly, but they usually emanate from the thought, belief and feelings of the parents and relations who give the children such names. Consequently, the Yoruba names are more than identification tags and labels, as they represent an intrinsic part of human's experience. In other words, *Yorùbá* names reflect their world view, ethnic, history and etymology of the people. In addition, Yoruba names show the moral value of the people.

Studies on names and naming convention have been reported in the literature, particularly in the area of semiotics, language, computer language, database and anthropology. However, the study reported in this paper presents a computational representation of the *Yorùbá* naming system through the building of an ontology model for *Yorùbá* names. The purpose of the study is to analyse the *Yorùbá* names identified, design an ontology framework based on the name identified, develop and implement a computational model designed for the representation of name concepts for Yoruba naming system. Nevertheless, in the process of representing the concept and relations

embedded in Yorùbá names within the Yorùbá cultural domain an ontology approach is employed. Ontology is, therefore, described as a formal, explicit description of a shared concept in a domain of discourse. It is a formalised means of representing the concepts of names in a machine and understandable form with its concepts well accepted and clearly defined with a means of identifying the relevant concepts ([Gru93]).

## 2. RELATED WORKS

Over the past decades, there have been many initiatives taken by scholars and researchers in archaeology, sociology, anthropology, history, linguistics and other related fields and domain. Researchers have been studying the culture of the African people and how to preserve, safeguard and make the implicit knowledge and information contained in the domain explicit and formal disciplinary ([Ali06], [Doe09]). Today, researchers in the computer science and engineering field have been exploring the capabilities of semantic technologies in the analysis, organisation and representation of domains such as cultural heritage and information systems ([Isa11]).

([Isa11]). explored the application of semantic web ontologies to the archaeology domain for representing data. In the application, the technology was found to be useful to the collection of cultural knowledge in a bid that more information would be made available and accessible to the public.

([BG12]) addressed the need for an automatic method of data entry in a bid to overcome the manual entry of terms and axioms describing the data of interest in the domain. In an effort to reduce the manual effort put into the representation, the author proposed a data mining approach with the use of Formal Concept Analysis (FCA) and Relational Concept Analysis (RCA) for the analysis of the data item and design of ontology. The data mining approach with the FCA was employed for the efficient management of the objects of the domain. This work further reinforced the consideration of the method for the analysis and design of the name concept in Yoruba culture and traditions.

([Has14]) addressed the challenge of formal representation of formal and digital documentation of Yoruba cultural heritage. In an attempt to represent the knowledge contained in the Yoruba Cultural Heritage domain, the knowledge embedded were captured and organized within a set of concepts. Also, qualitative and quantitative methods were used for the analysis of the elicited knowledge. Moreover, FCA and RCA were used for the analysis and design of the ontology. In addition, the ontology design was then implemented using Protégé editor

and validated for accuracy and completeness with competency questions formalised as Descriptive logic (DL) using validation metrics such as precision, recall and F-measure. In addition ([EC07]) in their work presented a qualitative review of relevant Software editing Tools for Ontology development. The work informed the need for considering protégé as ontology web development tool editor.

Similarly, ([OOA13], [Omo16]) presented an ontology framework for knowledge embedded in African Traditional Medicine (ATM) and Yoruba Traditional Medicine. In an effort to formalise the vocabulary used in the ATM practices, the author designed and developed an ontology-based model with descriptive logic to formalise the knowledge contained in the ATM domain. The logic provides automated support for a structured and organised representation of terms and concepts in the ATM domain.

## 3. MATERIALS AND METHOD

Toward accomplishing the objectives of the research, on the ontology of Yoruba naming convention, data (object of interest) was collected verbatim from oral sources, particularly from language experts through a combined method of interview and interactive discussion as well as from documented materials such as textbooks, publications, digital archives and online databases. Various methods and techniques used to achieve the knowledge elicitation, data analysis and ontology design aspects of the work are described in detail. The data preparation, features extraction, and the ontology design in this research are well described. The conceptual view of the Yoruba naming system was designed using the Unified Modelling Language (UML) tool to provide a detailed description of the Yoruba naming system. The UML tool was used for describing the static, dynamic behaviour and the structural view of the naming system. The use case for the YNS shows the function and the environment of the system. The use case was used to present the specification required for the naming system as shown in Figure 1 and Figure 2 respectively. The figures show the interaction between the various actors (user and administrator), the functions and the system. It also describes the details about the association existing between the function and their internal or external actor. Moreover, the use case diagram is represented by an ellipse, connecting lines with an arrow showing the direction of the Use case for the content of the proposed system. The functions are login, authentication, search names, search Attribute and log out.

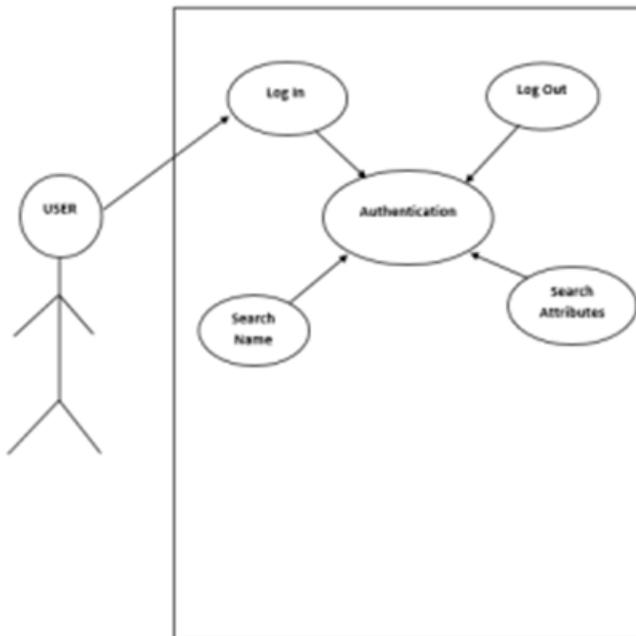


Figure 1: Use Case Diagram for Ontology User

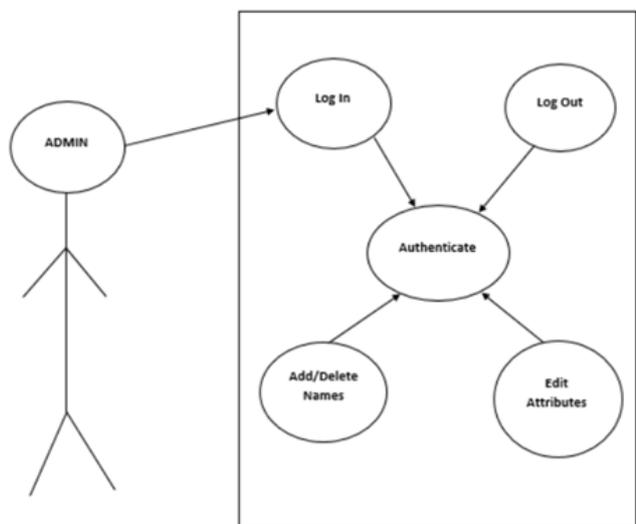


Figure 2: Use Case Diagram for Ontology Administrator

The sequence diagram for the Yoruba naming system shown in Figure 3 describes the various interaction between the objects or classes as they send a message to one another over time. The sequence diagram is used to describe how the use case as illustrated in Figure 1 will be implemented. The sequence diagram also portrays the actual objects and the interactions between the objects in a horizontal path and time sequence in a vertical direction. Here in Figure 3, the vertical dotted line represents the lifeline of the object and the horizontal arrow shows the interaction of message passed between objects.

Moreover, the messages represented by the horizontal arrow signify some message which may be actual parameters or operation names. Take, for instance, the narrowed elongated boxes on the object

lifelines depicts the activation of the objects when interactions are sequential. Each object module performs its tasks on the system. users and other stakeholders request information from the computing device simply by inserting a query term and the ontology will be searched. When a query is performed, the request is sent to the WAP gateway. The gateway then forwards the request to the HTTP server, which runs the scripts to provide the required information from the database to the user. The search is executed by string comparison between the query and annotated properties of all name concepts in the ontology. The gateway then converts the HTTP response received from the inference engine of the tool and returns the results to the browser as WML using the graphical user interface (GUI) of the OWL visualization component of the ontology editor.

In building an ontology model, it has been noted that there are no hard and fast rule or methodologies as observed from related literature, which was used in many related studies. In this paper, the method used for implementing the ontology for YNS is software engineering techniques. This methodology is divided into five (5) phases. These stages include the specification analysis, knowledge elicitation, modelling, formalisation and implementation. Each phase involved in building the ontology is subsequently used for the next until the final phase of the development process.

During the requirement specification phase, the needs in terms of the domain and scope of the ontology are defined. It also includes the usage and the reason for building the ontology. Here, the objects of interest in the naming domain are listed. Next, the knowledge elicitation phase involves the use of observation, interactive discussion and consultation method with the experts where a top-down approach was used for acquiring the information contained in the name data of interest. Once the analysis of the names is completed, the names which are the lexical terms of interest required for the development of an ontology model are created. The names as objects of interest are set as individual or objects that act as the basis for determining the classification in ontology development. Thereafter, a top-down approach was employed in classifying the name concept accordingly. This clearly identifies the class relating to the classification of objects of interest that has been listed.

At this stage, the data collected and the object of interest extracted were analysed using the method of Formal concept analysis (FCA). The FCA is a mathematical theory that is underlined by the concept of lattice structure which is derived from the binary relation existing in the name concepts,

otherwise called formal context. The FCA describes fundamentally the data structure which can be denoted by cross-table an interwoven open mesh frame made by crossing to form a pattern.

During the stages of building the ontology model for Yoruba naming system, an abstract representation of the real-life system (model) is constructed.

Formally, a formal context is defined as a three (3) tuple;

$$K := \langle G, M, I \rangle$$

Where;

G::= a set of objects i.e. Yoruba Name;

M::= a set of unary attributes of the names; and

I::= a binary relation defined on the Cartesian Product  $G \times M = I$ . i.e. the relation between the names

The representation of the formal context in the form of a cross table contains the left column and row. The column represents the set of objects of interest G, the upper row represents the set of attribute M and the cross-cell values represent the relationship I forming a bipartite graph ( $I \subseteq G \times M$ ). In the theory of lattice, each node represents a formal concept, and the ascending path of line segments represents the subconcept-super concept ( $\subseteq$ ) relationship. Therefore, the FCA form a concept lattice from a binary table *Objects X Attributes* where a maximum set of objects share at the best possible set of attributes as illustrated in Table 1. The table defines the properties and characterises the class of the name domain by its attributes.

Similarly, Table 2 shows the relations and inverse relations among some identified concepts in Yoruba Naming convention.

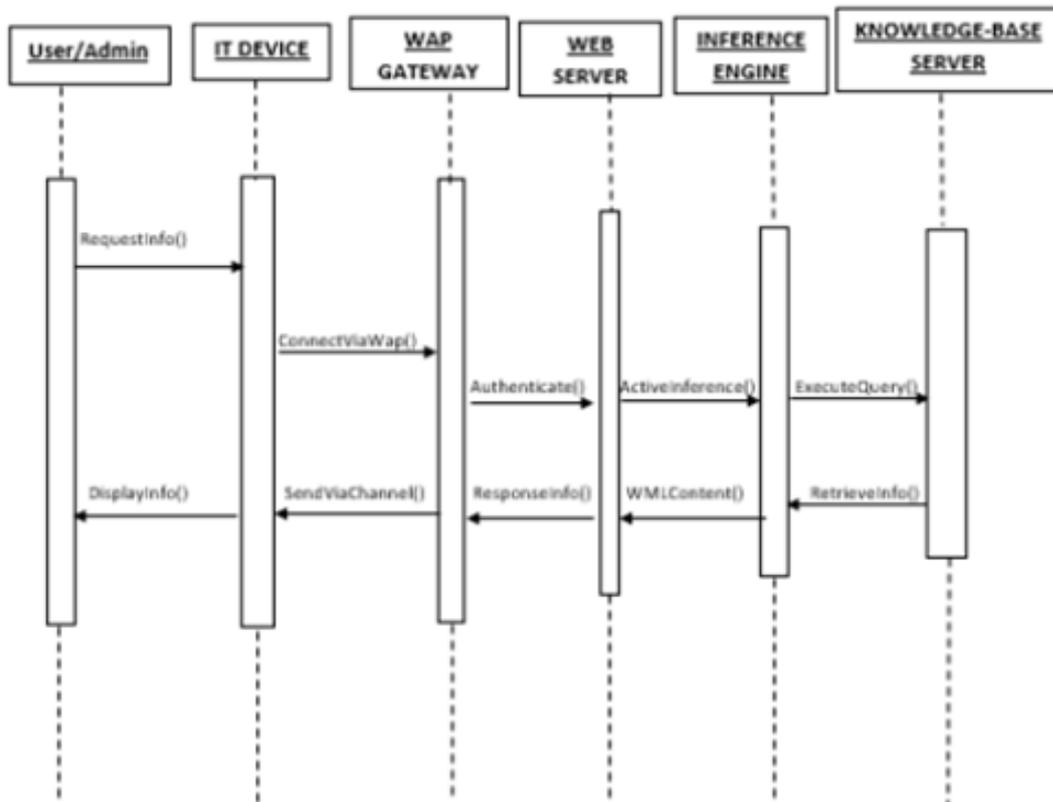


Figure 3: Sequence Diagram for the Yoruba Naming System

Table 1: Binary Relations Table

Relation Name	Source Concept	Target Concept
sexType	Name	Sex
believesIn	Name	Religious Belief
isDerivedFrom	Name	Natural Names

**Table 2: Relational Context for the Binary Relation, *isDerivedFrom*, in Yoruba Naming Convention Domain**

isDerivedFrom	Sangobiyi	Olayinka	Osuntola	Adetola	Ogunbiyi	Shobowale	Eegunyinmi
Ola		X	X	X			
Ade				X			
Eegun							X
Osho						X	
Sango	X						
Ogun					X		
Osun			X				

#### 4. SYSTEM IMPLEMENTATION AND RESULTS

The ontology for Yoruba naming convention was implemented using protégé editor. The Protégé is an Ontology Web Language 1 (OWL), which is an open source software tool and a knowledge management system that has the capacity to allow users easy access to edit, use and reuse the objects. The implementation of the Yoruba naming convention is described in details as follows.

##### Ontology Classes and Class Hierarchy

In ontology, a class is a term that is commonly used to denote a set of objects or collection of items of interest in the chosen domain. These objects of interest (class) are represented in a hierarchical tree form showing the various classes of the object of interest in the naming domain view as shown in Figure 4. Each class has its sub-class and super-class relations and relationship called roles, object and properties.

Figure 4 represents the sets of Yoruba Names and its subjects. The class name hierarchy starts with Names and extends into classes of names and extends into individual entities or sub-class under the class of names. These set of similar objects (classes) are arranged in a hierarchical way, that is, with subclass and superclass relations. This information obtained from the message communicated is then used by the reasoning engine for classification tasks. The classes in the Yoruba naming convention are Job, town and name.

##### Jobs

Job is a sub-class under the concept thing. The class provides a wide range of jobs engaged and practised by the kinds of jobs practised by the Yoruba people. This kind of jobs includes Farming, Hunting, metal works, trading, batik (adire) making, carpentry and many others. The kind of name given to a child born into such a family is premised on the job that is being practised by the family. Examples of names are Odetunji and so on. The kind of job being practised by a family sometimes determines the name given to the child born to such families.

##### Town

This is also a sub-class under thing. This class describes the names that depict the Town a child's ancestry comes from.

##### Name

Name is a sub-class of thing. The class contains the sub-classes of names such as Origin, Natural, Eulogy, Abiku, FamilyProfession, Honour, Royalty, Reincarnation, PredestinedNames, FamilySituation and ReligiousBelief. Origin It is a subclass under names. This class hold the information about a name relating to the town the name originated from. In Ile-Ife some of their surnames start with the prefix "Elu" which is peculiar to their local dialect. Examples of such names include Elujoba, Eludire, Elufowoju, Eludiora and many more to mention a few.

##### Honour

It is a subclass under names. This class holds information about names that show great respect, quality of persons with respect to labour and honesty. It is a name that bonds an individual to the society as quality of person with respect to labour and honesty it is a name designated for people who have the attributes of honour, wealth and chieftaincy title. Examples of such names include "Balogun" which means a general of war and is commonly attributed to the head of a military.

##### Natural

Natural is a sub-class under names. This class holds names that are names that occur naturally in the Yoruba language. An example includes "Akin" which means brave in the Yoruba language.

##### Royalty

Royalty is another sub-class under names. This class holds name with attributes of royalty. Example include names with prefix "Oye", "Ade", "Oba" and so on. some of the names include Oyebamiji, Adewale.

##### Abiku

Abiku is a subclass under names. This is at the name or words used in the identification of people or children whose family has records of infant deaths. Example of such names includes Malomo, Kokumo, Durojaiye, Yemiitan, Durosawo and so on.

##### Eulogy

Eulogy, otherwise known as cognomen or praise names is also a subclass under names. This class of

names are the names that are chanted in order to sing praises of the individual that holds the names irrespective of their gender. The names are used to praise and appeal a child's emotions. Example of pet names is "Abeke", "Adufe", "Alake", "Alao", "Akanji", "Akangbe", "Ishola" and so on.

#### **Family Profession**

This is a class that depicts the name of the ancestral family profession such as Hunting which means "Ode" in Yoruba. Most times, the family profession name has a prefix of "Ode" to their names. Example of such names includes "Odebode", "Odetoyin", "Odelay", "Odejobi" and so on.

#### **Reincarnation**

It is another sub-class under names class. The class name describes children that are born after the death of an elder or relative. Such children usually have attributes similar to that of the deceased relative. Example of such names are "Babatunde", "Yetunde" and so on.

#### **Religious Belief**

It is a sub-class under names. The class name gives the attributes of a child's family in terms of the Religious inclination's belief. The religion practiced by the child's family automatically reveals and reflects in the name given to the child. An example could be found among the Ogun worshippers' clan where Ogun is revered. They bear names like "Ogungbile", "Ogunronke", "Ogundeji", "Ogunlola", "Ogunseyitan" and so on.

#### **Predestined Names**

This is another subclass under the class Names. The class of predestined name, otherwise known as *Oruko amutorunwa* in Yoruba land. The name often explains the situation surrounding the birth of a child. Such scenarios include if the child is a set of twins called "Ibeji" in Yoruba land. Such children inevitably take on the names "Taiwo" and "Kehinde". "Taiwo" describes the first of the twin to be delivered while "Kehinde" is given to the second child of the set.

#### **Family Situation**

This is another subclass of the entity class name that describes the name given to a child based on the current situation and circumstance around the family. During the period which the family is whether pain, sorrow and distress, a child named "Remilekun" describes a period or time of comfort.

The protégé tool used for the implementation has components, which include the class component, object property, data property and visualization components, where different relationships such as sub-class, individual object in the naming domain and those related to other objects and to data values shown through their properties. Figure 5 shows the object property of the Yoruba naming system. The object property is one of the primary navigation component devices in Protégé, which is presented as a tree where tree nodes correspond to object properties. The child node of the class name represents an object property that is a sub-property of the property represented by the parent node. The object property of the Yoruba naming ontology system depicts the asserted characteristics of the Yoruba names object in a hierarchy view of the Protégé tool.

Figure 6 also shows the result of the visualisation of the Yoruba naming convention using the OntoGraf component of the protégé tool. The OntoGraf provides support for navigating the ontology system in an interactively way. Here, various layouts are supported for automatically organizing the structure of your ontology. Different relationships are supported: subclass, individual, domain/range object properties, and equivalence. Relationships and node types can be filtered to help you create the view you desire.

Figure 7 shows the Data Property Window view of the Yoruba naming convention. The figure provides the hierarchical view of the primary navigation devices in Protégé as a tree where tree nodes correspond to data properties.

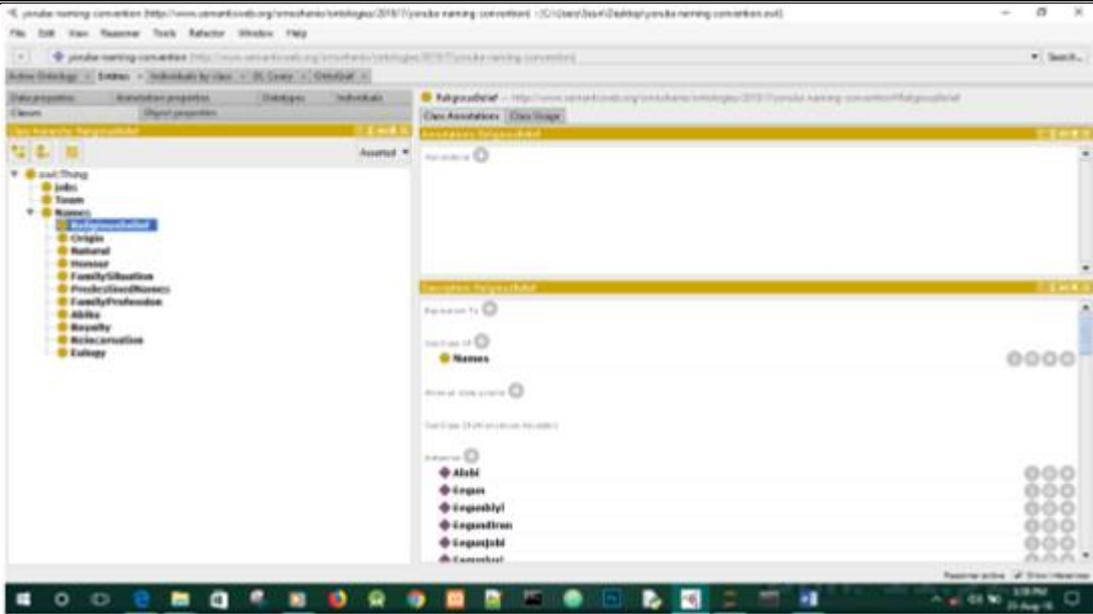


Figure 4: Screenshot of Individual Classes and Sub-Classes view of the Yoruba Naming Convention

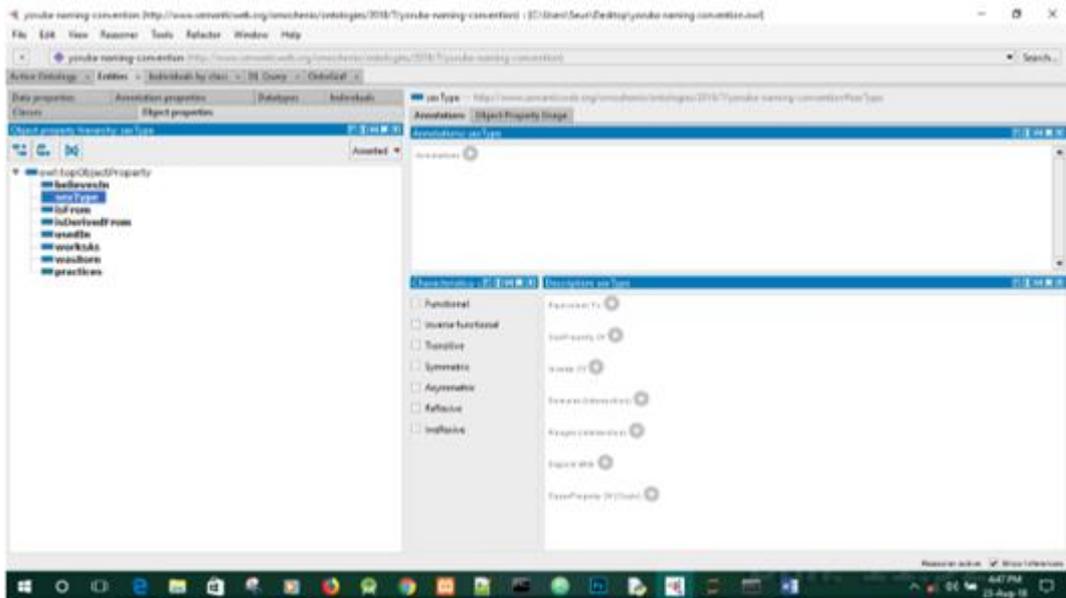


Figure 5: Screenshot of Object Property window of Yoruba Naming Convention using Protégé

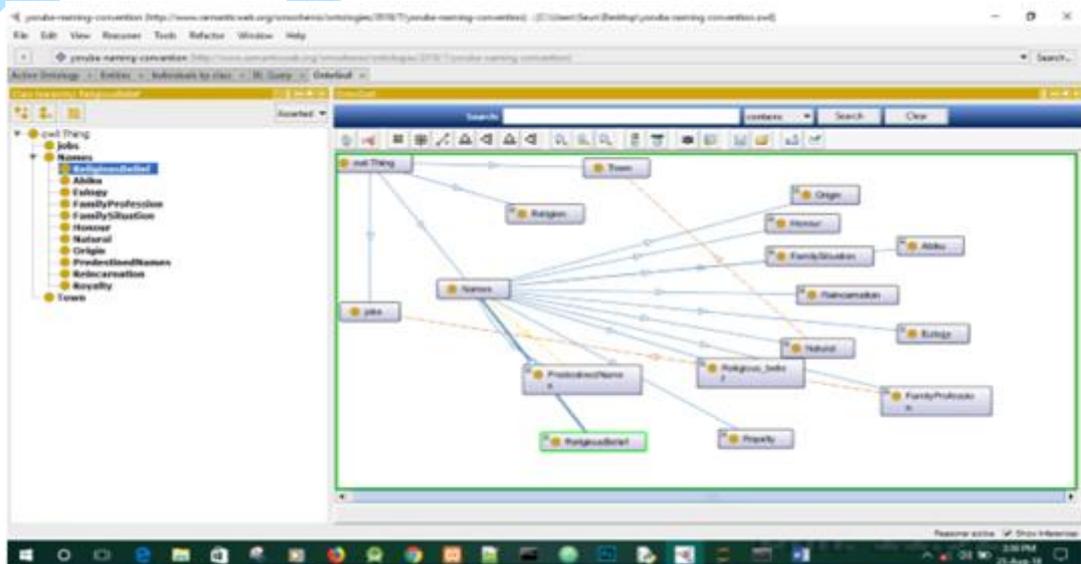


Figure 6: OntoGraf Visualization of Yoruba Naming Convention

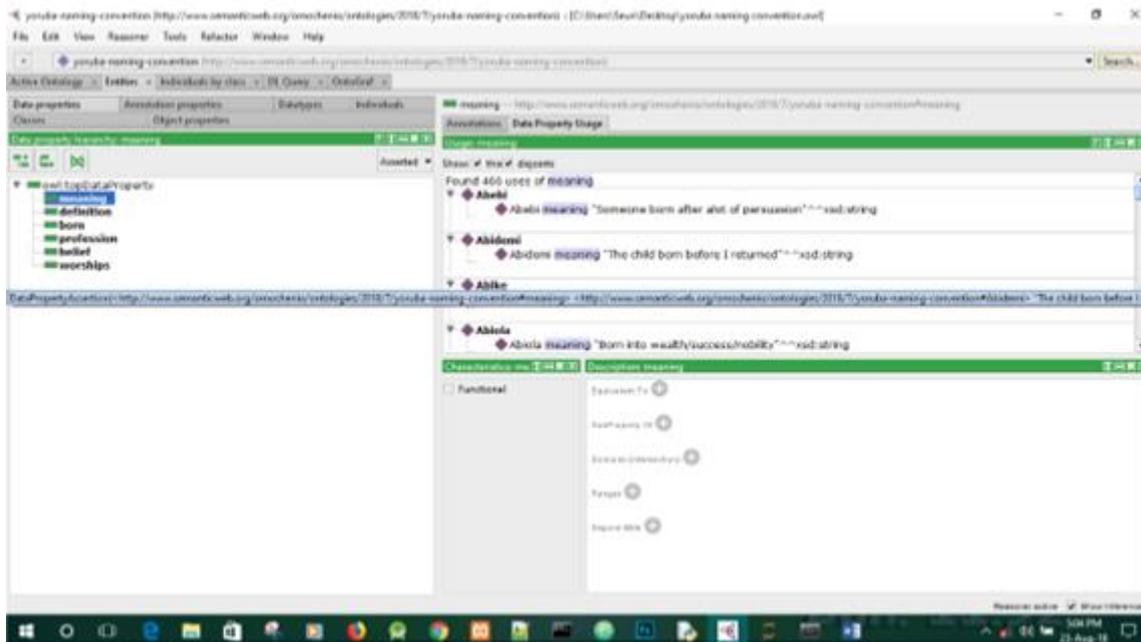


Figure 7: Data Property Window in Protégé

## 5. CONCLUSION

In this research, we have carried out a study on the identification and analysis of Yorùbá names. In the same vein, we have presented an ontology design model and implemented the Yorùbá naming system. The ontology design includes the phases of building the system from requirement specification to implementation and the review of related works. With the proposed ontology, the aim was to facilitate the Yorùbá cultural experts to manage the knowledge embedded and elicited from Yoruba cultural heritage. Similarly, we aimed at sharing and integrating this knowledge with other ontologies. As future works, the study continues the implementation as well as the validation process of the proposed ontology framework, which will involve domain and ontology experts.

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