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Enhancing Performance of Medical Expert System by Crisp Logic

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Abstract: Cancer disease diagnosis is difficult and needs higher level of expertise. Artificial Intelligence helps to solve the problem in Medical Expert System domain as expert people do. In the existing system, Fuzzy logic is used in medical expert system. This system is agroup of membership functions or rules and tilting toward multi-optional processing. Thiscreates confusion and gives a non-fixedresult which does not satisfy the user. The proposed system improve the performance of medical expert system by crisp logic, The Crisp Expert System defines imprecise knowledge and offers a linguistic concept with better approximation to medical condition. Crisp logic only permits conclusion which are either yes or no, there are also propositions with variables answers. The input variables their description value associated Crisp Sets and their indicator function indicates the membership of variables. The mathematical model developed is the pioneer attempt to predict the risk of Lung cancer disease and used to compare the performance of crisp expert system.

Keywords: Artificial Intelligence, Medical Expert System, Crisp Logic, Indicator Function, Boolean Logic.

I. INTRODUCTION

The Cancer diagnostic decision depends upon experience, expertise and perception of medical practitioner. Crisp logic presents powerful reasoning methods that can handle uncertainties and vagueness. The mathematical model developed is the pioneer attempt to predict the risk of Lung Cancer disease and used to compare the performance of Crisp Expert System.

A. Background

Fuzzy logic is used to model a nonlinear system which is complicated to model mathematically. Fuzzy logic is multi-valued. Using fuzzy expert system expert knowledge can be represented that use vague and ambiguous terms in computer.It is a system which is based on set of theory and continuous variables. Fuzzy expert system is based on set of symptoms and rules. They required number of parameters as an input which causes system gets enlarged and may not give satisfactory results. This creates ambiguity and difficulties for decision making. In that case the performance of the system gets reduced.

B. Motivation

In the domain of medical diagnosis, there are many variables that affect the decision process thereby causing the differences in the opinions of the practitioners. There are many uncertain risk factors, so sometimes disease is hard to detect.

In Medical Expert System, so many factors to analyse the disease diagnosis of a patient. That descends the performance of medical expert system. Motivated by the need of such an important tool, the Artificial Intelligence that is based on crisp logic for the diagnosis of the stages and types pertaining to Lung Cancer.

II. LITERATURE SURVEY

The need for best 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.

To remove the ambiguity in immune cells level and viral load, the authors [4] proposed fuzzy mathematical model of HIV infection diagnosis. Another approach for diagnosis of HIV [5] used fuzzy cluster means for set of symptoms produced from the steps of methodological and analytical decision in sequence.

In the reported work [6], 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 [7] prepared a rule based system that diagnosed fever and its severity on the basis of sex, age and body temperature.

For detecting arthritis in early stage and to remove uncertainty and imprecision and give precise treatment as per its type, the authors [8] developed a fuzzy logic controller (FLC) based system using Zadeh's fuzzy set theory. The authors [9] 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 [10], an expert system developed in MATLAB is presented which tried to

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determine and diagnose condition of migraine on the basis of symptoms provided.

III.EXISTING SYSTEM

The Fuzzy Expert System has proved its usefulness significantly in the diagnosis for the quantitative analysis and qualitative evaluation of medical data, consequently achieving the correctness of results. The expert system equipped with an inference mechanism (backward chaining, forward chaining or both) and requires knowledge to be entered according to a specified format. The object-oriented expert system is also developed to link the external databases with expert systems.
The expert system is reported for automatic generation of fuzzy expert systems using to typical diseases and decision support systems. The system has been found that the framework is developed for generation of fuzzy expert systems with respect to specific diseases general purpose is to diagnostic systems as well as for counselling of personal health. The expert system and frameworks are developed and used so far for the tasks of quantifying medical concepts, data interpretation inferential knowledge from the knowledge bases [2].

IV. PROPOSED SYSTEM

The Figure 1 Shows the flow chart diagram of proposed system. The proposed Medical Expert System is developing for cancer detection and obtaining type of lung cancer based on users selected symptoms using crisp logic. Crisp Logic is the method to give specific path for diagnosis and decision making because of their approach deal with uncertainties and ambiguity in the knowledge and information. Crisp Logic based on the crisp set. Crisp rule are IF-ELSE construction that have general form "IF A Then B ELSE C".

Designing of Crisp Expert System, take five symptoms which is related and mostly used for diagnosis lung cancer are:
1. Shortness of breath, 2. Chest pain, 3.Smoking, 4.Cough problem, 5.Weight loss.

These five symptoms were used as an input in crisp expert system. Based on these symptoms severity of lung cancer was predicted as an output.
In crisp expert system, patient data and disease history is store into the Training Database (TD). All symptoms are stored into the Knowledgebase symptom. Let, D be the training knowledge dataset. Which contain set of positive symptom (D+) and set of negative symptoms (D-). Under the Positive Symptoms and Negative Symptoms defined the dependent symptoms (D[i]). All symptoms is defined in the tree form.
Interface engine contains the crisp Rules and Indicator function, which is match the selected answer with the knowledgebase symptoms and find dependent symptoms. Interface engine keeps track the records input. It will synthesize data which will be depends to the particular type of disease.
The indicator function defined on a Positive Symptoms D+ that indicates membership of a symptom in a subset D[i] of D+, having the value of 1 for symptom in D+ then D[i] subset is executed. Otherwise, D- dataset is executed.
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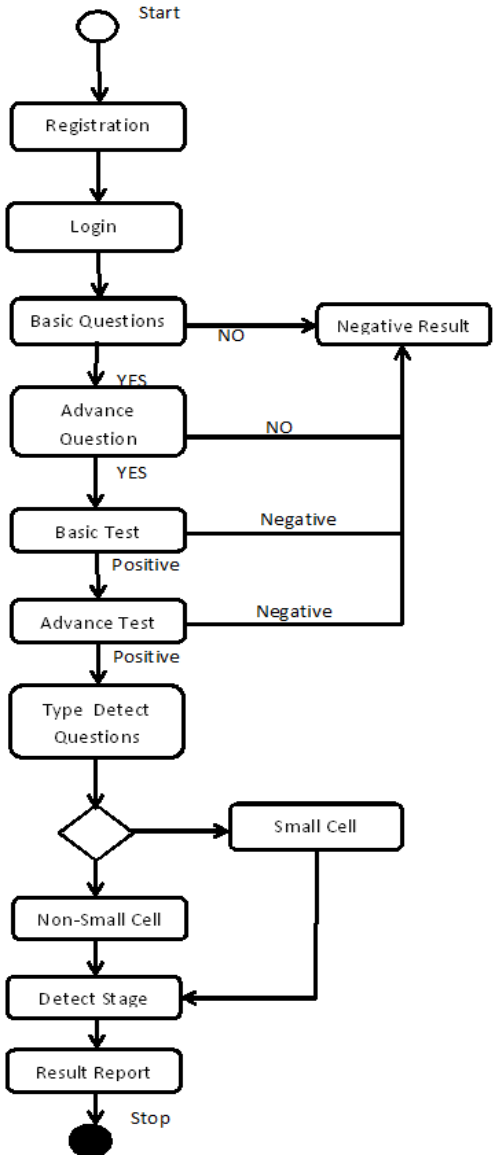

Figure1 Flow Chart Diagram of Proposed System

The Crisp Rule, 1 is used to denote the symptom select as Yes and 0 for symptom select as NO. Depend on the Crisp Rule Indicator Function of D[i] of some set D+, maps symptoms of D+ to the range (0, 1).
Enhancing the performance of the Medical Expert system, Crisp Chaining Algorithm, was proposed in to create a chain of all dependent symptoms which used the Crisp rules to match the symptoms. Using Crisp chaining

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algorithm searches the crisp rules until finds one where the IF clause is known to be true. When such rule is found, the Then clause, resulting in the addition of dependent symptoms. Otherwise,Else clause is resulting in the addition of new symptoms. Algorithm is executeduntil disease is found.

V. CRISP CHAINING ALGORITHM

UID: UserName
Que: Questions
QID: Question ID
QID Ans: Answer of QID
Key(UID, win status, QID)
1. Start
2. while(QID!=NULL)
3. If(QID==YES)
ADD QID Ans=1
If(QID Que == Que)
Gotostep2
Else
QID = QID + 1
Gotostep2
4. Else
ADD QID Ans=0
goto step 2
5. If(QID==NULL)
Display Result.

VI. PROPOSED ARCHITECTURE

The Figure 2 shows Architecture of proposed System basically has three main modules i.e. Training Database, Knowledgebase, and Interface engine.

1. Knowledge Base Symptoms: The knowledge base of symptom contain the knowledge necessary for understanding, formulating and for solving problems. To represent the facts and rules about a domain in same place. These facts and rules can describe all knowledge about diagnosis Lung cancer. It makes these available to the interface engine in a form that it can use. The facts may be in the form of background information built into the system or facts that are input by the user during a consultation. The important fact in diagnosis domain is the symptoms.

2. Inference Engine:Inference Engine is an intellect part of expert system. It is the portion of the system architecture that direct the system to choose the proper rule based on the information produced by the user[3]. The background information of lung cancer problem is analyze and classified according to the main symptom that distinguishes each problem. Knowledge is represent in the form of rules, using a rules, using a rule base approach IF – ELSE.

The proposed system for the confirmation of the disease and to determine which rules is selected to be fired.

The system starts asking the user for his/her symptoms and the user answers with a simple YES or NO. The system searches the inference rules, if the system is able to find the lung cancer, it will give the Type and stage of lung cancer with precautions. Otherwise, if the system is not capable of identifying the disease on the basis of symptom such as there is a similarity in symptoms, the system will ask some symptoms to the user.
Example 1 shows one of the production rules implemented in this system to determine lung cancer.
Example 1
If(You have slight cough?) YES
THEN You have continue cough from last
2-3 months?
You have coughing-up blood?
ELSE
You feel shortness of breath?
OR
If(You have slight cough?) NO
ELSE
You feel shortness of breath?

3. Training database: It consists of patients database used for manipulating an operation on the symptoms. This database provides the facility for determining the way for confirming result based on symptoms interface. It can be update or modified as per patients record formed.

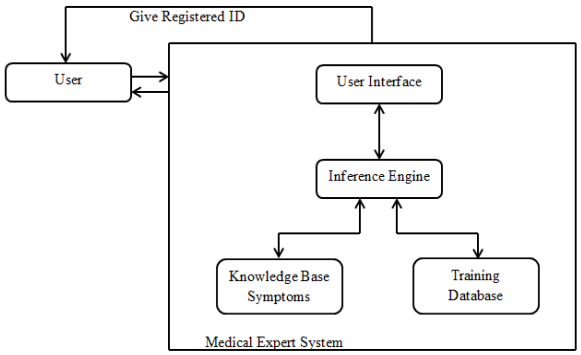

Figure 2 Architecture of Proposed System

VII. RESULTS AND DISCUSSION

A. Performance Matrix
Table Ishows that Time Complexity of Crisp Chaining Algorithm.

TABLE I TIME COMPLEXITY TABLE

Sr. No	Algorithmic Steps	Execution Times
1	while(QID!=NULL)	N
2	If(QID==YES)	Log(n)
3	ADD QID Ans=1 Gotostep2	n-1
4	Else QID = QID + 1 Gotostep2	n-1

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5	Else ADD QID Ans=0 gotostep2	n-1
6	If(QID==NULL) Display Result.	1

Time complexity for Crisp Chaining algorithm: nlogn

B. EXPERIMENTAL EVALUATION

In Table II indicates that if the Time comparison of Existing GreedyIL, Naive Bayes algorithm and Proposed Crisp Chaining algorithm.

TABLE III RESULT OF GREEDYIL, NAIVE BAYES AND CRISP CHAINING FOR TIME

Dataset Size	GreedyIL (Time)	Navie Bayes (Time)	Proposed Crisp Chaining (Time)
50	0.04	0.01	0.008
100	0.063	0.029	0.021
200	0.079	0.042	0.035
500	0.092	0.057	0.043
1000	0.12	0.072	0.063

In Figure 3 shows the comparison of time for Existing GreedyIL, Naïve Bayes and Proposed Crisp Chaining Algorithm and it is observed that, For every dataset size, 10 iterations are considered and average of 10 iterations is mentioned in above given table. Time is calculated by difference between the submission process is done to the results generated[11].

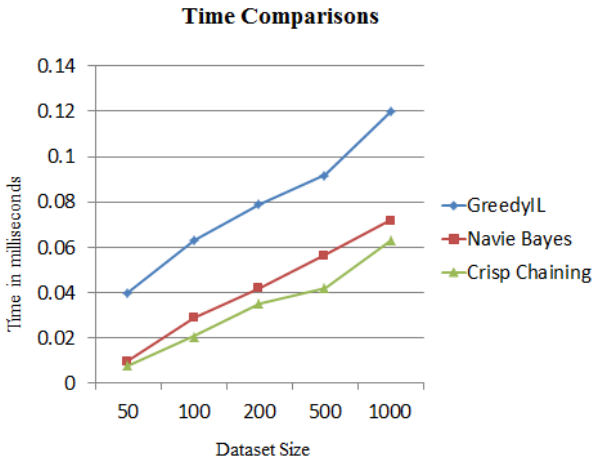

Figure 3 Dataset VS. Size

VIII. CONCLUSION AND FUTURE SCOPE

In the crisp logic system the uncertain and qualitative knowledge of the problem domain has been handled absolutely through integration of expert system technology with Crisp logic concept. The System model produced significant bases for performance assessment and adequate support in decision-making. Process Knowledge expressed in the form of crisp rules to solve problem in narrow domain. It is a very efficient, less time-consuming and more exact method to calculate the risk.

In future, expert systems may be developed that will understand human perceptions, gestures. The development of interfaces and sensory systems to acquire symptomatic parameters, their mapping and input mapping of responses of the human organs will be the potential paradigm of the research in future. Upload the test report then system scan the report and take decision.

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