International Journal of Information Technology and Knowledge Management
July-December 2008, Volume 1, No. 2, pp. 517-525

A INVESTIGATIVE SURVEY OF APPLICATION OF KNOWLEDGE BASED SYSTEMS IN LEGAL DOMAIN

N. B. Bilgi & R. V. Kulkarni

Abstract

Law in a general form prescribes the frame of possible behavior of players in the domain regulated by it. A law can be considered as a set of rules forming a knowledge base and problems arising in the domain of its application should be answered based on it. Knowledge based systems get their power from the expert knowledge that has been coded into facts, rules, heuristics, and procedures. The knowledge is stored in a knowledge base separate from the control and inference components. This makes it possible to add new knowledge or refine existing knowledge without recompiling the control and inference programs. The primary objective of the paper is to survey the research work in incorporation of legal knowledge and reasoning strategies into the automation of the legal tasks, thereby resulting in productive decision making.

Keywords: Knowledge, Knowledge Based Systems, Knowledge Engineer, Expert Systems

1. Introduction

A Knowledge Based Systems/expert system whose aim is merely to provide advice and guidance to the user and not autonomously to provide reasoned solutions is essentially a Knowledge Based System. Research on this topic is being done in numerous organizations all over the world, from higher education laboratories to research institutes and software development organizations. The decades of 80's and 90' saw great use of Knowledge Based Systems, but in last decade the use of Knowledge Based system has been less or that it is embedded with other technologies.

1.1. Statement of the Problem

To undertake a brief Survey of Research Work on Knowledge Based / Rule Based Expert Systems in Legal Domain over two decades.

1.2. Purpose

The goal of the study is to conduct a brief survey of the research work in the area of Legal Knowledge Based in past two decades. This study has been undertaken keeping in the mind the research work to be undertaken by the authors of this paper.

1.3. Significance of the Study

It is difficult to develop a system which is capable of duplicating the intellectual process of a human legal expert. Law requires that we understand and experience through analogy. It is possible to only create a computer logic which appears to simulate aspects of this process. Hence we feel that the study, undertaken to know about the research work done in the area of Legal Expert Systems over past decades. This will help the authors in their research of creating new prototype of an expert system in one of the aspect of legal system.

2. Background

2.1. Build Legal Reality within the Expert System

Computers have long been utilized in the sphere of law. Basic applications such as word processors, spreadsheets and databases have all found their way into legal offices. Recently, more sophisticated tools such as computerized legal research systems, document drafting packages, and practice management systems have become increasingly common. Most exciting however, has been the prospect of using artificial intelligence (AI) techniques to create 'automated legal reasoning systems', computer systems that reason with and apply the law in an effort to resolve legal disputes. Examples of such systems include legal expert systems. However, the practical benefits of such automated reasoning systems have fallen short of optimistic early predictions they have not resulted in computer systems that can independently and inexpensively provide expert advice about substantive law.

The failure of efforts to create automated legal reasoners has led to a reassessment and reclassification of research aims. The key objective has been transformed into the creation of 'Knowledge Based Systems'. The purpose of a Knowledge Based System is not necessarily autonomously to provide solutions to legal problems. Instead, the goal is to incorporate legal knowledge and reasoning strategies into the automation of legal tasks so as to make the systems that perform those tasks more productive. This goal is far less grand than that for automated legal reasoners. In addition to this change of focus, new approaches in AI have recently emerged. These new approaches may overcome some of the limitations inherent in earlier attempts to automate legal reasoning. What general benefits these new approaches might provide, and what specific benefits Knowledge Based Systems might provide in law is open to examination.

2.2. Application of Knowledge Based Systems in Legal Domain over Two Decades: A Literature Study

The authors during the literature study observed that during the '90s, there was a special trend of using the term "knowledge-based systems" for not only computer applications

implementing Artificial Intelligence concepts, but also organisational systems that paid a special attention to knowledge acquisition, storage and retrieval.

In order to know of the previous research done in this direction, the authors examined several studies dedicated to the topic or to broader topics including references to KBSs. Most of studies dealt with broader topics with references to KBSs But just few of these were focused on KBSs in law, hence the reason for reviewing these studies. A literature survey was carried out know about the Knowledge Based Systems in law over last two decades. It showed that the Expert Systems developed can be categorized into following types. In the Reading Guide on Knowledge-based Legal Applications by Russell Allen and Graham Greenleaf highlights same.[7]

- The 'expert systems', and the main models of computerized inferencing (drawing inferences) that have emerged.
- The relationship between legal theory (jurisprudence) and computerization of legal tasks.
- Rule-based reasoning and its applications to statute-based law.
- Case-based reasoning and the problems of applying it (or neural networks or anything else) to case law.
- The relationships between inferencing and the other technologies of hypertext and text retrieval.
- The special issues in web-based legal inferencing, and the opportunities for greater integration with hypertext and text retrieval.
- Automated legal document generation systems
- Evaluation of Legal Knowledge Based systems

In the subsequent part the authors present the study conducted many authors who have given the view points on the aspect of the study which is the topic of the paper.

Andrew Stranieri., *et al.* [8] Opine that the evaluation strategies to assess the effectiveness of legal knowledge based systems enable strengths and limitations of systems to be accurately articulated. This facilitates efforts in the research community to develop systems and also promotes the adoption of research prototypes in the commercial world. However, evaluation strategies for systems that operate in a domain as complex as law are difficult to specify. The authors present evaluation frameworks put forward by Reich and describe how this motivated the evaluation of systems in Australian family law. Strategies surveyed include a comparison of linear regression with neural networks, user acceptance surveys, a comparison of system predictions with those from past cases, and a comparison of system outputs with those proposed by

a panel of lawyers. Specific criteria for the evaluation of explanation facilities are also described. Bench-Capon., *et al.* [9] Discusses the potential for providing knowledge based support for the task of formulating policy, and determining what legislation is required to implement the policy. The authors also discuss of previous work in this area, certain major obstacles are identified, chief among these is the need to match what the KBS can do with the way in which policy makers conceptualize and perform their task. Effective support can only be provided by a system which can be fully integrated into the working practice of its users. Some examples of an alternative approach, based on hypertext, are discussed, and authors also come out with some proposals for overcoming the obstacles with a combination of the hypertext and knowledge based approaches. Groendijk, C. [10] Opine that in most contemporary legal knowledge based systems, conclusions are reached by applying rules to case descriptions. A case description usually consists of a limited set of facts. In human judicial problem solving, the application of legal rules is not based on the facts directly, but on a structured interpretation of these raw data. A structured data interpretation serves as a guide through the problem space it enables the problem solver to ask context sensitive questions and to make plausible default assignments. Authors proposed, a neural method to create structured data interpretations is advocated and a method to integrate these networks with a rule based system is presented. Hage, J. C., *et al*.[11] Argue the thesis that the rules of law are best viewed as rules for dialogues rather than as rules constituting institutional facts. Starting from this view, a dialogical model of legal reasoning is developed. The authors provides an example of such a model in action and also give a prelude to an intelligent legal tutoring system, incorporating the chosen view and the dialogical model as starting points. The adoption by AI researchers specializing in law of new AI techniques, such as case based reasoning, neural networks, fuzzy logic, deontic logics and non-monotonic logics, may move closer to achieving an automation of legal reasoning. Unfortunately these approaches also suffer several drawbacks that will need to be overcome if this is to be achieved. Even if these new techniques do not achieve an automation of legal reasoning. Michael Aikenhead, [12] Opine that Computers have long been utilized in the legal environment. The main use of computers however, has merely been to automate office tasks. More exciting is the prospect of using artificial intelligence (AI) technology to create computers that can emulate the substantive legal jobs performed by lawyers to create computers that can autonomously reason with the law to determine legal solutions. Such attempts have not been successful. Modeling the law and emulating the processes of legal reasoning have proved to be more complex and subtle than originally envisaged. Moles, R. N.[13] Compares two different approaches to the development of expert systems in law: the ‘law is rules’ approach and the ‘semiotic view’. The former is exemplified by some of the logic programmers (Kowalski, Sergot, Bench-Capon), the latter by a norm-based, information-systems methodology (Stamper). In looking at them from the point of view of a legal theorist,

the authors are concerned more with their view of law than with the computational aspects of their work. P. Hassett, [14] Opine that legal expert systems use a knowledge base of legal rules to address legal issues. Such systems are said to be undesirable (a) because of the difficulty of replicating a multi-textured process such as legal reasoning, and (b) because law in its highest and best forms is humanistic rather than mechanistic. Both these objections seem particularly apt in the context of the exercise of judicial discretion. Author identifies some disadvantages of judicial discretion and some benefits of legal expert systems. By reference to a prototype expert system for making bail recommendations, the authors also discusses how the advantages of expert systems can be used to improve the exercise of judicial discretion and how the perceived disadvantages of expert systems can be minimized or avoided. R.M. di Giorgi., *et al.*,[15] Opine that at present, legal operators have at their disposal many legal data banks, documenting international and European Commission regulations, national and regional legislation, case law of the different courts and legal doctrine. This information is organized in non-standard documentary structures and has to be consulted in separate data banks utilizing different information retrieval systems. To overcome the problem of the consultation of these data banks, a joint project was launched to experiment the application of hypertext system on a collection of legal documents including legislation, case law and legal doctrine, relating to the specific sector of environmental law. Authors proposed the use of hypertext approach to facilitate access to non-homogeneous legal data not only for legal experts like lawyers but also for non-legal expert users including public officials, members of environmental protection associations, economic operators and citizens. R. Santhanam,.*et al.*,[16] Opine that research in knowledge-based systems (KBS) has become an important area of inquiry within decision sciences. The authors present the results of an extensive survey of research papers published on this topic. We determined frequency counts of papers and also performed a content analysis of the papers we surveyed. The results indicate that there are a large number of studies informing of the design and development issues relating to KBS. However, there seems to be less research examining issues relating to the management and impact of KBS on individuals and organisations. The authors summarise their key findings and identify avenues for future research. Trevor Bench-Capon., *et al*., [17] Opine that Legal knowledge based systems (KBSs) are, by definition, grounded on law. Very often the relevant law is subject to routine amendment and repeal, such changes occurring at irregular and unpredictable intervals. These systems are thus particularly affected by significant problems of adaptation as a result, a fact which has limited their practical take-up. If they are to be of more practical use the maintenance issues associated with these systems must be taken seriously. The authors discuss the issues associated with the maintenance of legal KBSs and describe a suite of maintenance tools designed to address these issues. Stranieri., *et al.*, [18] Opine that few automated legal reasoning systems have been developed in domains of law in which a judicial decision maker has

extensive discretion in the exercise of his or her powers. Discretionary domains challenge existing artificial intelligence paradigms because models of judicial reasoning are difficult, if not impossible to specify. The authors argue that judicial discretion adds to the characterisation of law as open textured in a way which has not been addressed by artificial intelligence and law researchers in depth. The authors demonstrate that systems for reasoning with this form of open texture can be built by integrating rule sets with neural networks trained with data collected from standard past cases. The obstacles to this approach include difficulties in generating explanations once conclusions have been inferred, difficulties associated with the collection of sufficient data from past cases and difficulties associated with integrating two vastly different paradigms. Valente, A., *et al.*, [19] Opine *that d*espite interesting efforts in the years gone by, major approaches to legal knowledge engineering have failed in bringing up a coherent theory about legal knowledge and legal reasoning. Meanwhile, important results have been obtained in other application areas of AI by the use of a model-based approach to knowledge engineering. The authors discuss the model-based paradigm, criticize present approaches to legal knowledge engineering and also propose a model-based approach to legal knowledge engineering as a new direction towards the solution of the main issues in the field.

2.3. Definition of the Terms Used

2.3.1. Expert Systems

We assume that the readers are already familiar with the main concepts of expert systems or the Knowledge Based System. The term Expert System and Knowledge Based System is interchangeably, A possible definition of expert systems *is 'An expert system is an intelligent system that is able to use expert knowledge*, stored in the form of inference procedures to resolve complex problems'. The goal of the designer of an expert system is to somehow capture the knowledge of a human expert relative to some specific domain and code this in a computer in such a way that the knowledge of the expert is available to a less experienced user. The various definitions are cited in the literature that contains this type of systems. From a strictly technical perspective, a KBS is:

> "a program for extending and/or querying a knowledge base. A knowledge base is a collection of knowledge expressed using some formal knowledge representation language. A knowledge base forms part of a knowledge-based system (KBS)".[1]

Nowadays to construct expert systems generally so called expert system shells are used. These expert system shells provide basic functions for the applications and support two basic type of knowledge representation: rule based or frame based.

A definition which includes both finality and functionality is given by the Elsevier Knowledge-Based Systems journal.

"Knowledge-Based Systems (the journal) focuses on systems that use knowledge-based techniques to support human decision-making, learning and action. Such systems are capable of cooperating with human users and so the quality of support given and the manner of its presentation are important issues." [2]

Building an expert system is known as *Knowledge Engineering* and its practitioners are called *Knowledge Engineers*. The knowledge engineer must make sure that the computer has all the knowledge needed to solve a problem. The knowledge engineer must choose one or more forms of knowledge representation. He must also ensure that the computer can use the knowledge efficiently by selecting from a handful of *reasoning methods*.

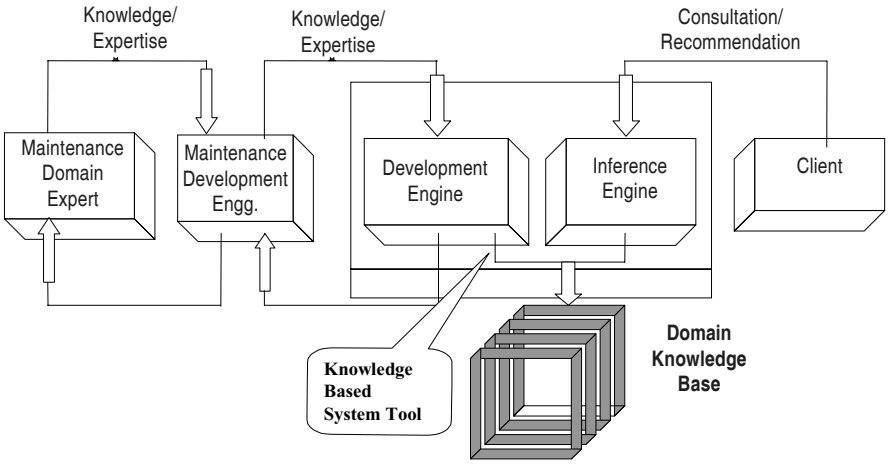

Figure 1: Knowledge Based Systems

3. Results

The authors of the paper, are of the opinion that Legal laws have been codified in the Knowledge Based System /Expert System in sub-domains of the Legal System such as Case-based reasoning, hypertext and text retrieval, Automated legal document generation systems and Rule-based reasoning and its applications to statute-based law to name a few. The results of the study shows that over past two decades lot of work has been carried out in the development of Knowledge Based / Rule Based Expert Systems in many of aspects of Legal System in many countries.

4. Conclusion

Trevor Bench-Capon. Opine that 'Legal knowledge based systems (KBSs) are, by definition, grounded on law'. Mr. P. Hassett, *et al*. opine that 'Legal Expert Systems use a Knowledge Base of legal rules to address legal issues'. The views expressed are

apt statements which convey that law by itself is rule based which is an advantage in itself. This advantage can be used effectively to codify the law in form of rules in the Knowledge Based System /Expert Systems. This is also the opinion of the other authors of papers which have been cited earlier**.** The authors of this paper conclude that the Knowledge Based Systems have been extensively used in Legal domain.

5. Future Scope of the Paper

The authors have undertaken a research work in the domain of Knowledge Based System and are in final stages of developing a prototype Rule Based Expert System for one of the aspect of Indian Legal System. The implementation of the Expert System will be done in an Expert System Shell CLIPS or JESS.

Acknowledgements

We are indebted to Mr. G. M. Wagh Principal, R.L. Law College for his timely help.

Reference

[1] FOLDOC(2000) (the Free On-Line Dictionary of Computing), [online], *http:// www.nightflight.com/foldoc/index.html*

[2] International Journal of Knowledge-Based and Intelligent Engineering Systems (2004) (IJKBIES), [online], *http://www.iospress.nl/html/13272314.html*

[3] Dan W Patterson, Introduction to Artificial Intelligence And Expert Systems, Prentice-hall of India (2004)*,* 13–14

[4] Edward Feigenbaum *Paper at the International Joint Conference on Artificial Intelligence (IJCAI)* in (1977).

[5] Stelzer, D. "BWM / WBS, Grundbegriffe des Wissensmanagements", [online], 2003-10-21, TU Ilmenau, Fachgebiet Informations- und Wissensmanagement, *http://www.wirtschaft.tu-ilmenau.de/deutsch/institute/wi/wi3/lehreundforschung/veranstaltung*, (2003)

[6] Donald. A. Waterman, "A Guide to Expert System", Pearson Education Association, (2002). 12–23.

[7] Russell Allen and Graham Greenleaf Introduction to Inferencing, UNSW LAWS 3035, Computerisation of Laws.

[8] Andrew Stranieri and John Zeleznikow 1999 in "The Evaluation of Legal Knowledge based Systems" in *International Conference on Artificial Intelligence and Law Proceedings of the 7th International Conference on Artificial Intelligence and Law* Oslo, Norway 18 –24 Year of Publication: 1999 ISBN:1-58113-165-8

[9] Bench-Capon, Trevor in "Support for Policy Makers: Prospects for Knowledge Based Systems", in *Legal Knowledge Based Systems: Information Technology and Law* .ISBN 90 5458 031

[10] Groendijk, C. 1992 "Neural Schemata in Automated Judicial Problem Solving", in *Legal Knowledge based Systems* JURIX 92: *Information Technology and Law, The Foundation for Legal Knowledge Systems*, (1994), ISBN 90 5458 031

[11] Hage, J. C., G. P. J. Span and A. R. Lodder 1992., " **A Dialogical Model of Legal Reasoning" in** Legal knowledge based systems JURIX 92: *Information Technology and Law*, *The Foundation for Legal Knowledge Systems*, 113–122, (1994) ISBN 90 5458 031 3

[12] Michael Aikenhead 1995, "Legal Knowledge based Systems: Some Observations on the Future", in First Published in *Web Journal of Current Legal Issues* in Association with Blackstone Press Ltd [1995] 2 *Web JCLI http://www.ncl.ac.uk/~nlawww/articles2/aiken2.html.*

[13] Moles R.N., "Expert Systems - The Need for Theory", in: Legal Knowledge based Systems JURIX 92: *Information Technology and Law , The Foundation for Legal Knowledge Systems*, (1994), 113–122, ISBN 90 5458 031 3.

[14] P. Hassett, 1992, "Can Expert Systems Improve the Exercise of Judicial Discretion", in Legal Knowledge based Systems JURIX 92: *Information Technology and Law, The Foundation for Legal Knowledge Systems*, (1994), 159–170, ISBN 90 5458 031.

[15] R.M. di Giorgi and R. Nannucci, A Legal Hypertext System, in: Legal Knowledge based Systems JURIX 92: Information Technology and Law, *The Foundation for Legal Knowledge Systems*, (1994), 171–178, ISBN 90 5458 031 3.

[16] R. Santhanam, J. Elam, in A Survey of Knowledge-Based Systems Research in Decision Sciences (1980-1995) *The Journal of the Operational Research Society*, **49**, (5) (May, 1998), 445-457 doi:10.2307/3009883.

[17] Trevor Bench-Capon and Frans Coenen 2004 in Artificial intelligence Review, Springer Netherlands., ISSN 0269-2821 (Print) 1573-7462 (Online), **6**, (2) (June, 1992), 129–143.

[18] Stranieri, Andrew, and John Zeleznikow in "Automating Legal Reasoning in Scretionary Domains *Legal Knowledge Based Systems: Foundations of Legal Knowledge Systems.*

[19] Valente, A. and J.A.P.J. Breuker in "A Model-based Approach to Legal Knowledge Engineering", in *Legal Knowledge based Systems* JURIX 92: *Information Technology and Law, The Foundation for Legal Knowledge Systems*, ISBN 90 5458 031 3, (1994), 113–122.

N. B. Bilgi
Department of Master of Computer Applications
Gogte Institute of Technology
Udyambag
Belgaum - 590008. India
E-mail*: nbbbgm@rediffmail.com*

R. V. Kulkarni
Department of Statistics and OR
Chh. Shahu Central Institute of Business Education and Research SIBER
Kolhapur – 416004 India
E-mail: *drrvkulkarni@siberindia.co.in*