

# Fuzzy expert system and its utility in various field

Nidhi Mishra<sup>1</sup> and P. Jha<sup>2</sup>

<sup>1</sup>Dr.C. V. Raman University, Bilaspur (C.G.), India.

<sup>2</sup>J. Yoganandam Chhattisgarh College, Raipur (C.G.), India.

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## Abstract

Today's Fuzzy Logic plays an important role in every field of our life. Fuzzy expert system presents expertise knowledge and it has been effectively applied to solve the problems, classification and modeling in such diverse areas as science, engineering, business and medicine. This paper provides an overview of this fuzzy tool and highlights the basic feature of expert system with fuzzy logic.

**Keywords:** Fuzzy logic, Fuzzy expert system, Fuzzy rule, Fuzzy tool.

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## INTRODUCTION

Now a day's fuzzy logic proves its importance in our life. Fuzzy logic is conceptually simple and easy to understand and the mathematical concepts behind fuzzy logic are very easy. Fuzzy sets were originally introduced in 1965 by L.A. Zadeh [1]. There are thousands of researchers are working with fuzzy logic and producing patents and research papers. According to Zadeh's report on the impact of fuzzy logic as of March ,2013.there are 26 research journals on theory or applications of fuzzy logic, there are 89,365 publications on theory or applications of fuzzy logic in the INSPEC database, there are 22,657 publications on theory or applications of fuzzy logic in the MathSciNet database, there are 16,898 patent applications and patents issued related to fuzzy logic in the USA, and there are 7149 patent applications and patents issued related to fuzzy logic in Japan. The number of research contributions is rising daily and is growing at an increasing rate. Fuzzy logic systems can be used for complex medical and engineering applications such as intellectual fault recognition, control systems, development diagnostics, decision making and expert systems. One of the most important application of fuzzy logic is Fuzzy Expert System. expert system is a computer system that developed the decision making ability of a human expert. It uses human knowledge and data to explain problems that would want human intelligence. The expert system represents expertise knowledge as data or rules within the computer.

There are several application areas of expert system such as agriculture, engineering, education, environment, law manufacturing, auditing, medicine etc. In this paper we will show how fuzzy expert system utilized in various field like agriculture, education, environment and medical engineering expert system.

## Review of Literature

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1. He Yue , Guo Yue and Guo Yi et al. described the immune system that protects the human body, on the basis of the immune algorithm using a flow chart and Fuzzy Cognitive Map (FCM)[2].
2. Yataka Hata , Syoji Kobashi and Hiroshi Nakajima et al. described the practical application of management system for human health and worked on the scheme to concentrate medical diagnosis and health management [3].
3. Christian J. Schuh et al. proposed a survey related to the fuzzy logic, fuzzy sets and relations and fuzzy control and their application in medical science and explained gluco notify patient glucose data setting, fuzzy automata concept for ARDS therapies [5].
4. Supriya Kumar De, Ranjit Biswas and Akhil Ranjan Roy et al. proposed to extend the research and using the idea of intuitionistic fuzzy set theory and introduced the case study of some patients, collected the data of their symptoms and used this data in IF theory and gave the result in tabular form [4].
5. Sanjeev Kumar, Gursimranjeet Kaur et al. define a fuzzy expert system to detect the heart disease in the person[6].
6. Kerim Göztepe et al. proposed Fuzzy Rule based system for cyber security and he was developed a fuzzy rule based technical indicator for cyber security with the use of an expert system [7].
7. S. Martha Merlyn,S. Shiney Valentina, Sachidanand Singh, J. Jannet Vennila and Atul Kumar et al. introduce a fuzzy logic control for the diagnosis of eosinophilia. The design is based on Mamdani-style inference system which is very good for the representation of human reasoning and effective analysis [8].
8. Sourav Mandal , Sumanta Chatterjee , Biswarup Neogi et al. designed a expert intelligent system to develop hardware fault detection for any computer system [9].
9. Asser Abdel amid et al. Explained the development methodology of an expert system has two aspects:

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\*Corresponding Author

Nidhi Mishra

Dr.C. V. Raman University, Bilaspur (C.G.), India.

Email: [nidhimishra1908@gmail.com](mailto:nidhimishra1908@gmail.com)

Knowledge engineering, and Software engineering. From the software engineering aspect, there are four activities for expert system development: requirements specification, design, implementation, and testing [10].

### Fuzzy Expert System

Expert system (ES) was introduced by researchers in the Stanford heuristic programming project, including the "father of expert system" Edward Feigenbaum, with the Dendral and Mycin system. Principal contribution to the technology were Bruce Buchanan, Edward Randall Davis, William, Craik Scott and others at Stanford. In the 1980s, expert systems known as a practical device of the real world problems the expert system became popular with the fifth generation computer systems project in Japan and improved research funding in Europe. Amplification in the FES continued in the 1990s.

#### An expert system consists of four major components:

**Knowledge base:** It is developed by some combination of humans and an automated learning system.

**Problem Solver:** This is a combination of algorithms and designed to use the knowledge base in an attempt to solve problems in a particular field.

**Communication:** This is intended to make possible proper relations both with users of expert systems and developers of the expert system.

**Explanation and Help:** This is designed to give help to the user and provide explanations of the "what and why" of the expert system and to solve the problem.

#### Utility of Fuzzy Expert System in Different Field:

We have different application areas of expert system such as agriculture, engineering, education, environment, law manufacturing, auditing, medicine etc. now we will show how fuzzy expert system utilized in various field:

##### Agriculture Field

The expert system for agriculture is same as others knowledge based system, its use the rule based which the experience and information of a human expert is captured in the form of IF-THEN rules and facts which are used to solve problems. There are some benefits from the expert system for agriculture field –

1. It has the ability of understanding and transparency makes relations more user friendly.
2. It has the capacity to reproduce human consideration and reasoning.
3. The expert system makes variation of knowledge very easily
4. Machine learning technique can be acquired automatically and directly from experimental data and real time examples and helps to provide the right information which is timely and actionable.

5. It has the capability to handle vague data and information.

#### Some Types of Agriculture Expert System for Different Uses:

1. CLAEX- This is a blackboard based included expert decision support system for agricultural management developed at University of California. This expert system can be used by grower, advisor and managers
2. GSI Expert System- This is expert system was developed in 1987 as an efficient dives to assist farmers and agri-business persons.
3. DSS4AG- The decision Support System for Agriculture (DSS4AG) is an expert system being developed by the site specific technologies for agriculture (SST4AG) important farming research project to make cost-effectively best possible decisions on fertile use
4. CLIPS- Expert System- It is a C Language Integrated Production System, developed by Purdue University agricultural scientists. This is form of artificial intelligence gives an addition tool, which will make possible farmers to economically use a computer program to reach conclusions with reference to cost-effective alfalfa production that normally would require discussion with an expert. It is easy to understand and updates and it can be modified for use in other states or agricultural regions
5. VARIEX- This expert system developed at Technical University of Brno, Czechoslovakia. Enables selection of the best cultivators for diverse agricultural situations.

#### Education Field

According to Markham H.C (2001), expert system is beneficial as a teaching tool because it has prepared with the unique features which allow users to ask question on how, why and what format. When it used in the class atmosphere, surely it will give a lot of advantage to student as it arrange the answer without referring to the teacher. Besides that, expert system is able to give reasons towards the given answer. This feature is really great as it can make students more understand and sure with the answer. Even though by the fuzzy expert system we are also evaluate the teacher Performance Evaluation. This way FES is not only being helpful for decision-makers to evaluate teachers' abilities but may also be adopted in writing Annual Confidential Reports (ACR) of about all the employees of an organization [11].

Expert system had been used in several fields of study including language, mathematics related field and business study. Through this expert system, teacher to make his lecture more creative and well-organized without increasing the staff number and analyze subject related error also.

#### Environmental Management

Fuzzy expert system for environmental management which was proposed by Nazar M.Zaki and Mohd Daud from the faculty of engineering, University Putra Malaysia. The system was actually a cost effective integrated environmental monitoring system for Environmental Impact Assessment (EIA) project as well as environmental database management system. The application of expert systems technology in the domain of environmental management is more effective, efficient and at reasonable costs.

## Water Resources Management

The role of water in human life is significant as it plays a very essential role in the procedure of human body. Fuzzy logic provides an efficient and useful expert system for classifying drinking water quality based on limited observations. Fuzzy Drinking Water Quality Index (FDWQI) is developed for evaluation of water quality for drinking purpose. Fuzzy expert system makes it possible to combine the certainty levels for the acceptability of water based on an approved parameter [12]. Another example of expert system development in the domain of environmental management is the Geographic Information Systems (GIS) and simulation models for Water Resources Management; a case study of the Kelantan River, Malaysia by K.Fedra in 2002[13].

## Sports field

Fuzzy logic is very flexible and conceptually easy to understand and it is based on natural language. Which is used by ordinary people on a daily basis .so player easily accept it. Mohammad Bazmara, Shahram Jafari and Fatemeh Pasand define a Fuzzy expert system for goalkeeper quality recognition. In his work the fuzzy expert system is used as a suitable tool to study the quality of a goalkeeper and compare it with others. Previously researches are used to find the goalkeepers' indexes in soccer also [14].

## Industrial Engineering

In general, industrial engineering is concerned with the design, operation, and control of systems whose components are human beings, machines, material and money. Contrary to other engineering disciplines, industrial engineering deals not only with technical issues involving man made systems, but also with behavioral ergonomic, organizational, economics and other issues. This implies that industrial engineering is a cross- disciplinary field. Subject areas covered by industrial engineering. Fuzzy set theory, which was motivated to a large extent by the need for a more expressive mathematical framework to deal with humanistic systems, has undoubtedly a great deal to offer to industrial engineering. Fuzzy sets are convenient for estimating the service life of a given piece of equipment for various conditions under which it operates.

## Civil Engineering

One important category of problems in civil engineering for which fuzzy set theory has already proven useful consists of problems of assessing or evaluating existing constructions. Several applied areas of fuzzy expert system have already been found to be of grade utility in civil engineering. They include fuzzy decision making (often combined with fuzzy risk analysis), approximate reasoning (utilized in specialized expert systems), and fuzzy control (applied, e.g. to the control of traffic in cities.

## Mechanical Engineering

It has increasingly been recognized in engineering that the early stages in engineering design are more important than the later stages. Fuzzy expert system is used for describing complex production process consisting of many mutually dependent activities.

## Computer Engineering

Since the mid- 1980s, when the utility of fuzzy controllers became increasingly visible, the need for computer hardware to implement the various operations involved in fuzzy logic and approximate reasoning has been recognized. Either of the two modes of fuzzy computer hardware has some favorable features. Digital fuzzy hardware is characterized by flexible programmability, and good compatibility with existing computers, which are mainly digital, it is suitable for implementing complex schemes of multistage fuzzy inference. Analog fuzzy hardware, on the contrary is characterized by high speed and good compatibility with sensors.

## Robotics

The main subjects of fuzzy set theory that are relevant to robotics include approximate reasoning, fuzzy controllers and other kinds of fuzzy systems, fuzzy pattern recognition and image processing, fuzzy data bases, information reclamation systems and fuzzy decision making. In robotics, all these subjects and a lots of others are utilized as components integrated in the overall architecture of intelligent robots.

## Medical Field

Research into the use of artificial intelligence in medicine (AIM) started in the end of the 1960's and produced a number of experimental systems [8].

### Some types of medical expert system:

1. INTERNIST (Pittsburgh University, 1974) was a rule-based expert system for the diagnosis of complex problems in general internal medicine. This system covered 80% of the knowledge of internal medicine, but was criticized for the superficiality of their knowledge.
2. MYCIN (Stanford University, 1976) MYCIN was the first well known medical expert system developed by Shortleaf at Stanford University to help doctors, not expert in antimicrobial drugs, prescribe such drugs for blood infections
3. CASNET (Rutgers University, 1960) was an expert system for the diagnosis and treatment of glaucoma.
4. HELP -The HELP (Health Evaluation through Logical Processes) System is a complete knowledge based hospital information system. It supports not only the routine application of an HIS including ADT, order entry/charge capture, pharmacy, radiology, nursing documentation, ICU monitoring, but also supports a robust decision support function.[15]
5. EXPERT (Rutgers University, 1979) was an extension generalized of the CASNET Formalism which was used in creating discussion systems in rheumatology and endocrinology.
6. ONCOCIN (Stanford University, 1981) was a rule-based medical expert system for oncology Protocol management.

It was designed to assist physicians in treating cancer patients receiving chemotherapy [16],[17].

7. PEIRS-PEIRS (Pathology Expert Interpretative Reporting System) appends interpretative comments to chemical pathology reports (Edwards et al, 1993).
8. SETH - The aim of SETH is to give exact advice about the treatment and monitoring of drug poisoning.

The fuzzy expert system try to improve the daily activities of doctors and nurses in a hospital, providing tools to access patient or clinical records, to way patients and caregivers in a wireless, mobile and context-aware environment. In hospital software systems it is possible to find a large amount of information saved in several forms, like Electronic Health Records, inheritance information systems and medical images. Information can come from crucial care as well as any other sector of the hospital, fuzzy expert system in medicine helps very much in the integration of patient data, facilitating research, hospital management, formulation, clinical trials, clinical research, and patient care.

FES also helps to diagnosis of various disease like cancer, heart disease, back pain, anemia tuberculosis, asthma, diabetes, arthritis and HIV etc[18],[19],[20],[21].These systems are now widely used in hospitals and clinics. They are proved to be very useful for patient as well as for doctors in making decisions.

## CONCLUSION

So we can surely say that Fuzzy Logic and Fuzzy Expert System is very useful for many people concerned in research and development including physician, engineers (mechanical, electrical, civil, agricultural, chemical, aerospace\biomedical, computer, environmental, geological, industrial ) mathematicians, computer software developers and researchers, natural scientists (biology, chemistry, earth science, and physics), social scientists (economics, management, political science, and psychology), public policy analysts, business analysts because of that fuzzy logic is the flexible device to develop classification model with an easy to understand framework and constructed with simple and proficient language. In this paper, we give a systematic introduction to concepts in fuzzy logic as well as fuzzy expert systems and their utilization in the field of agriculture, medicine, environmental management, water management and engineering field. FES provides proficient tools for modeling ambiguity in human reasoning. A fuzzy expert system represents knowledge in IF-THEN rules, and implements fuzzy reasoning. So we can surely say that fuzzy expert system and utility of expert system in the various field of our life are expected to increase in the near future. Fuzzy Expert system has a wide scope in the development of our real life.

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