Journal of Material Science and Mechanical Engineering (JMSME)
Print ISSN: 2393-9095; Online ISSN: 2393-9109; Volume 2, Number 2; January-March, 2015 pp. 170-173

http://www.krishisanskriti.org/jmsme.html

Expert System for Small or Medium Enterprise: A Review

Sahil Seth[1], Shikha Kashyap[2] and Gagan Baradia[3]

[1]Department of Mechanical Engineering, ITM University, Gurgaon, India
[2]Department of Mechanical Engineering, ITM University, Gurgaon, India
[3]Department of Mechanical Engineering, ITM University, Gurgaon, India
E-mail: [1]sahilseth01@yahoo.in, [2]shikhakashyap@itmindia.edu, [3]gaganbaradia@itmindia.edu

Abstract—*This paper aims to review the work done on the development of expert system for small or medium enterprise around the world. The review work emphasizes on the Indian market where large number of small and medium enterprises survives and are having huge potential for the usage of an expert system. Analyzing pros and cons of expert systems and identifying the gaps which could be bridged to take a step closer in developing an intelligent system which not only emulates human expert but does it better. Expert system is a part of study of artificial intelligence and is also the first successfully developed structure of artificial intelligence. Expert system is a tool of utmost utility in every field from manufacturing to service industry and has found its way in various applicatory usage in each field. It is a tool most preferred in management department because of its decision making ability which is, if not more but at par with that of an expert.*

Keywords: *Artificial Intelligence, Expert Systems, Knowledge Base, Inference Engine, Small-Medium Enterprises*

1. INTRODUCTION

Feigenbaum, who was leading the Stanford heuristic programming project is referred as the "father of an expert systems". The expert system is a small part in the study of artificial intelligence. Artificial intelligence is the amalgam of set rules programmed into the brain of a machine with its ability to infer and deduce new facts. This ability of a machine to deduce new facts from those which are already known to it is called artificial intelligence. The study of artificial intelligence is greatly technical and is divided into various parts. These are the subfields in the study of AI. Some research fields targets on specific problems regarding AI and others focus on the hardware exploring different tools for its use. The foremost objective of AI research includes planning, learning, reasoning, knowledge, inference, decision making and the ability to move and manipulate different objects.

2. EXPERT SYSTEM: OVERVIEW

2.1 Definition of Expert System

A computer system which is capable enough to emulate the decision-making capacity which is unique to humans is called an expert system [1]. The main purpose for the development of an expert system is to solve complicated problems using reasoning and knowledge. The start of work in the field of expert system goes back to 1970s but it proliferated in 1980s [2]. Expert Systems, being the major part of the study of AI, it is an advanced form of AI software [3].

1.2 Classification of Expert System

The division of expert system takes place mainly in two parts [4].

- The Knowledge Base
- The Inference Engine

Knowledge base consists of various facts and rules which are programmed into the microchip of an expert system and stored into its memory bank. These key rules serve as its commandments and the expert system strictly follows them. The response generated from such expert systems are by and large non-adaptive. These are the most basic types of expert systems as they have no unique ability to adapt to different scenarios to come up with a unique solution. These are particularly rigid types of expert systems.

Inference Engines are advanced forms of knowledge based expert systems as they are capable to apply the rules to various facts known to them so as to deduce new facts. The Inference engine based Expert systems work usually on one of the following two types of models [6].

- Forward Chaining
- Backward Chaining

In Forward Chaining, some of the facts are known and further new facts are asserted.

Backward Chaining works in totally reverse direction as it starts with the goal and works backward to determine what all facts must be asserted to achieve the goal.

3. TOOLS & TECHNIQUE

Various Software tools are available for the development of an Expert system. Most of these tools are based on C, C++ computer programming language. Many business application vendors such as Siebel, Oracle, SAP etc. provide quick solution to the requirement of Expert System. These companies are mainly working on the development of Expert Systems as per to the needs of their customers. These tools are user friendly and easy to handle for both, the programmer and the user. Logic programming is the key to developing a system which does all the required functions and provides appropriate advices when the data is entered.

3.1 Software Techniques

Over the time, Expert systems evolved and with them many new techniques started being incorporated with them so as to increase its efficiency and also to make it more flexible. These techniques are the base of the programming behind expert system development and logic used in them discerns them from each other.

Following are some of these techniques which are favorable in Inference engines [5]:

- Fuzzy Logic- It is amongst the first extension of representation of knowledge using simple rules and associating a probability factor with each rule.
- Hypothetical Reasoning- Hypothetical reasoning consists of dividing the knowledge base into many possible views, aka virtual worlds. This enables the inference engine to explore multiple possibilities simultaneously and to come up with one which is most efficient and gives optimum result.
- Ontology Classification- It is an evolved form of knowledge base as it comes up with an addition of object classes, hence developing a new type of reasoning method. With this method, it is possible for the system to reason not only about the values but also the structure of the object making it even more precise in its inference of a particular scenario.
- Truth maintenance- The main function of truth maintenance system is to record the dependencies in a knowledge-base. The main advantage of this type of system is that when facts are altered, all the dependent knowledge alters accordingly.

4. ADVANTAGES

- The goal of an Expert system which is knowledge based is to make the available critical information which is required in the system to work unequivocally [6].
- Traditionally, the logic embedded in a computer code is only understood and reviewed by the programmer but with the help of an expert system, the rules specified are in a format that is intuitive and easily understood even edited by domain experts and its users.
- The most obvious benefit of this explicit knowledge representation is quick development and ease of maintenance of the system
- Expert system also acts as one of the finest method of managing database and with the ease of coding, even the user can alter the rules as per to the requirement.

5. LITERATURE REVIEW

The review of various research papers was done and the observation and conclusion of some of them are as follows. Engin et al. [7] has developed two rule based expert system to support university students. First expert system was the course advising system and its sole purpose was to recommend courses to undergraduate students on the basis of their eligibility with respect to eligibility criteria set by the institute. The second expert system were having a unique function of suggesting scholarships to undergraduate students on the basis of their eligibility. These systems were implemented and tested using Oracle Policy Automation (OPA) software.

William Mettrey [5] focused on various tools that were available for the development of knowledge based systems. There are number of tools supporting development, execution, and maintenance of knowledge-based expert systems which are being widely marketed. Most of these systems are designed for applications that can be executed on personal computers but are not suitable for building large knowledge-based systems. The assessment is done on the state of tools which are currently being used to develop large knowledge-based systems. Collective strengths and weaknesses of several tools were evaluated.

The summary of other literature reviewed are arranged in the tabular form as follows-

Sr. No.	Area of Application	Authors	Findings
1	Banking and Loan	J Levy et al. [22]	The paper presents a computer-based Fuzzy Logic Evaluation System to commercial loan analysis.
2	Oil And Gas Industry	V. Uraikul et al. [27]	Mixed-Integer Linear Programming (MILP) model is used to optimize network system's compressor selection operations in natural gas pipeline.
3	Environmental Management in Manufacturing	Stephen burke et al. [29]	The paper deals with environmental management of manufacturing in SME's.

4	Calculation of Defects	Xiao Liu et al. [21]	An expert system is developed to realize an appropriate combination of material database,condition database and knowledge database.
5	Eco-Efficiency	Maria Blanca et al. [30]	A comparison analysis of eco-efficiency in small and medium sized enterprises (SMEs) of Venezuela is done reaching to conclusion that legal environmental regulations are followed.
6	Cost Management	Grahovac et al. [8]	Development of an expert system for cost related decision making and continuous cost management called COMEX (cost management expert system)
7	Human Assessment	Vladan Papic et al. [17]	Expert System designed to identify the sports talent using human assessment.
8	Service Sector	Wen Hsien Tsai et al. [31]	Development of an integrated framework for successful implementation of ERP systems and results show a causal relationship.
9	Environmental Industry	Hernandez et al. [24]	A method adviser and sustainability tool is developed called GREENESYS to increase efficiency and effectiveness.
10	Design industry	Michele Germani et al. [32]	The paper evaluates and defines a platform dedicated to mechanical product field SME's.
11	Education industry	Shin-Yeu Lin et al. [14]	The paper aims to integrate Expert system in Education industy.
12	Machining	Luis Rubio et al. [12]	The purpose is to present an open and modular expert rule-based system to automatically select cutting parameters in milling operations.
13	Food Packaging Industry	Suziyanti Marjudi et al. [16]	The paper focuses on produce of House of Quality QFD diagrams and tackling the minimal use of software in SME's.
14	Renewable energy	Mehdi Motevasel et al. [20]	An expert energy management system (EEMS) for optimal operation of WTs is developed and successfully generates DERs and ESS.
15	Tourism Industry	Erdogan Koc et al. [11]	Using Triangulation method as a research strategy and analysed research papers in top 3 tourism journals.
16	Paper Industry	Lundmark et al. [19]	A survey of econometric analyses of demand and supply suppleness in markets of recycled paper and resulted in positive output supply.
17	Mechanical Equipment	Ratnayake et al. [23]	Maintenance engineering application's events comes back to human errors. Knowledge based engineering approach is used.
1	Human Computation	Folorunso et al. [18]	Crowdsourcing is improvised by using a unique combination of Trust-Based Access Control (TBAC) strategy and fuzzy-expert systems enhancing the human computation quality.
20	Household	Nguyen et al. [15]	Paradigm shift in water level consumption information which is available to customer using Intelligent metering technology.
21	Design Industry	Mannan et al. [13]	It presents the workings of Inherently Safer Design concept, its principles, definition and industrial application.
22	Education	Engin et al. [7]	A course advising expert system is formed to guide undergraduate students and was tested using Oracle Policy Automation (OPA) software.

It has been observed that the work done on the development of expert system in variety of fields is highly appreciated. The growth of this work done is at its highest in the current decade, although the work goes back to as far as 1967.

5.1 Identified gaps in the literature

Various expert systems are developed till date and almost all of them are very specific to the company or purpose they were developed for. The biggest gap observed is that hardly any work is done on developing an expert system for small and medium enterprises, which inculcates all its common parameters to build a generalized expert system. Even if the work is done for SME's, it is still not very adaptive to the Indian market. The structure of Indian market for SMEs differs a lot from their foreign counter-parts and this raises the need to develop an expert system for such industries.

Traditional systems are not very good at handling uncertainties, this motivates the development of expert system which can mimic the human brain perception process and can take situational uncertainties and data vagueness into the consideration.

6. CONCLUSION

Expert system, being a part of the study of artificial intelligence is definitely a big step towards the development of system which can mimic human perception and decision making abilities and can also consider all the data vagueness. A knowledge based expert system will not be successful in doing so but Inference type models are possibly the answer. The expert system finds its application in variety of fields and its importance is increasing day by day. Development of a generalized expert system for different SMEs doing similar types of work is highly demanding area these day. And Indian small or medium enterprises sector shows huge potential for implementation of such expert systems.

REFERENCES

[1] Peter Jackson, (1998), Addison Wesley, Introduction To Expert Systems (3 ed.), p. 2.
[2] T Cornelius Leondes, (2002). Technology of knowledge management and decision making for 21st century: Expert systems. pp. 1–22.
[3] Stuart Russel & Peter Norvig (1995), Artificial Intelligence-Modern Approach. Simon & Schuster. pp. 22–23.

[4] Stella Nwigbo & Agbo Okechuku Chuks, A catalyst in educational development in Nigeria: School of Science Education: Expert system.
[5] William Mettrey (1987). AI Magazine Vol :8, "An Assessment of Tools for Building Large Knowledge- Based Systems". pp. 81-89.
[6] Hayes-Roth, Frederick Waterman; Douglas Lenat, Donald; (1983). Building Expert Systems. Addison-Wesley. p. 6.
[7] Gökhan Engin, Burak Aksoyerb, Melike Avdagicb, Damla Bozanlıb,Umutcan Hanayb, Deniz Madenb, Gurdal Ertekb, Procedia Computer Science 31 (2014) 22 – 31.
[8] Danijela Grahovac, Vladan Devedzic-Expert Systems with Applications, Volume 37, Issue 12, December 2010, Pages 7684-7695.
[9] R.M. Chandima Ratnayake, September 2014, International Journal of Disaster Risk Reduction, Volume 9, pp. 84-98.
[10] S. Muthukaruppan, M.J. Er- Expert Systems with Applications, Volume 39, Issue 14, 15 October 2012, Pages 11657-11665.
[11] Erdogan Koc, Hakan Boz, October 2014,Tourism Management Perspectives, Volume 12, pp. 9-14.
[12] Luis Rubio, Manuel De la Sen, Andrew P. Longstaff, Simon Fletcher- Expert Systems with Applications, Volume 40, Issue 6, May 2013, Pages 2312-2322.
[13] Sam Mannan- Lees' Process Safety Essentials, 2014, Pages 383-401.
[14] Shin-Yeu Lin, Chong-Wei Su, Jung-Shou Huang- Expert Systems with Applications, Volume 39, Issue 3, 15 February 2012, Pages 3249-3256.
[15] Khoi Anh Nguyen, Rodney A. Stewart, Hong Zhang- Expert Systems with Applications, Volume 41, Issue 2, 1 February 2014, Pages 342-356.
[16] Suziyanti Marjudi, Riza Sulaiman, Nur Amlya Abdul Majid, Mohd Fahmi Mohamad Amran, Muhammad Fairuz Abd Rauf, Saliyah Kahar, 2013, Procedia Technology, Volume 11, pp. 518-524.
[17] Vladan Papić, Nenad Rogulj, Vladimir Pleština- Expert Systems with Applications, Volume 36, Issue 5, July 2009, Pages 8830-8838.
[18] Olusegun Folorunso, Olusegun Afeez Mustapha- Applied Computing and Informatics, In Press, Corrected Proof, Available online 18 July 2014.
[19] Anna Mansikkasalo, Robert Lundmark, Patrik Söderholm, January 2014, Forest Policy and Economics, Volume 38, pp. 17-29.
[20] Mehdi Motevasel, Ali Reza Seifi, July 2014, Energy Conversion and Management, Volume 83, pp. 58-72.
[21] Xiao Liu, Fu-Zhen Xuan, Jun Si, Shan-Tung Tu- Expert Systems with Applications, Volume 34, Issue 1, January 2008, Pages 222-230.
[22] J Levy, E Mallach and P Duchessi, A fuzzy logic evaluation system for commercial loan analysis Omega, 1991, vol. 19, issue 6, pages 651-669.
[23] Ratnayake, C., (2014), KBE development for criticality classification of mechanical equipment: A fuzzy expert system, International Journal of Disaster Risk Reduction, Volume no. 9, pp. 84-98.
[24] Hernandez,N., Kremer,G., (2012) Original Research Article Expert Systems with Applications, Volume no. 39, pp. 9543-9553.
[25] Khoi Anh Nguyen, Rodney A. Stewart, Hong Zhang An autonomous and intelligent expert system for residential water end-use classification, Expert Syst. Appl. Vol. 41 No. 2 Pg. 342-356.
[26] Preece,A.D., Moseley,L.,(1992) ,Empirical study of expert system development Original Research Article Knowledge-Based Systems, Volume 5, pp.137-148.
[27] V. Uraikul, C. W. Chan and P. Tontiwachwuthikul, (2004), Journal of Environmental Informatics 3 (1) 33-41.
[28] Faculty of Engineering, University of Regina, Regina, Saskatchewan S4S 0A2, Canada.
[29] Stephen Burke, W.F.Gaughran(2006), Intelligent environmental management for SMEs n manufacturing, Robotics and Computer-Integrated Manufacturing (Impact Factor: 1.84).
[30] María Blanca Fernández-Viñé, Tomás Gómez-Navarro, Salvador F. Capuz-Rizo, May 2010, Volume 18, Issue 8,Journal of Cleaner Production, pp. 736-746.
[31] Wen-Hsien Tsai, Michael J. Shaw, Yi-Wen Fan, Jau-Yang Liu, Kuen-Chang Lee, Hui-Chiao Chen, January 2011, Volume 50, Issue 2, Decision Support Systems, pp. 480-490.
[32] Michele Germani, Maura Mengoni, Margherita Peruzzini, January 2012, Computers in Industry, Volume 63, Issue 1,pp. 12-29.
[33] Gray,L., Chiu,V., Liu, Q.,Pei,L.,(2014), The expert systems life cycle in AIS research: Original Research Article international Journal of Accounting Information Systems, In Press, Corrected Proof, Volume 4,Page no 218-238.