Computable Law and Electoral Act: Concepts and Model of an Expert Assistant

C. P. E. Agbachi

Department of Mathematical Sciences, Kogi State University
Anyigba, Kogi State, Nigeria

Abstract *— Inmany a developing country, such as Nigeria, disputes arising from election process can be fraught and common. The lingering nature, controversy all impact adversely on the nation's body politics. It is evident, the overwhelming number of court cases in the judicial system. Inherent in this situation are long delays and attendant ill effects. With trend in the upward, and no sign of abating, it would be welcome indeed any contributions towards accelerated judgement of court cases in our system. Thus, this paper discusses the concepts of Artificial Intelligence, in application to automated Legal Assistant, as it pertains to the Electoral Act of Nigeria.*

Keywords*—Jurisprudence, Expert System,Knowledge Engineering, Legal Reasoning, Hybrid-Base.*

I. INTRODUCTION

Computable law emanates from the study of Law and Computing, discussions in many forums [1, 2]. It isan ongoing investigation into the process of law and how models can be constructed so that same process can be assigned to a machine. They have been varying degrees of success across organisations over the decades, as well as issues of acceptability.Yet, it remains well received within the context of an Expert System as a legal assistant.

A. Expert System

Expert System is a relatively new and modern concept evolving from main stream application of Artificial Intelligence. By thismodel, a machine can achieve the Turing Test [3] when the scope is confined to a narrow domain of specificity. Over the decades, there have been many Expert Systems and Assistants, with results as good as human expertise and thus, one reasonto adopt use in the field of law.

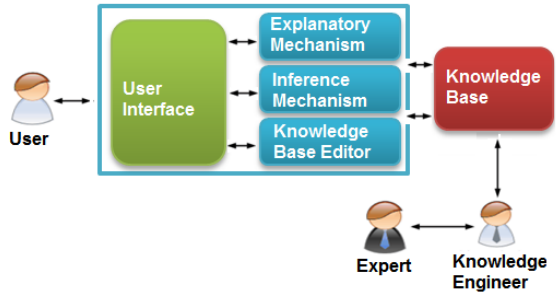

Fig. 1

An Expert System includes key components, Knowledge Base, Inference Engine and Work Base, comprising of facts and databases, Fig 1.

1. User Interface:

In generic terms anyone can be a user of an expert system. But there are cases where the ES is not supposed to supplant the human of which a trial judge is one. So while the system may be as good as a judge, it should operate with human oversight. Thus, the user should be a legal professional.

The user interface would provide the same environment as an election court room. By this model, legal opinions, facts and adjudications etc. are available from the interface.

2. Domain Expert:

The domain expert is vital in constructing an expert system. It is this knowledge that is represented in the machine as source of expertise. This expert therefore must be very knowledgeable in the field of law in matters arising from electoral act and adjudication, in order to achieve congruence between formal and informal reasoning, Fig 2.

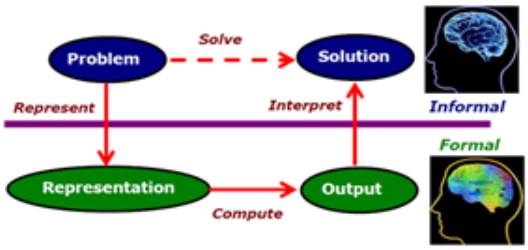

Fig. 2

The form and modelsfor translating this wisdom into machine readable format is known as knowledge representation (KR). The process is carried out through Knowledge Engineering in order to create a Knowledge Base (KB).

3. Knowledge Base:

Knowledge Base is the one of the modules of an expert system, which consists of information provided by the expert. It is where the knowledge is stored, the output of Knowledge Representation.

Acquired information from expert must be in the form of problem solving rules or procedures, Fig 3. Other familiar methods include, Predicate Logic, Fuzzy Logic, Semantic Networks and Frames.

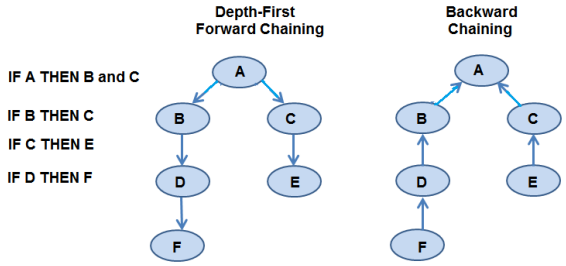

Fig 3

4. *Work Base:*

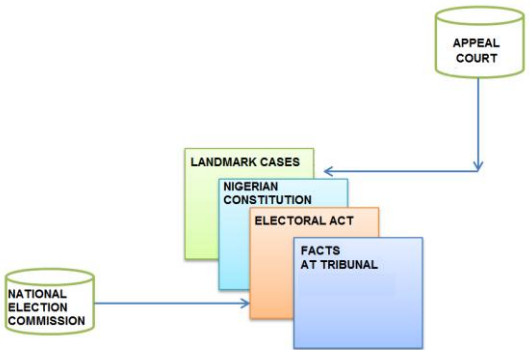

Fig 4 Work Base

A Work Base consists strictly of working memory that comprises of facts of the matter. However in real situations this embraces extended and associated databases. In this context, apart from facts at the tribunal [4], public references include Electoral Act as available at National Election Commission. It also includes the Nigerian Constitution and landmark cases in the Appeal and Supreme Court, Fig 4.

5. *Inference Engine:*

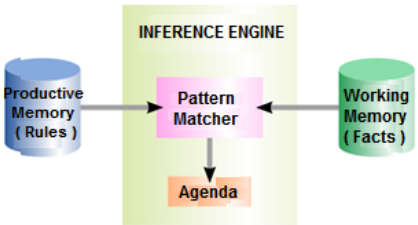

Fig 5

The inference engine is a representation of the human mindand comprises of generic control mechanism that applies the axiomatic knowledge in the knowledge base to the task-specific data to arrive at some solution or conclusion. There are quite a number of inference techniques that include:

- Abstraction (generalization)
- Pattern Matching
- Case-Based Reasoning, analogy
- Logical inference:
  - deduction
  - abduction
  - induction
- Rule-Based Inference:
  - forward chaining
  - backward chaining
  - top-down
- Problem reduction (AND-OR graph search)
- Consistency-Based Reasoning
- Graph Transformations, Graph Grammars

II. MODELS

The fields of law are quite numerable and with various areas of specializations. Branches include Constitutional Law, Land Law, Property Law, Medical Jurisprudence etc. For each of these fields, there are different models for optimisation. With the potential application in Electoral Act, the interest would bein a jurisprudentialrepresentation.

A. Jurisprudence

Jurisprudence [5],in the proper sense of the word, is the science of law. It is that science which has as its function, to ascertain the principles on which legal rules are based. By so doing, it isnot only able to classify those rules in their proper order, and show the relation in which they stand to one another, but also settle the manner in which new or doubtful cases should be brought under the appropriate rules. Jurisprudence is more a formal than a material science. When a new or doubtful case arises to which two different rules seem, when taken literally, to be equally applicable, it may be, and often is, the function of jurisprudence to consider the ultimate effect which would be produced if each rule were applied to an indefinite number of similar cases, and to choose that rule which, when so applied, will produce the greatest advantage to the community.

Given the above overview, questions arise on suitable foundations for a Legal Expert System in relation to jurisprudence. While there are a variety of views a number of important opinionsstand out and may be stated as follows [6, 7]:

a. All expert systems in lawnecessarily make assumptions about the nature of law and legalreasoning. As such they must embodytheories of legal knowledge, legal science, the structure of rules,the individuation of laws, legal systems and sub-systems, legalreasoning, and of logic and the law (as well perhaps as elementsof

a semantic theory, a sociology, and a psychology of law), theoriesthat must all themselves rest on more basic philosophicalfoundations. If this is so, it would seem prudent that the generaltheory of law implicit in expert systems should be explicitly articulatedusing (where appropriate) the relevant works of seasonedtheoreticians of law.

b. Successful legal knowledge engineering presupposes soprofound a familiarity with the nature of law and legal reasoning. It is therefore scarcely imaginable that such mastery could be gainedother than through immersion in jurisprudence.

c. The scientific character of law is justifiable on three grounds: thedemand for full justice, that is for solutions that go to the root ofcontroversies; the demand for equal justice, that is a like adjustmentof like relations under like conditions; and the demand forexact justice, that is for a justice whose operations, within reasonablelimits, may be predicted in advance of action. In other words,the marks of a scientific law are conformity to reason, uniformity,and certainty.

d. Judgment machine naturally follow the concept of scientific character of law and is welcome in the sense of disclose all possible available alternative legal rules.But whilea machine could perform some of the functionsof a judge, that role for humans would remain becausethe solution to a legal problem may depend upon extra-rationalfactors, involving the whole of human experience.

e. From a jurisprudential point of view, the law hasbeen made completely determinable. If acomputer can be programmed to make judicial decisions, human discretion will have been completely removed. By this argument, people would live under the rule of law and not under the rule of persons.

There are also equally strong opinions on the other side of the divide. For example, responding:

f. It is true that all legal expert systems necessarily makeassumptions about the nature of law and legal reasoning. However,a lawyer must have a model of the law which includes assumptions about the nature of law and legalreasoning, but that model need not rest on basic philosophicalfoundations. It may be a pragmatic model, developed throughexperience within the legal system. Many lawyers perform theirwork with little or no jurisprudential knowledgeand there is noevidence to suggest that they are worse at their jobsthan lawyers well-versed in jurisprudence.

g. It is normal to acquire technical skills of legal reasoning and legalargumentation which make up the concept of 'good lawyer' byimmersing oneself in substantive legal subjects. So, Jurisprudencehas to do, not with the lawyer's role as a technician, but with anyneed he may feel to give a good account of his life's work to community.

h. Alegal expert system need only operate at the same level of abstractionas does a lawyer, rather than at the philosophical levelof a jurisprudent. The fact that many lawyers have mastered theprocess of legal reasoning, without having been immersed in jurisprudence,suggests that it may indeed be possible to develop legalexpert systems of good quality without jurisprudential insight.

i. The ideal of certainty in law is tolerable only in the context ofan empirical world in which forces inducing change are so manifoldthat the attainment of the goal is never possible. A judgment machine in removing uncertainty in the law raises the possibility of the petrifaction of the law.

j. Science does not and will not offer any law machines thatgive automatic answers to specific questions put to them, whetheras to particular cases or as to ultimate legal issues such as therelative importance of interests that may be in conflict. It may, indeed, provide data from which social or ethicaljudgments may be made; but the judgments will remain with man.

k. Asthe law is expressed in natural language, it is subject to considerable semantic indeterminacy. It is therefore possibleto use rules deductively to solve clear cases,where there is general agreement that they fall within the scopeof a rule. The English system of precedent has, by its use, a body of rules of which a vast number, of both major and minor importance, are as determinate as any statutory rule. They can now only be altered by statute, as the courts themselvesoften declare in cases where the merits seem to run counterto the requirements of the established precedents.

An appraisal of these positions may leave one ambivalent. However any decision on model has to be situated in context of challenges the Legal Expert System is expected to overcome. This task can be amplified as in Fig 5, of a typical judicial process.It can be seen that same arguments, similar cases, often lead to different court resolutions.

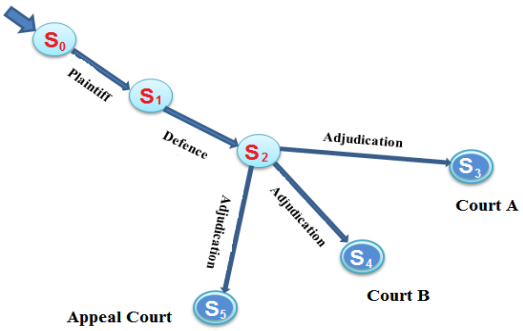

Fig 5Non-determinism in Judicial Process

As such disputes arising from election process are fraught and common. The lingering nature, controversy all impact adversely on the nation's body politics. Inherent in this situation are long delays and attendant ill effects. With upward trend, it istimelyany contributions towards accelerated judgement of court cases in our system, which minimizes non-determinism.

With this objective, the arguments in (a) to (e) are supportive and appear to offer solution. Even the opposingcontentions in (h) and (k), give grounds in favour of automation. The Electoral Statute is in nature of clear rules with mostly clear cases, and thus amenable to jurisprudential model and software application.

B. Knowledge Representation

Knowledge Representation (KR) can be described as a concept for representing a problem in the language that a computer can understand.For the electoral statute this means constructing, through knowledge engineering, a knowledge base representation of the opinion of a legal expert.

There are three basic methodsin consideration, namely:

- Rule-based
- Case-based and
- Hybrid model

1. Rule-Base:

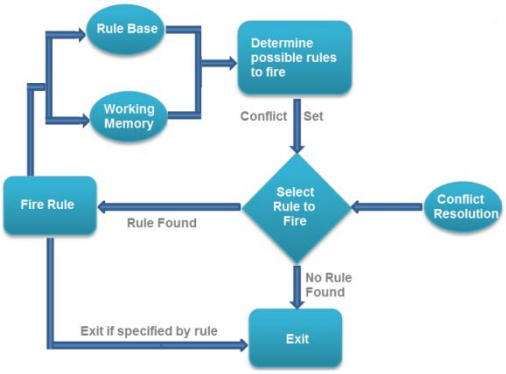

Fig. 6 Forward Chaining Procedure

A rule is a conditionalstatement that links given conditions to actions or outcomes [8].By itself, a rule-based system consists of if-then rules, a bunch offacts, and an interpreter controlling the application of therules, given the facts.These if-then rule statements are used to formulatethe conditional statements that comprise the completeknowledge base. A single if-then rule assumes the form'if x is A then y is B' and the if-part of the rule 'x is A' iscalled the antecedent or premise, while the then-part of therule 'y is B' is called the consequent or conclusion.

Thereare two broad kinds of inference engines used in rule-basedsystems: forward chaining and backward chaining systems.

In a forward chaining system, Fig 6, the initial facts are processedfirst, and keep using the rules to draw new conclusionsgiven those facts. As the processing progresses,new subgoals are also set for validation. Forward chainingsystems are primarily data-driven, while backward chainingsystems are goal-driven.

Consider an example with thefollowing set of if-then rules:

Rule 1: If A & C then Y
Rule 2: If A & X then Z
Rule 3: If B then X
Rule 4: If Z then D

Suppose the task is to prove that D is true, given that A and B are true.According to forward chaining, start with Rule 1 and go ondownward till a rule that fires is found. Rule 3 is the onlyone that fires in the first iteration. After the first iteration,it can be concluded that A,B, and X are true. The seconditeration uses this valuable information. After the seconditeration, Rule 2 fires adding Z is true, which in turn helpsRule 4 to fire, proving that D is true.

Forward chainingstrategy is especially appropriate in situations where dataare expensive to collect, but few in quantity.However,special care is to be taken when these rules are constructed,with the preconditions specifying as precisely as possiblewhen different rules should fire.

In the backward chaining method, processing starts withthe desired goal, and then attempts to find evidence forproving the goal.

Resumingwith the same example, the taskto prove that D is true would be initiated by first finding arule that proves D. Rule 4 does so, which also providesa subgoal to prove that Z is true. Now Rule 2 comesinto play, and as it is already known that A is true, thenew subgoal is to show that X is true. Rule 3 providesthe next subgoal of proving that B is true. But that B istrue is one of the given assertions. Therefore, it could beconcluded that X is true, which implies that Z is true, whichin turn also implies that D is true.

Backward chaining isuseful in situations where the quantity of data is potentiallyvery large and where some specific characteristic of thesystem under consideration is of interest. If there is notmuch knowledge what the conclusion might be, or there issome specific hypothesis to test, forward chaining systemsmay be inefficient. In principle, the same setof rules is applicable for both forward and backward chaining. In thecase of backward chaining, since the main concern is withmatching the conclusion of a rule against some goal thatis to be proved, the 'then' (consequent) part of the rule isusually not expressed as an action to take but merely as astate, which will be true if the antecedent part(s) are true.

Rule base logic follows the so called rule of the thumb. That is model of human reasoning. The Electoral Statute comes under definitional law and in rule based logic finds natural representation. It is therefore one of the models deemed suitable for knowledge representation.

2. *Case-Base:*

An expert is one who has vast specialised experience, havingwitnessed numerous cases in the domain and generalised this experience to apply it to new situations. Whenconfronted with a problem, the expert is reminded of previous similar problems and their respectiveresolutions. It might be that the expert has so many exemplary cases for a given problem that the experiencehas been distilled into a general rule to be applied. Still, this general rule has its root in actual experience.Hence it can be stated that the design expert derives the knowledge from experience and the basic unit ofknowledge is case but not rules. Experts gain knowledge through accumulating new design episodes,remembering their own experiences and the lessons learnt from mistakes. They can reason by analogy andsolve the new problems [9].

Reasoning based on the similar past problem-solving experience helps the designer to exploit the usefuldetails for application to a particular similar case. This problem-solving strategy is termed case-basedreasoning (CBR) [10]. It is based on the observation that human reasoning processes are founded on specificexperience rather than a set of general guidelines. Thus compared to other AI-based reasoning methods, CBRis a process of considering past cases and arriving at decisions on comparison between the current situationand the old cases. The solutions to problems are accomplished from past experience, stored in the form ofcases, rather than from rules or first principles. That is, the case-based problem solver works by recallingwhat has happened in the past in similar situations rather than by projecting what could work in the future.

CBR provides many advantages to problem solving in a knowledge-based environment. It allows one topropose solutions quickly, thus avoiding the long process of decomposition and recomposition involved in asynthesis process. It is useful in situations where the domain knowledge is not completely available ordifficult to obtain. The past cases may help to provide warnings of potential problems that have occurred inthe past and to avoid repeating the mistakes. However, it is to be emphasised that blind use of past cases tocurrent situations should be avoidedand knowledge cum expertise is needed to transform or to adapt the past caseto the current problem.

With regard to Electoral Law, there are cases that are resolved in the Appeal and Supreme courts that serve as references. In this respect, the principle of *staredecisis*is applicable, which holds that courts should apply the doctrine of precedent.

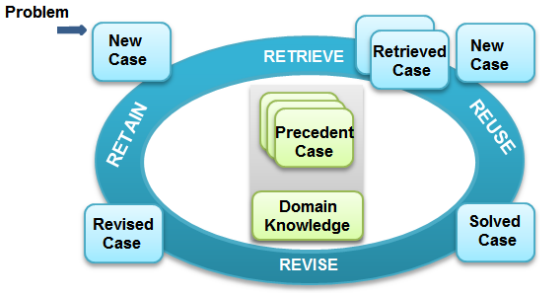

Fig.7

A case based system is typified by four key phases: Retrieve, Reuse, Revise, and Retain.

Whenever a new input case has to be dealt with, the system performs inference in this cycle Fig 7.

Retrieval of appropriate cases is a most important task.The recall of past cases is done based on thesimilarities between the current case and the past cases. It is possible that many cases may be available for acurrent problem situation. However a case, in general, is a contextualised piece of knowledge representing an experience and itrepresents knowledge at an operational level. For example, it contains specific knowledge that was applied or theparticular strategies that were applied for solving a problem. Thus, there are two parts of a case:

- Theknowledge it contains and
- The context in which it can be used

It is this second part which is important forselecting or retrieving a case for a given context. One of the widely adopted techniques is to use indices and similarity metrics forselecting cases.

In the reuse phase, a solution for the new case is created based on the retrieved most relevant case(s).

The revise phase validates the correctness of the proposed solution, perhaps with the intervention of the user. Finally, the retain phase decides whether the knowledge learned from solution of the new case is important enough to be incorporated into the system. Quite often the solution contained in the retrieved case(s) is adapted to meet the requirements of the new case.

Usual adaptation methods are substitution, transformation and derivational replay [11, 12].For the adaptation task, domain knowledge, usually in the form of rules, is employed. Incorporation of knowledge during the operation of a case-based system enhances its reasoning capabilities. This is a major advantage, since the knowledge base of intelligent systems employing other representations remains rather static during operation.

3. Hybrid Base:

The point has been made for rule based system as being ideal for representing knowledge involving electoral statute. However, in any set of rules there are bound to be exceptions and in such a situation the system would be found wanting.

A case based system embodies the knowledge and experience of an expert who can reason by analogy. Yet when the case is entirely new, without any precedent, or when case library is limited to a few records, the best recourse would be to available statute.Against this background, the best option lies in an integrated system of rule and case based legal expert system, Fig 8.

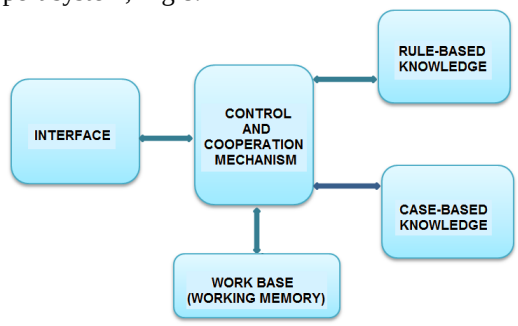

Fig.8

The form of this integration varies with applications. However, as described in [13], there are modes of operation in Rule-Dominant, Balanced Mode and Case-Dominant models.

In Rule Dominantmodel, rule-based component prevails in the inference process, such that the case-based component plays acomplementary role. That is to say the priority is for the rules to fire to conclusion but in the event they are unable to do so, case-based components are invoked to deal with the situation. Examples includeIKBALS II [14].

AtBalanced Mode, components are equal with none in supportive mode. Examples include CABARET [15], dealing with legal reasoning. The architecture consists of two co-reasoners, the rule-basedcomponent and the case-based component of equal status. There is also a controller, which observesthe operation of the whole system and each co-reasonerseparately. It then decides how they will proceed in thereasoning process as a whole and individually, assigning tasks to each co-reasoner.

Case Dominant category consists of models in which the case-basedcomponent plays a more important role and the rule-basedcomponent is less significant. This situation can arise when the case library contains limited number of cases such thatrules are invoked when the cases cannot produce asolution. In this paradigm, therules play a supportive role to case-based reasoning.

III.DESIGN

The design follows hybrid base architecture. This includes interface, and control mechanisms, Fig. 8. A client and server, internet based configuration is visualized for parallel use and access from any court location. The starting point though is a model of legal reasoning.

A. Model of Legal Reasoning

An Expert System advice should mirror the forms and interface that are generally used by lawyers. Hence, in this respect, the system being considered will be so designed as to operate at the same level of abstraction as would a lawyer.

A lawyer examines the facts of the case in question, the instant case, and determines which area of law, and which statutes (if any) apply. These statutes are applied to the facts of the instant case. The meaning of a concept in a statute may be open-textured, and may determine the result of the application of that statute to the instant case. A lawyer argues about the meaning of an open-textured concept by reference to the facts of the instant case and those of previously decided cases.

The results ascribe a meaning to an open-textured concept which, when the statute is applied, leads to a desired result in the instant case. No two cases can be completely identical, given the plethora of facts associated with any given case. Some of these differences may be insignificant, and much of a lawyer's reasoning by analogy concerns the legal significance of these differences. Thus, a lawyer argues with cases in the following fashion:

- If the result of a previously decided case is desirable, she/he argues that there are no legally significant differences between the previous case and the instant case, so the previous case should be followed.

- If the result of a previously decided case is undesirable, she/he argues that there is some legally significant difference between the previous case and the instant case upon which the previous case should be distinguished.

B. Interface

Inference embodies models of legal reasoning, with user communications through an interface. This is designed to recreate the environment of a tribunal court room. Furthermore, it should in the forms that are familiar in legal practice.

In a more expanded mode, the interface includes aBlackboard [16]. The blackboard is a shared repository of problems, goals, partial solutions, suggestions and contributed information. The blackboard can be viewed as a dynamic library of requests and contributions that have been recently provided through the cooperation mechanism between the rule base knowledge and the case base knowledge.

C. Control

In some hybrid systems, users have an option to choose rule or case based approach in arriving at a resolution. The design in this application adopts a rule-dominant approach. It is preferable though to automate the process. For this reason a control mechanism is required.

The control mechanism can examine and assess all the options available in rule and case base and assign scores for each as described in [17]. It is then able to compute best rule and best case results and make a selection by comparison.

The control mechanism can also reorganize the knowledge bases and use them in the most effective and coherentmethod.Facilityexists when the need arises, in adaptation, for passing the appropriate part of knowledge from one knowledge base to another and converting from one representation form into another. Control and cooperation mechanisms make use of the work data base, the knowledge bases, and the blackboard to accomplish task.

Work base comprising of working memory, includes facts of the case, Electoral Act, Nigerian Constitution, and landmark election cases, Fig. 4. At the onset, the working memory usually is empty but during the execution of the system it will accumulate and comprise of assertions generated from the processes of cooperation between the knowledge bases.

IV. IMPLEMENTATION

The development of an expert system usually follows a path ofconstruction inthe environment of a shell. These shells comprise of all the components but without a knowledge base. This domain information has to be provided in the course of development. The advantage of shells is in the fact that inference engine and interface are already available to use, freeing and assisting the engineer in a speedy exercise.

There are many commercial shells such as CLIPS1, EXSYS2 etc. However for a prototype,Visual Prolog [18, 19] which is freely available is satisfactory. This is the shell in supervised work, Development of a Legal Expert System for Handling Electoral Cases [20]. The salient features of this work are a template to build on and can be described in the data design, program flow and interface.

A. Data Design

The data flow diagram of the system is illustrated in Fig. 9. The DFDs model the relationship between various components and show how input data is transformed to output results through a sequence of functional transformations.

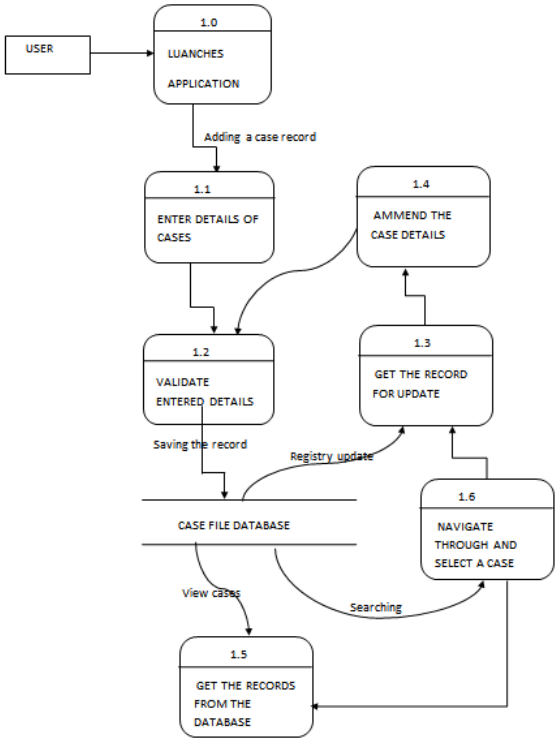

Fig. 9 Data Flow Diagram

B. Program Flow

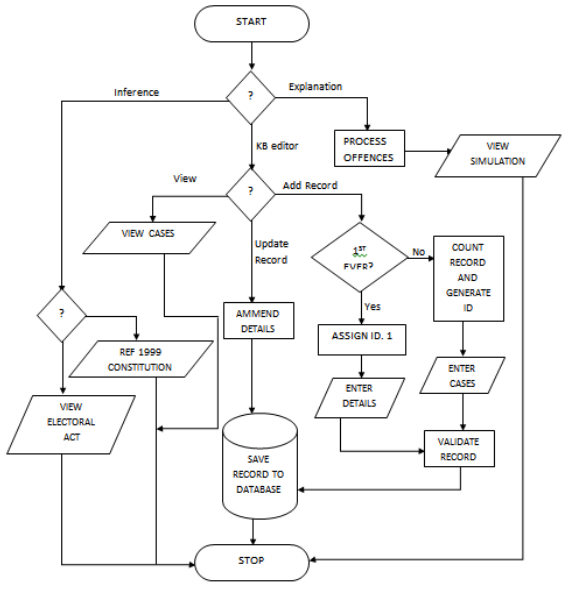

Fig. 10 Flow Chart

The program flow chart is illustrated above, Fig. 10. It may be added that in a web based client and server configuration, as envisaged, the records and databases would be centrally located within the secure precincts of the Supreme Court.

C. Program Interface

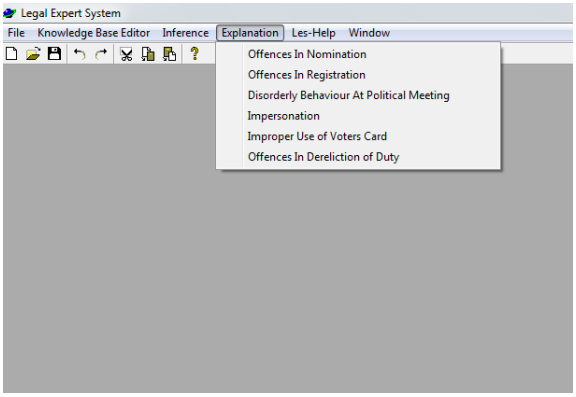

Fig. 10

The launch of the system and explanation menu lists six electoral offences in the electoral act. And when any in the list is selected, a new window page containing predefined rule for that offence appears.

Hence a case of impersonation brings up the page in Fig 11,containing the rules guiding against impersonation.

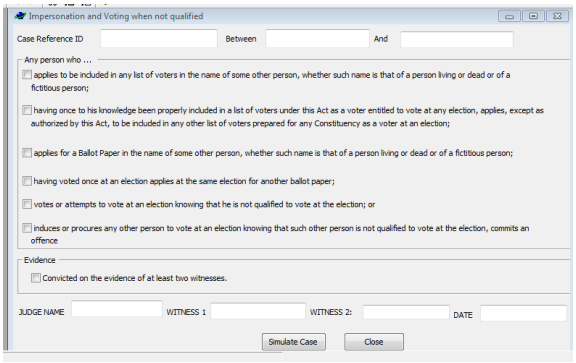

Fig. 11

The next course of action is to fill the form and check the boxes against the rules of electoral act. Once satisfied, the Simulate Case button is activated to generate a Conclusion as in Fig 12. OK button saves the judgement to records.

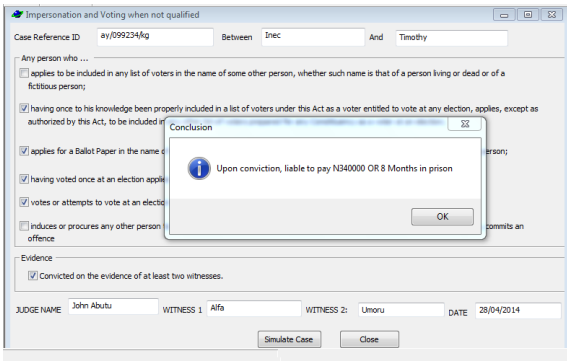

Fig 12

V. CONCLUSION

An analysis and evaluation of the performance of the system prototype shows that the conclusions are in accord with human legal reasoning. Thus, the law is computable and both jurisprudential approach and case procedure are perfectly representable.

However the human oversight is important and the role of any legal system is to enhance the process of law. With further developmentsin progress,the goal of complete coverage and representation of the electoral law is in sight. It is then expected that lawyers and judges would avail of this package.The result will be very welcome, leading to consistency, uniformity, determinism and prompt in judicial decisions.

REFERENCES

[1] Rinke Hoekstra, "Knowledge Representation in the Legal Domain", Leibniz Center for Law,Faculty of Law, University of Amsterdam.

[2] Robert Kowalski, MarekSergot, "ComputerRepresentation of the Law", Department of Computing,Imperial College, London.

[3] Efraim Turban and Jay E. Aronson, "Decision Support Systems and Intelligent Systems", 6th ed, Copyright 2001, Prentice Hall, Upper Saddle River, NJ.

[4] AbimbolaAkeredolu, ChinedumUmeche, "ICLG: Litigation & Dispute Resolution 2012 - Nigeria", Banwo&Ighodalo, Global Legal Group.

[5] Black's Law Dictionary, "What is Jurisprudence", http://thelawdictionary.org/jurisprudence/

[6] James Popple, "A Pragmatic Legal Expert System", Dartmouth Publishing Company. © James Popple 1996

[7] Richard E. Susskind, "Expert Systems in Law: A Jurisprudential Inquiry",Oxford University Press (Clarendon), Oxford1987

[8] Ajith Abraham, "Rule-based Expert Systems", Oklahoma State University, Stillwater, OK, USA

[9] Slade, S., "Case-Based Reasoning: A Research Paradigm", AI Magazine, 12(1), 42, 1991.

[10] C.S. Krishnamoorthy; S. Rajeev, "Artificial Intelligence and Expert Systems for Engineers", CRC Press LLC 1996

[11] Janet. L. Kolodner, "An Introduction to Case-Based Reasoning", Artificial Intelligence Review 6, 3--34, 1992.

[12] R. Mitra, J. Basak, "Methods of Case Adaptation: A Survey", International Journal of Intelligent Systems, Vol. No. 6, p. 627-645.June 2005.

[13] Jim Prentzas, IoannisHatzilygeroudis, "Integrations of Rule-Based and Case-Based Reasoning",Dept. of Computer Engin. & Informatics, University of Patras 26500 Patras, Hellas (Greece).

[14] G. Vossos, J. Zeleznikow, Th. Dillon, and V.Vossos, "An Example of Integrating Legal Case-Based Reasoning with Object-Oriented Rule-Based Systems: IKBALS II", in Proc. 1991 International Conference on Artificial Intelligence and Law, pp. 31-41

[15] E.L. Rissland and D.B. Skalak, "Combining Case-Based and Rule-Based Reasoning: A Heuristic Approach", in Proc. 1989 International JointConference on Artificial Intelligence, pp. 524-530.

[16] Hussein H. Owaied, Mahmoud Malek Abu-A`ra and MonzerMoh`dQasem, "A Hybrid Scheme for Knowledge Representation",Journal of Applied Sciences, 11: 2525-2535, 2011.

[17] Kamalendu Pal, John A Campbell, "An Application of Rule-Based and Case-Based Reasoning within a Single Legal Knowledge-Based System", The Data Base for Advances in Information Systems, Vol. 28, No. 4

[18] T. W. de Boer, "A Beginners Guide to Visual Prolog Version 7.1",Available: http://www.inf.fu-berlin.de/lehre

[19] D. Merritt, "Building Expert System in Prolog", Book Edition, © Springer Verlag, 1989.

[20] Louis Mummy Abbah, "Development of Legal Expert System for Handling Electoral Cases", Bachelor's Thesis, Kogi State University, Anyigba, Nigeria, 2014.