Study of Need and Framework of Expert Systems for Medical Diagnosis

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Abstract *: In general, in the real world applications, the information for analysis is incomplete, may be precise and have traces of uncertainty which make process of final decision a difficult task. In the field of medical diagnosis this same scenario is seen. To handle such problems artificial intelligence provides a solution by the way of expert systems. Fuzzy logic works on uncertainties and incomplete information and concludes which discrete decision. So many researchers have designed expert systems for medical diagnosis by using fuzzy rules. This paper is step to locate the researchers, their track in the way for designing expert system for various diseases in India. This survey paper would provide a path for developing fuzzy tools for medical diagnosis where there is still a scope of prediction accuracy. It provides the reasons for researchers to work in helping medical practitioners for precise diagnosis. In this paper, the various fuzzy rule based expert systems along with their individual feature are studied.*

Keywords *– Expert Systems, Fuzzy Logic, Medical Diagnosis, Artificial Intelligence and Rule based system*

I. INTRODUCTION

As per the human nature, he takes decision on the basis of his past experience or the evidence produced with the context of the problem. By profession, doctors too follow the same strategy when they are diagnosing diseases or treating patients. In medical diagnosis, doctors make diagnosis on the basis of matching precise symptoms or measurements. As per the experience, expertise, awareness and observation of the doctor, medical diagnosis varies from one medical practitioner to another.

The health care system constitutes people and resources to provide health care services to make the society healthy. In India, many people die due to improper treatment as an outcome of improper diagnosis. In urban India, there are preferably more heath care systems as compared to those in rural areas of India. Also another aspect is that in medical diagnosis there are many stages of the disease and if they are diagnosed at earlier stage then the possibility of recovery of patients increases but that too conditional that the diagnosis is correct.

In India almost 60% population lives in rural areas where the availability of medical practitioner is either less or they are least expertise in diagnosis. This leads to a huge number of deaths in rural are due to lack of proper medical diagnosis followed by proper treatment.

With the advent of technology and computerization of day to day working, medical practitioners too sought help of computers in many ways in their diagnosis. This paper would help the researchers to contribute and ease the process of medical diagnosis. Moreover this study would set up a path and motivate them to explore the various medical diseases and accelerate the medical diagnosis with good accuracy.

II. LITERATURE REVIEW

The need for good medical facility and facilitating the process for diagnosis and treatment motivated us to study the framework of various medical expert systems. In medical field there are many reported disease but with respect to our study we have considered around fifteen commonly identified diseases and the expert systems developed for them. In the reported work [1] the authors have tried to prepare a generalized system with many subsystems having independent intelligent controllers. It covered all the symptomatically guiding details and then accordingly through the combination of symptoms diagnoses the precise disease of the patient.

In the reported work [2], the authors prepared a fuzzy logic system which classified blood pressure within the range of 0 to 1 to help the patients having high level of blood pressure. Using fuzzy logic, the authors [3], designed automated fuzzy expert system for diagnosis of hypertension. They used age, diastolic blood pressure, Systolic blood pressure, and body mass index for diagnosing the risk of hypertension. In another approach for diagnosing hypertension, the authors [4] created a fuzzy expert system depending upon parameters for this system are body mass index, heart rate, blood pressure, age, genetics, physical activity, diabetes. As per results reported by author, the system was accurate, efficient and fast in diagnosing risk of hypertension.

The author [5] detected heart diseases in the person by using Fuzzy Expert System using symptoms cholesterol, chest pain type, blood pressure, maximum heart rate, old peak, blood sugar. They conveyed

patient about the presence of heart disease along with precautions accordingly from 0 to 1 discrete values depending upon Mamdani inference method with 92% accuracy. In the reported work [6], author have created a fuzzy expert system for diagnosis of heart disease considering symptoms resting electrocardiography (ECG),chest pain type, blood pressure, maximum heart rate, cholesterol, resting blood sugar, old peak (ST depression induced by exercise relative to rest), exercise, sex, thallium scan and age. Depending on these parameters this system diagnosed from 0 to 4 discrete values depending upon Mamdani inference method with 94% accuracy. In [7] using MATLAB, a five layer an advanced fuzzy system was used to the heart disease. In [8], the author determined coronary heart disease risk of patient for the next ten years by creating a fuzzy expert system. They update the patients with the ratio of the risk. They also suggested the patients for normal living, some diet specifications and the précised treatment. Using Mamdani inference system, a combination of data mining technique with fuzzy rules was used in [9] to reduce count of attributes for cardiovascular disease diagnosis which covered two steps classification and diagnosis of the disease and rate of risks of the respiratory diseases. A fuzzy rule based inference system for lung cancer accepted the symptom and as per symptoms gave the disease confirmation and its stage [10].

A joint effort of neural networks and fuzzy logic is reported in [11], for the diagnosis of carcinogenesis for both pre-clinical and post-clinical study. The prostate cancer diseases were diagnosed, analyzed and learnt by using a fuzzy expert system [12] in which it used age, prostate specific antigen (PSA), and prostate volume (PV) as input elements and computed prostate cancer risk (PCR). It also helped in rapid, economical, without risk manner as compared to traditional systems for finding the requirement of biopsy and ratio of risk of the cancer diseases. In the approach [13], the authors used a set of fuzzy rules to process data from breast cancer cases gave better results as compared to an expert for predicting the cancer risk. By using age and cancer state, the author [14], developed an expert system which revealed the patients, the categorized status as Serious, Not Serious and Very Serious.

For diagnosing asthma, the authors [15] used Saturation of oxygen, Day time symptoms frequency and Night time symptoms frequency, Peak Expiratory Flow Rate, Peak Expiratory Flow Rate variability for designing the self organizing fuzzy rule based system. Another fuzzy rule based expert system [16] for diagnosing asthma followed two part approach in which part A used six subsystems namely medical factors, allergic rhinitis, symptoms, symptom hyper-responsiveness, genetic factors, and environmental factors while part B used eight subsystems including response to short-term drug use, symptoms, challenge tests genetic factors, allergic rhinitis, and, bronchodilator tests, exhaled nitric oxide and PEF tests. At the end the defuzzified values provided the evaluation of chances and stages of asthma of the patient.

In the reported work [17], Malaria diagnosis and treatment was handled by fuzzy expert system (FESMM) which comprised of knowledge base that involved clinical observations, medical diagnosis and expert knowledge, fuzzification, inference engine and defuzzification. In the system for inference, root sum square method was used and for defuzzification centre of gravity was used. Another approach for diagnosis of Malaria was managed by simple, portable, more rapid accurate fuzzy expert system [18]. In another approach, the authors [17] contributed in diagnosis of mosquito borne diseases in rural areas. They developed the system in Matlab which diagnosed the disease efficiently in small amount of time on the basis of identified symptoms.

Depending upon clinical observation symptoms, the fuzzy expert system was designed using Visual Prolog Programming language ver. 7.1 in [20] to diagnose back pain. The authors, by combining fuzzy parameter (little, medium, high) with clinical observation symptoms like age, body mass index and gender, diagnosed the disease as well as gave precise treatment and advice.

To remove the ambiguity in immune cells level and viral load, the authors [21] proposed fuzzy mathematical model of HIV infection diagnosis. Another approach for diagnosis of HIV [22] used fuzzy cluster means for set of symptoms produced from the steps of methodological and analytical decision in sequence.

In an approach [23], the authors developed a fuzzy inference system for diagnosis of hypothyroidism. Also in the work, the author used fuzzy logic in diagnosis of cortical malformations, hepatitides, pulmonary embolism, diabetes, rheumatic and pancreatic diseases.

In the reported work [24], the author proposed a web-based expert system to automate the process and increase the accuracy of diagnosing Human disease.

For prescribing food, diet and medicine, to the patients, the authors in [25] prepared a rule based system that diagnosed fever and its severity on the basis of sex, age and body temperature.

For diagnosing the edge within color bone marrow microscopic images, in the paper [26] the author presented a Fuzzy Inference System. The system was robust with respect to variations in illuminant level conditions taking into consideration stability degrees of color components.

In the work [27], the author initially discussed various Medical Diagnosis Expert Systems to diagnose memory loss disease. They concentrated on very important diseases related to memory loss like Huntington's disease, Alzheimer's disease, multi-infarct and Parkinson's disease.

For detecting arthritis in early stage and to remove uncertainty and imprecision and give precise treatment as per its type, the authors [28] developed a fuzzy logic controller (FLC) based system using Zadeh's fuzzy set theory.

The authors [29] developed a Fuzzy Logic Based Smart Anesthesia Monitoring System for identifying critical events during anesthesia and for accurately diagnosing a hypovolaemia event in anaesthetized patients.

In a reported work [30], an expert system developed in MATLAB is presented which tried to determine and diagnose condition of migraine on the basis of symptoms provided.

III.   CONCLUSION

By going through the reported work and studying the present scenario, we came to a conclusion that especially in rural areas there is a great need for implementing medical diagnosis expert systems. In this paper, we have tried to highlight the various expert systems and the methods used by the researchers in the field of development of fuzzy expert system for diagnosis of various diseases. This would help to pass the expert knowledge to the forthcoming generations of doctors that would extend their services in field of medical diagnosis. Also the fuzzy expert system can help in complicated, difficult diagnosis of diseases.

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