

## Semantic Judge Assistant (SJA): An Ontology-Based Case Classifier for Nigeria Judicial System

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### Abstract

#### Keywords:

Cases, classifier, ontology, court, accuracy, timeliness, case classification, semantic

*Cases are filed and classified based on type and nature of cases under different jurisdiction of a court. This is because different orders and rules are prescribed and laid down for different types of cases in the court. The classification is essential in order to ensure orderliness, accuracy and in deciding the procedure to be followed as well as setting up the bench for the same. Accuracy and timeliness is highly needed in classification of case. The aim of this study is to design a Semantic Judge Assistant (SJA) that aids technical classification and judgment of seemingly similar cases using an ontological approach. In enhancing and advancing the accuracy of case classification in a judicial system, the need for approach rich in semantic analysis cannot be overemphasized. Ontology will be of great use since it represents the semantic relationship of terms. In addition, to build on the concept of judicial precedent and the principle of stare decisis, cases need to be classified to enable fast tracking and comparison of seemingly similar cases. To ensure successful implementation of the work, adequate information was gathered from our learned friends and protégé software was used for the visualization and building of the system.*

Accepted: 27 June 2019

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### INTRODUCTION

The Nigeria judiciary is the arm of government that administers justice in accordance to the constitution. The term is used to refer generally to the courts, the judges, magistrates, adjudicators and other supporting personnel who run the system. The role of the judiciary cannot be over emphasized as it is a stabilizer in the political system and has the extra duty of the protection of the constitution ensuring that the Executive and Legislative arms of government do not function outside their powers but should be within their constitutional provisions and right.

The Judicial System in Nigeria is a key aspect of our democratic way of life. It upholds peace, order and good government. Citizens look to the judiciary to uphold their rights and governments

look to the courts to interpret laws. It is seen to be the most respected of the other two arms of government as it protects the constitution of the Federal Republic of Nigeria, as well as, the fundamental rights of the Nigerian citizenry. The judiciary administers justice in accordance to the law, that is, they are saddled with the responsibility to handle cases. These cases are handled based on court hierarchy in each state and territory. By virtue of section 6(1) and (5) of the 1999 Constitution, the following courts are established in the Federal Republic of Nigeria according to their hierarchy, Supreme Court being the highest court of the land, Court of Appeal, Federal High Court, The High Court of the Federal Capital Territory, State High Court, the Sharia Court of Appeal Federal Capital Territory, the Sharia Court of Appeal of states, the Customary Court of Appeal of the Federal Capital

Territory, the Customary Court of Appeal of States and the Magistrate Court (District court).

In Nigerian legal system based on common law, Justice do not just administer to cases brought before them, but would check if the case has been previously determined and if it was, the present court will consider the jurisdiction of the court that gave the earlier decision and thereafter follow or reject it depending on the hierarchy of the court that decided the earlier case. This work designed an Ontology-Based Case Classifier which helps to classify case in the Nigeria Judicial System with a view in assisting the judges in their jurisdiction and also to eradicate some of the challenges faced by the judiciary.

Rudi et al., (1998) defines ontology as “a formal, explicit specification of a shared conceptualization”.

Ontologies have been used and applied in different areas. They are well known and mostly used in information and knowledge based systems which include; knowledge acquisition e.g. Protégé developed by Noy *et al.*, (2001), knowledge sharing, knowledge Re-use, verification and validation, domain theory development.

The semantic richness of ontology and the ability to reduce or eliminate the conceptual and terminological confusion among the members of a virtual community of who need to share electronic documents and information of various kind as stated by (Roberto and Paola, 2004) makes it suitable to be used as a classifier. Some application has been developed using ontology which include: email filtering, electronic news classification and classification of electronic documents in a library. Documents may be difficult to understand due to the use of ambiguous terms used. However, since ontology represents the semantic relationship of the terms, they can be used to correctly identify the subject of the document. Hence ontology is used to ensure the accuracy in classification. This study will enhance the classification of cases in the Nigeria judicial system. Legal case in the general is a dispute between opposing parties resolved by a court, or by some equivalent legal process. Legal case can either be civil or criminal in which exists an accuser and one or more defendants.

Cases (civil or criminal) are filed and classified based on type and nature of case under different jurisdiction of a court, reason being that cases are not proceeded the same way. This is because different orders and rules are prescribed and laid down for different types of case in the Court. The classification is essential in order to ensure orderliness, accuracy and in deciding the procedure to be followed as well as setting up the bench for the same.

Several works have been done on ontology in the legal domain and are mostly in some advanced countries with a view to expediting their justice

delivery system. Only one work exists for the Nigerian judicial system which is proposed by Ekuobase and Ebietomere (2013). The research geared towards expediting the Nigerian justice delivery system and therefore builds ontology for the Nigerian case laws that will guarantee or ensure high relevance of case laws retrieved with the intention to meet up with the developing countries. This study therefore proposes another scheme, ontology-based case classifier to classify cases so as to speed up jurisdiction and thereby enhance the Nigeria judicial system.

## LITERATURE REVIEW

In recent years, the conception about ontologies has become increasingly important in the design and development of knowledge based and expert systems, Legal domain is not an exception. A number of ontologies specifically for the legal domain have been developed and have increasingly formed part of systems development. From the literature reviewed, we present some previous research effort on the domain of law and legal practice.

Visser and Bench-capon (1998) discussed four conceptualizations of legal domain referred to as ontologies, presented criteria for a comparison of the ontologies and discussed the strengths and weaknesses of the ontologies in relation to those criteria. Bruninghaus and Ashley (2005) presented a paper that present methods for automatically finding abstract, legally relevant concepts in case texts and demonstrate how they can be used to make predictions of case outcomes, given the texts as inputs. Ortiz-Rodriguez and Villazón-Terrazas (2006) proposed *EGO Ontology Model: law and regulation approach for E-Government*. The aim of the author's work is to manage in different ways the legal knowledge to improve the systems applications. Hoekstra *et al.*, (2007) researched on LKIF Core Ontology of Basic Legal Concepts. A legal core ontology that is part of a generic architecture for legal knowledge systems was described, which will enable the interchange of knowledge between existing legal knowledge systems. Adam and Rinke (2010) discussed Legal Case OWL Ontology with an Instantiation of a legal case Popov v. Hayashi. The ontology makes explicit the conceptual knowledge of the legal case domain, supports reasoning about the domain, and annotates the text of cases, which in turn can be used to populate the ontology. Alexandra *et al* (2013) designed OntoLaw – Ontology Based Legal Management and Information Retrieval System. The article presents an ontological approach for the Romanian legal documents and concepts which was structured in two main components: a legal ontology called OntoLaw and an ontology management and information retrieval system, called OntoLawApp. Ekuobase and Ebietomere

(2013) proposed Ontology for Nigerian Case Laws (ONCL). With the use of electronic storage for storing of case laws, there is provision of unlimited storage space, electronic information is presently syntactically organized, accessed and retrieved. The problem with this scheme is that most of the search results are irrelevant and so much man hour is still required to get the relevant case laws (documents) because it only addresses the problem of space and not the primary problem of inefficient access and retrieval of relevant case law. To eliminate this issue, they proposed a scheme, Ontology for Nigerian Case Laws though electronic that will guarantee or ensure high relevance of case laws retrieved. Marcello (2013) researched on Interpreting Judgments Using Knowledge Representation Methods and Computational Models of Argument, which was aimed at formalizing legal concepts and argumentation patterns contained in a judgment, with the following requirement: to check, validate and reuse the discourse of a judge and the argumentation he produces as expressed by the judicial text. Marcello and Aldo (2014) covers part of the research work of Marcello (2013) whose aim is to define a Semantic Web framework for precedent modeling. The article of Marcello and Aldo (2014) aims to apply legal theories to a set of real legal documents, possibly defining OWL axioms in a Judicial Ontology Library (JudO) that provides a semantically expressive representation, and a solid ground for a (future) argumentation system that applies a defeasible subset of predicate logics. These works focused on case storage and case retrieval. As part of the essential elements of jurisdiction stated in the court of Onyenucheya v. Military Administrator, Imo state, that a court must have cognizance of the class to which the one to be adjudicated belong to, this work however, design an Ontology-based Case classifier that aids technical classification and judgment of seemingly similar cases using an ontological approach.

## METHODOLOGY

To build a new ontology, either from scratch or reusing ontology, it should be built based on the present needs of it (Pinto and Martins 2001). In building this ontology, Noy and McGuinness' methodology shall be adopted in the pursuit of a successful implementation of this work, the following procedure shall be followed:

1) **Information Acquisition:** Legal case knowledge acquisition is an important aspect in this work as the correctness of the results of the system relies mainly on the correctness, accuracy and completeness of the knowledge base and on the reasoning process that will infer the procedure to be followed on a case. In this phase, information shall be collected such

as categories of jurisdiction, type of cases and relevant orders of the Supreme Court rules.

- 2) **Construction of domain ontology:** the domain ontology was developed following the Noy and McGuinness (2001) stages of ontology development which include:
  - i) Determining the domain and the purpose
  - ii) Considering the reuse of existing ontologies;
  - iii) Identifying the main concepts
  - iv) Defining the classes and their hierarchy
  - v) Defining properties;
  - vi) Defining the main properties;
  - vii) Creating instances
- 3) **Prototype Development:** A Web-based information system was designed to manage and query the legal ontology.
- 4) **Evaluation:** In this phase the efficiency of the classification by the developed system was assessed.

## DESIGN

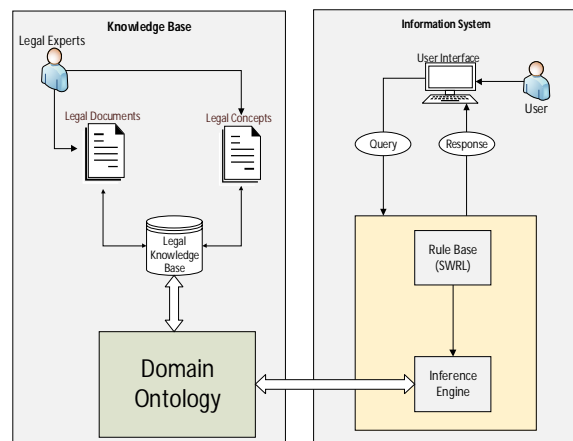


Figure 1: Architectural model for the study

### Detailed analysis of the Model

The model consists of the following major components:

- i. Knowledge Base
- ii. Information system

### Knowledge Base

The knowledge base is made up of the legal concepts, the legal documents and the domain ontology.

- i. **Legal documents and Legal concepts:** are collated from legal experts in the legal domain which forms the legal knowledge base. They are legal term of art that is used for any formally executed written

document that can be formally attributed to its author, records and formally expresses a legally enforceable act, process, or contractual duty, obligation, or right, and therefore evidences that act, process, or agreement.

- ii. **Legal Knowledge Base:** The legal concept together with the legal documents acts as the legal knowledge base. It serves as a database where all the concepts are stored for the ontology either by the legal experts or the ontology developer.

- iii. **Domain ontology:** It contains relevant concept related to legal cases concepts, case types, jurisdiction, court concepts etc. The ontology represents these legal concepts in hierarchies of categories. It also represents the relationships among the concepts and the descriptions of the concepts so that they can be organized and efficiently accessed. The ontology is created using protégé, an ontology editor.

### Information System

The proper integration of the ontology with the information system furnishes the goal of obtaining an ontology based case classification system.

- i. **User Interface (UI):** this is a web application that the user will interact with when a query is to be done.

- ii. **Rule Base:** This include Semantic Web Rule Language (SWRL) which are used to assert classification from the knowledge base created using protégé editor. SWRL was developed to be the rule language of the semantic web. SWRL allows users to write rules that can be expressed on terms of Ontology Web Language (OWL) concept and that can reason about OWL individuals. The SWRL are created from valid relationship between ontology concepts. The rules are used to infer new knowledge from already existing ontology knowledge and legal concept.

In writing semantic rules, we start with the concept in which the property belongs, and then chains the concept to other facts in a step-by-step manner until the objective is achieved. Each step is expressed as an atom and the rule is expressed in the form of “(atom<sub>1</sub> ^...^ atom<sub>n</sub>) → consequence” to express the cause-effect relationship (Lezcano et al, 2011).

The classifying rules are specialized for each types of legal case as it is stated in the 1999 constitution of the Federal Republic of Nigeria and the Criminal Code Act. This study focus on classification for punishment purpose and will therefore infer judgment after being classified. For example, to assert and convicts a party of an Assault, the following rule is formulated in SWRL format:

```

IF      respondent strikes
OR      respondent touches
OR      respondent moves
OR      respondent applies force
on another person directly or
indirectly without      his
consent or with his consent
IF      consent is obtained by
fraud
OR      by any bodily act
attempts or threatens to apply
force of any kind to the another
person without his consent
THEN   is type of case: Assault
AND    recommended judgment:
Imprisonment
    
```

This rule is codified in predicate logic as shown in the following rule. L, C, R, Cs, A are variables where L, C,  $\forall R$  is universally quantified, Cs and A are existentially quantified. This rule example concludes on "classification of case as an Assault" based on the Criminal code act.

```

□ L, ∃C, R, Cs, Ac
LegalCase(L), hasConsentValue(Cs),
hasActionValue(Ac), Respondent(R),
Complainant(C)
SummonToCourt (C, R)
A hasConsentValue (R, "Fraud")
A hasActionValue (R, "moves,
strike, touches, force")
→ Assault (R, C)
A isTypeOfCase (L, "Assault")
A recommendedJudgement (R,
"Imprisonment")
    
```

The above rule codified in predicate logic is easily converted to SWRL based on the Syntax:

```

LegalCase (?L), Complainant (?C),
Respondent (?R)

SummonToCourt (?C, ?R)

A hasConsentValue (?R, "Fraud")
A hasActionValue (?R, "moves, strike,
touches, force")
    
```

→ Assault (?R, ?C)  
 A isTypeOfCase (?L, "Assault")  
 A recommendedJudgement (?R,  
 "Imprisonment")

iii.

**Inference Engine:** inference engine serves as the reasoning component which uses the knowledge base (legal concept, legal knowledge base and domain ontology), and the SWRL rules in the rule base to classify a specific case. The rule base include all the rules used to classify case from the knowledge base acquired from legal experts.

For example:

```
[IF]
    ?class1 rdfs:subClassOf ?class2
    AND
    ?instance rdf:type ?class1
[THEN]
    ?instance rdf:type ?class2
[IF]
    ?class2 rdfs:subClassOf ?class1
    AND
    ?class3 rdfs:subClassOf ?class2
[THEN]
    ?class3 rdf:type ?class1
```

### Building the Ontology

We build on our experience using Protégé-2000 as ontology-editing environments. Noy and McGuinness methodology shall be followed in the course of this work. The methodology is explicitly iterative and it has an integrating part early. In the building phase they give a lot of guidelines e.g. whether to introduce a new class or not, that the siblings in the class hierarchy should have the same level of generality, and so on. This is a really important part, which could contribute a lot if used in our application cases. Noy and McGuinness (2001) are also the only ones that discuss naming conventions and why this is important amongst other methodologies.

### Determine the domain and scope of the ontology

It is very essential to start the development of an ontology by defining its domain and scope. That, answer several basic questions:

- i. What is the domain that the ontology will cover?
- ii. For what we are going to use the ontology?
- iii. For what types of questions the information in the ontology should provide answers?
- iv. Who will use and maintain the ontology?

The answers to these questions may change during the ontology-design process, but at any given time they help limit the scope of the model. Consider the Semantic Judge Assistant Representation of legal cases and Judges is the domain of the ontology.

### Consider reusing existing ontologies

In this phase we consider what someone else has done and checking if we can refine and extend existing sources for our particular domain and task. Reusing existing ontologies may be a requirement if our system needs to interact with other applications that have already committed to particular ontologies or controlled vocabularies. Many ontologies are already available in electronic form and can be imported into an ontology-development environment that you are using. The formalism in which an ontology is expressed often does not matter, since many knowledge-representation systems can import and export ontologies. Even if a knowledge-representation system cannot work directly with a particular formalism, the task of translating an ontology from one formalism to another is usually not a difficult one.

### Enumerate important terms in the ontology

It is useful to write down a list of all terms we would like either to make statements about or to explain to a user. What are the terms we would like to talk about? What properties do those terms have? What would we like to say about those terms? For example, important legal-related terms. Initially, it is important to get a comprehensive list of terms without worrying about overlap between concepts they represent, relations among the terms, or any properties that the concepts may have, or whether the concepts are classes or slots.

### Define the classes and the class hierarchy

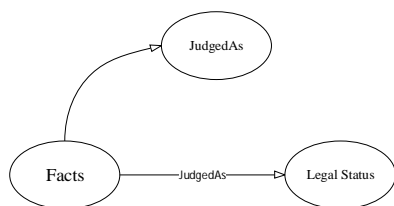
There are many approaches for developing a class hierarchy; we name a three of them. The first is top-down approach, which starts with creating definition of the most general concepts and then their specializations (creating subclasses); the process is recursive for every class until we reach the most specific definitions. The second is the bottom-up approach, which goes the other way first we define the most specific concepts and then group them into more general concepts by creating common super class for them. Combination of both when we start with few general (or 'top level') concepts and few specific (or 'bottom-level') concepts and fill the middle levels consequently. This step starts by defining classes which are selected in earlier stages as mentioned in the above procedure. We used a bottom-up approach to develop the class hierarchy in the ontology, through representing the core concepts (main classes) and subclasses as classes in the ontology.



**Figure2:** SJA ontology super classes in Protégé

**Define the properties of classes—slots**

Defining object properties (relations) among classes is a requirement to come up with the ontology. Classes alone will not provide enough information. Creating object properties plays important role in connecting classes (concepts) of the ontology. There is a close relation between the properties of classes and relationships between classes. For example, the property of the class Facts is Judged As. It is also a relation from the class of Facts to the class of Legal Status as shown below.



**Figure3:** Classes and object properties

**Table 1:** This table contains object properties with the domain and range

No	Object Property	Domain	Range
1	ActIn	CaseDeciders	Court
2	BoundedTo	Court, Parties, CaseDeciders	LegalPrinciple
3	MakesJudgement	CaseDecider	LegalCase
4	HasAppellateJurisdictionOver	Court	Court
5	HasOriginalJurisdictionOver	Court	LegalCaseType
6	HasComplainant	Defendant, LegalCase	Prosecution, Plaintiff
7	HasRespondent	Plaintiff, Prosecution,	Defendant

		LegalCase	
8	IsInJurisdictionOf	LegalCaseType	Court
9	IsTypeOfCase	LegalCase	LegalCase Type
10	SummonToCourt	Plaintiff, Prosecution	Defendant

**Table 2:** This table contains Data properties with the domain and range

No	Data Property	Domain	Range
1	NameOfCase	LegalCase	xsd:int
2	ArguedDate	ArguedDate	xsd:dateTimeStamp
3	DecidedDate	DecidedDate	xsd:dateTimeStamp
4	PublishedDate	PublishedDate	xsd:dateTimeStamp
5	Complainant	LegalCase	xsd:string
6	Respondent	LegalCase	xsd:string
7	JudgementTaken	Judgement, CaseLaw	xsd:string
8	CourtNumber	Court, LegalCase	xsd:int
9	NameOfCaseDecider	CaseDeciders, LegalCase	xsd:int
10	SuitNumber	LegalCase	xsd:int

**Define Facets of the Slots**

Slots have different facets that describe the value type, allowed values, the number of the values cardinalities, and other features of the values the slot can take. A value-type facet describes what types of values can fill in the slot. There exist many value types in developing ontology which includes: string, Boolean, number, enumerated and instance.

**Creating Instances**

The last step is creating individual instances of classes in the hierarchy. Defining an individual instance of a class requires (1) choosing a class, (2) creating an individual instance of that class, and (3) filling in the slot values.

## IMPLEMENTATION

The ontology is first design using protégé and OWL 2 which serve as the knowledge base of the system. The ontology provides classes as the

various concepts in the domain, relationships among these concepts, and properties as the attributes possess by the concepts

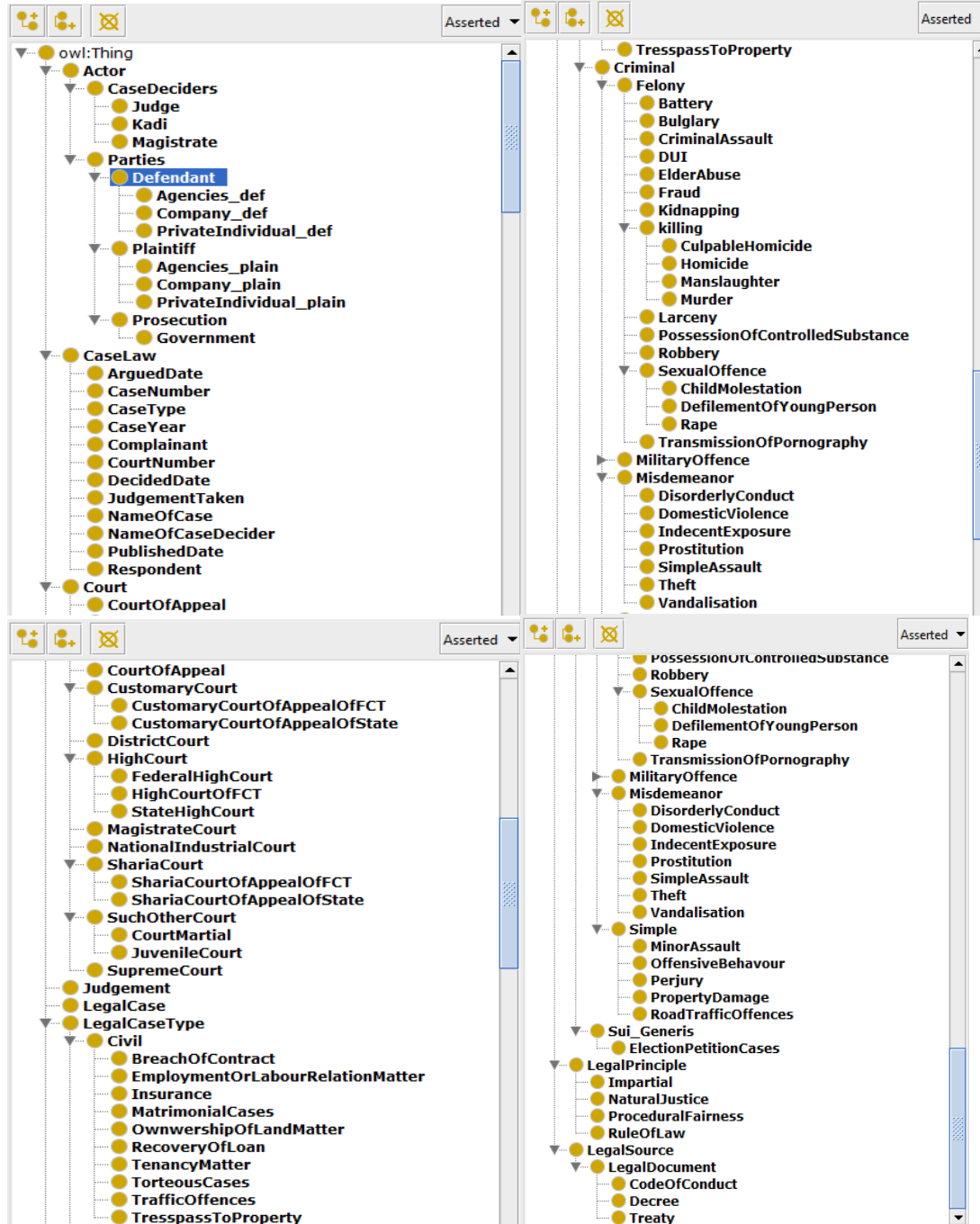


Figure 4: SJA ontology class hierarchy

**Web-based information system:** This is designed to manage and query the SJA ontology.

**Login Page:** Before the user can have access to the system, the login credentials must be supplied after he/she must have been given a user id and role by the admin or power user.

## SUMMARY

This research work considered the classification of cases using ontological approach which has proved to be very rich in semantics and with the use of SWRL rules, more annotations are generated. According to findings, cases are filed and classified based on type and nature of cases under different jurisdiction of a court. Case classification is a very vital and sensitive aspect in the Judicial System of any Nation because it deals with life rights of the citizens. Most of these legal rights and processes are documents and might contain ambiguous terms which could be difficult to understand, yet, orderliness, accuracy and timeliness has to be maintained. This work thereby tends to eliminate this difficulty.

## CONCLUSION

Based on findings from this work it was revealed that injustice could be done to cases, justice could be delayed due to some unknown reasons and cases maybe misjudged due to ambiguity. Hence to assist the Judge or any other case deciders, SJA ontology was developed. In building the ontology, (Noy and McGuinness, 2001) methodology was adopted. It was built using protégé 5.2 and OWL 2 using the SWRL rule to generate new axioms that the OWL 2 tool cannot expressed. It is therefore hoped that with this system in place the injustice and delay in justice will be reduced and Justice delivery system in the nation will be expedited.

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