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A Novel Fuzzy Rule Based Expert System for Allergy Detection

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ABSTRACT:
In this research paper, author proposed an expert system for allergy detection in human being. The proposed system will assist the doctors to diagnose the various allergies related to human being. Fuzzy rule have been used to develop the allergy detection system and further these fuzzy rules have been implemented in MATLAB. The developed system uses different cases to find out about the various characteristics of allergies. All the common types of allergies are detected by using various types of rules. So patients have no need to go to different doctors for diagnosis. A single system will be responsible for curing all types of allergies. The developed system uses three AI proficiency i.e. Fuzzy generator, Fuzzy system of logic and normal based reasoning. The developed system when tested with 20 patients shows 95%accuracy.
KEYWORDS: *Allergy, expert system, Fuzzy rule, diagnostic system.*

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I. INTRODUCTION TO EXPERT SYSTEM

Expert system is one of the areas of artificial intelligence. An expert system is a knowledge based system that works on the basis of rules that includes the knowledge and analytical skills of one or more human experts in a particular problem domain. The aim of the design of the expert system is to capture the knowledge of a human expert related 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 knowledgeable user. Expert system gives high quality experience, domain particular knowledge; apply algorithm, forward or backward reasoning, unsteadily and describing ability. Rule based expert system involves knowledge base, Inference engine, knowledge acquisition, explanation facility and user interface. For knowledge representation techniques, forward and backward chaining rules are used. Often the expert knowledge field is **"**fuzzy**"** in nature and includes a great deal of relating knowledge, so the knowledge engineer must be an expert in the work on knowledge elicitation.[20-21] Knowledge-based systems introduce a method that skilful can be captured, coded, and recycle. Basically, a knowledge-based system involved some representation of expertise, or a problem to be resolved, and some techniques to apply the expertise to a problem in the form of rules.

1.1 COMPONENTS OF EXPERT SYSTEM

I. Knowledge Base: The knowledge base include the knowledge essential for understanding, formulating and for solving problems. It is a storage warehouse of the domain particular knowledge captured from the human expert via the knowledge acquisition module. To introduce the knowledge production rules, frames, logic, semantic net etc. is used.

II. **Inference Engine**: Inference Engine acts as brain of expert system. It uses the control structure (rule interpreter) and provides procedure for reasoning. It acts as an interpreter which analyzes and processes the rules. It is used to perform an action of matching antecedents on the bases of responses given by the users and firing rules.

III. Knowledge Acquisition: Knowledge acquisition is the process of extracting and organizing knowledge from existent sources, so it can be used to a computer program for designing or extending the knowledge base. It is a small system which assists experts to design knowledge bases. For knowledge acquisition, techniques used are protocol analysis, interviews, and observation.

IV. Explanation Facility: Explanation Facility is a small system that describes the system's actions. The description can range from how the end or moderate solutions were get to justifying the requirements for additional data. Here user would like to ask the fundamental questions why and how and work as a tutor in sharing the system**'**s information with the user.

V. User interface: It is a means of communication with the user. It provides facilities such as menus, graphical interface etc. to make the dialog user friendly. Answerability of user interface is to changing the rules from its internal description (which user may not understand) to the user understandable form. The relationship between these components and the general architecture is shown in figure 1.

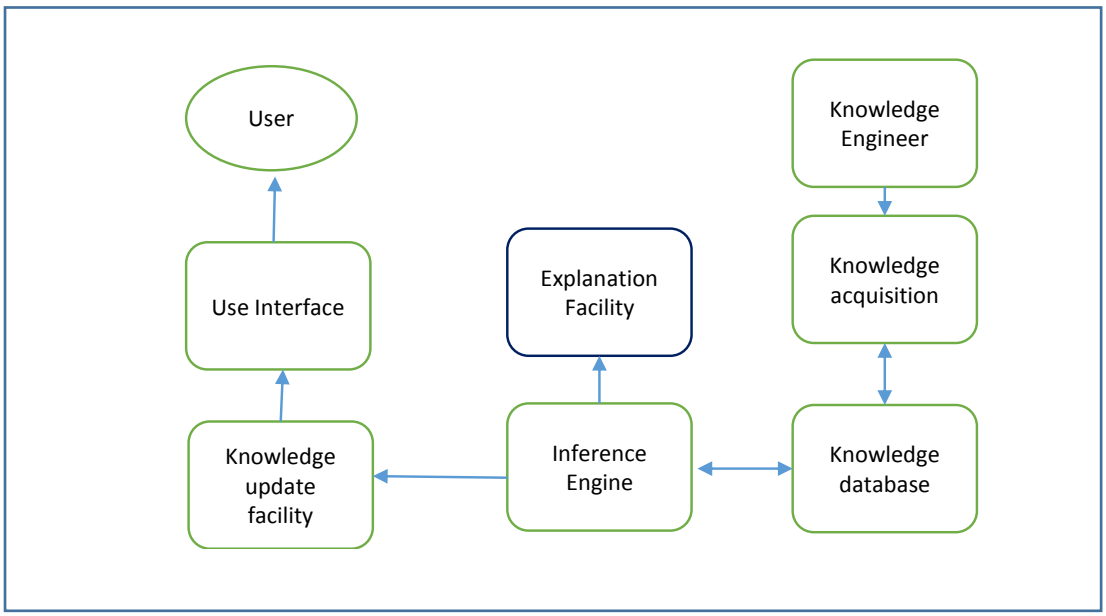

Figure 1: General architecture of Expert system

The figure 1 shows the relationship between five major components of expert system i.e. knowledge base, inference engine, knowledge acquisition, explanation facility and user interface.

1.2 Introduction to Allergy

Allergy arises when a person's immune system responds to environment elements that are dangerous for most people. These elements are known as allergens. There are many agents that causes allergy. These include allergens Pollens, spores of mold, animal dander, house dust, foods, feathers, dyes, soaps, detergents, cosmetics etc. When someone is unprotected to the allergen then immune system again generates large number of antibodies that cause to break down of mast cells which contain chemicals like histamine. This procedure is called sensitization. Sensitization may take days to years. In some cases sensitization begin as the person influenced shows symptoms but never fully establish the allergy to the allergen. Various symptoms of allergy include sneezing, shortness of breath, wheezing, runny nose and eyes, pain over the sinuses, coughing, skin rashes, swelling of the lips or face, itching eyes, ears, lips, throat and roof of the mouth, nausea, vomiting, abdominal cramps and diarrhea. Various types of allergies include allergy due to food, pet allergy, insect byte allergy, skin allergy, drug allergy etc. some of the most common allergies are described below:

A. Food Allergy

Food is an integral part of life; however, for some, it can also be deadly. Sufferers of food allergies must avoid, for example, certain cereals, nuts or fish at all costs, and scrutinize the list of ingredients of every food item to make sure that it is safe. The consequences of accidentally eating just a tiny morsel of the wrong food can be serious: breathing difficulties, swelling of the lips and throat, abdominal cramps and vomiting, and possibly death.

B. Pet Allergy

Most of people like Fido and Fluffy, but as soon as they creeping up on your lap, you're left with a runny nose and watery eyes. Allergies to pet hair stem from the oil that animal's secrete from their coats as well as from the protein in their hair.

C. Insect Bites Allergy

An insect stings or bites as part of its defensive mechanism. However, when an insect bites, it leaves proteins in the skin that are also allergy triggers for some people. The allergy can manifest as mild swelling and

itchiness, but it can also be life-threatening for some people. Five insects' stings cause allergic reactions that are honeybees, hornets, wasps, yellow jackets and fire ants. The severity of an insect sting reaction varies from person to person and from one sting to the next. You may not experience an allergic reaction until you have been stung several times.

D. Skin allergy

Bumps, itching, redness and some other skin conditions are much common, and their cause may not be easily observable. Rashes can be caused by number of objects, involving plants (poison ivy), allergic response to a medicine or a food, or sickness (measles or chickenpox). Eczema and hives, both of which are related to allergies, are two of the highly common skin rashes.

E. Drug Allergy

People with drug allergies may feel symptoms unconcerned of either their medicine comes in liquid, pill or inject able form. When you are not feel allergic symptoms at the beginning you start take a drug, your body could be generating antibodies to allergy. As a result, the next time you take the drug, your immune system may see it as an attacker, and you will develop symptoms as your body releases chemicals to fight against it.

F. Sinus infection

Sinus infection is a biggest physical issue. It trouble to 31 million people in the United States. Americans spend more than $1 billion every year on over-the-counter medications to treat it. Sinus disease is responsible for 16 million doctor visits and $150 million spent on prescription medications. People that are suffer from allergies, asthma, structural blockages in the nose or sinuses, or people with powerless immune systems are at higher risk.

H. Asthma

Asthma is a general lung condition that causes breathing problems. People of all ages influenced with asthma. Mostly starts in childhood, although it can also appear for the first time in adults. There's currently no solution for asthma, but there are simple treatments that can help keep the symptoms under control so it doesn't have a significant shock on your life. [16] Some people, especially children, may eventually grow out of asthma. But for others it's a lifelong condition.

I. Dust Allergy

Dust allergies make it problematic to breathe and may cause asthma symptoms, for example wheezing, coughing, tightness in the chest and shortness of breath. Dust particles are stubborn allergens because they invisible to the naked eye and they present dust, which is available in just about every home and workplace setting. Some people become itchy due to dust. People with dust allergies of generally suffer the most within their own homes or in other people's homes. Oddly enough, their symptoms generally worsen during or instantly after vacuuming, sweeping and dusting. The process of cleaning can stir up dust particles, making them easier to inhale.

J. Eye Allergy

Eye allergy is the most common allergy influences the eyes. Numerous people with allergies get allergic conjunctivitis when their eyes come in touch with an allergen. The allergen triggers the release of histamine. This usually results in itching, redness, burning or tearing in eyes. These are the thin membranes covering the eyelids and the uncovered surface of the eyes. Eyes Allergy can be seasonal or perennial stream.

K. Allergic rhitins

An allergen is differently harmless element that causes an allergic response. Allergic rhinitis is an allergic response to particular allergens. Pollen is the highly common allergen in seasonal allergic rhinitis. These are allergy symptoms that arise with the change of seasons. You can treat your allergic rhinitis in various methods. These involve medications, home remedies and possibly alternative medicines. Talk to your doctor before taking any other medicine measure for allergic rhinitis. There is two types of allergic rhinitis are seasonal and perennial. Seasonal allergies generally occur in the spring and rainy season and are mostly reaction to outdoor allergens such as pollen. Perennial allergies can arise whole year, or at any time among the year in response to indoor elements such as dust particles and pet dander.

II. LITERATURE REVIEW

Morais, Sergi, et al. 2020[32] in their research discussed the major global problem i.e. intolerance, toxicity and allergy related to food allergy. This research work mainly reviews the current analytical approaches in food-specific IgE biosensing, including immunochemical and lateral flow assays, electrochemical biosensors, array technologies, nanomaterial-based techniques, label-free sensors and microfluidic systems. The point is to move a nearer additionally invigorating situation for development in the food sensitivities theme. Viewpoints on the fate of biosensor innovation applied to in vitro IgE judgments are likewise offered from a scientific perspective.

Smita Sushil Sikchi, et al,[2016][14] reviews the trend in development of FES and application potential over past two and half decades in the medical field, based on the references of articles from several

journals, proceedings and web media. In order to investigate the significance of FES for medical diagnosis, the past work is reviewed and suggested the future scope.

J. Angeline Felicia, et. al. [2016][16] showed that Monitoring of Vital Physiological Parameters can be helpful in detection and prevention of allergy. This is based on the system for analyzing and processing the vital physiological signs such as ECG, temperature, etc., to measure heart rate, blood pressure and temperature of the human body is presented in this paper. The collected signals are imported and handled by Linux processor via microcontroller over bridge communication. Suitable filters have to be designed to suppress the noises present in the signal and to obtain the original information.

A.S.Deshpande, et al , [2016] [1] discussed various automatic skin cancer detection and analysis system with the use of generally available software for doctors. IN all these systems, image is pre-processed by using median filter for removing the noise. Then image is segmented by using Fuzzy C-Means (FCM). Then Grey Level Co-Occurrence Matrix (GLCM) is used for textural feature extraction. Extracted textural features are energy, homogeneity, entropy, contrast, correlation, cluster shade prominence, variance information measure of correlation, dissimilarity. Then Classification of skin cancer is done by using Support Vector Machine (SVM).

Chanchal Sharma, et al,[2015][9] In their research work proposed fuzzy rule based system for treatment of patients suffering from epistaxis. These fuzzy rules are applied on the basis of the symptoms seen in the patient. For the identification of disease Epistaxis, firstly fuzzy rules applied based on the symptoms selected by the patient and secondly for the improvement of developed system, expert learning system is proposed by which disease diagnosis accuracy has been enhanced. Author mentioned that by using this expert learning system, the doctors can find the allergy with more probability. The proposed system shows improved interpretation accuracy in diagnosis of epistaxis in patient.

V. Saravanan et al., [2014] [15] describes the path to personalized medicine needs the use of new and customized biopharmaceutical products containing modified protein. Hence, assessment of these products for allergen city becomes mandatory before they are introduced as therapeutics. Despite the availability of different instrument to predict the allergen city of protein, it corpse challenging to predict the allergen and non-allergen, when they percentage significant sequence law of similarity with known non-allergens and allergens, respectively.

S. Krishna Anand, et al., [2013][13] discussed that use of a wide variety of Soft Computing techniques in variety of applications and medical field is no exception. Although its usage is predominant in areas like cardiac and diabetes, sufficient amount of research has not been conducted in exploring its usage in the functioning of lungs. Keeping in view this aspect, the work carried out places a great deal of importance in the way the lung functions and also in detecting problems associated with lungs primarily Asthma and Chronic Obstructive Pulmonary Disease (COPD). A fuzzy expert system has been designed that takes into account details of various patients and identifies the problem the patient is likely to encounter.

Tajul Rosli Razak, et al., [2013][17] proposed a scheme to diagnose early symptom of shuttle i.e. grippe or avian influenza disease using a fuzzy expert approach which is a combination of expert scheme and fuzzy organization of logical organization. A Doctor of the Church will be a domain expert in this study to obtain selective information about the bird flu disease. The expert system will convert the information obtained from a doctor to be a rule base and then stored in knowledge based. Fuzzy logic will take portion as an inference engine that will detect whether the patients has a bird flu disease infection or not. The consequence and 3 senses of finding from the studies had shown disease.

Munirah M.Yusof, et al,[2013][8] described that Human center abuse tends to assume that certain cutis disease are not severe job. If their children peel had been infected by certain tegument disease, most of the parent or shielded will try to goody this infected tegument on their own. However, some clip s this discourse was not suitable with that particular peel problem and can shuffling it became worse. This paper proposes a development of an Online Children Cutis Disease Diagnosis System. This governing body enables drug user to recognize skin disease faced by children through online and provide user advises or discourse in shorter meter full point of time. To do so, user will then service in detective piece of work the skin disease and provide discourse prompting.

Raad Alwan,[2013] [10] showed an epitome Expert Organization (ES) is flesh to deal and diagnose disorder in Urology domain, where the cognition had been acquired from a specialist and medical text books, and tested in real number world on a phone number of event under the supervision of specialists' medical team. The architecture of the Urology Expert System (UES) contains five subsystem : the production rule noses representation has been used in the knowledge base subsystem in order to model the cases that the system batch with. A backward chaining scheme is the control strategy that has been used in the Inference Engine subsystem.

Susan Waserman et al,[2011][18] showed that Food for thought allergic reaction is defined as an adverse immunologic reaction to a diet airy protein. Food-related chemical reactions are associated with a broad array of mansion and symptom that may involve many bodily arrangement s including the Sir Robert Sir Robert

Peel, gastrointestinal and respiratory nerve pathway, and cardiovascular system. Food allergic reaction is a wind cause of anaphylaxis and, therefore, referral to an allergist for appropriate and timely diagnosing and discussion is imperative.

Ali.Adeli, et al, [2010][2] designed a Fuzzy Expert Organization for mettle disease diagnosis. The designed placement of rules of rules radix d on the V.A. Medical Kernel , Long Beach and Stephen Grover Cleveland Clinic Basis information base. The system has social unit y triad input dramaturgy of operations and one production subject area. Input fields are chest of drawers pain in the neck orifice character , pedigree pressure, cholesterol , easing ancestry sugar, maximum nerve charge per unit , resting electrocardiography (Cardiogram), physical exertion , old crest (ST depression induced by exercise relative to rest), thallium scan, sex and age.

Maryam ZOLNOORI, et al,[2010] [7] describe Asthma, a chronic lung disease, has increasing pace in developing countries. Fatal bronchial asthma attack as a sudden aggravation of asthma threatens the life of asthmatic patient role, even patient with a consideration of good-ascendency asthma. So prognostication the peril of fatal asthma is a great contribution decreasing the opening of asthma death rate and unwholesomeness. In this paper a fuzzy expert organization is developed for prediction of fatal asthma. Fuzzy-principle, modular representation of variables in regard to patient role' percept of the disease, and minimizing the need for science laboratory data are the most important lineament of this arranging.

Hirosato Seki, et al.,[2010] [4] Mentioned that conventional fuzzy inference method can be improved by using a single input rule modules and connecting it to fuzzy inference method (SIRMs method). This will results in reduction of number of fuzzy rules drastically. Additionally, Seki et al. have proposed a useful sort SIRMs strategy which sums up the ensuing piece of the SIRMs technique from genuine numbers to capacities. In this paper, we determine a learning calculation of the useful kind SIRMs strategy from the steepest plunge technique, and the useful sort SIRMs strategy is demonstrated to be better than the ordinary SIRMs strategy and neuro-fluffy strategy by applying to ID of nonlinear capacities and a clinical determination framework.

Mir Anamul Hasan,et al,[2010] explained that Human disease diagnosing is a complicated process and requires high level of expertise. Any attempt of developing a entanglement -based expert organization dealing with human disease diagnosis has to overcome various difficultness. This paper describes a projection work aiming to develop a web-based fuzzy expert arrangement for diagnosing human disease. Authors use linguistic rules to describe systems. This inquiry project focal point on the enquiry and development of a web-based clinical tool designed to improve the quality of the exchange of wellness information between health care pro and patient. Practitioners can also use this web-based tool to corroborate diagnosis. The proposed system is experimented on various scenario in order to evaluate its carrying into action. In all the cases, proposed system exhibits satisfactory final result.

St. Karagiannis, et al,[2007] [11] In this research work author proposed an expert system that will help in finding the patient on the basis of their medial background. The system is specially designed to detect the patients suffering from skin disease and help in the search for suitable skin test selections. Skin testing is the tool used most widely to diagnose allergies. The language of expert systems CLIPS is used as a tool of designing. Further, author mentioned that the proposed expert system was tested with certain medical cases and the system produced suitable successful skin tests.

Martha Merlyn, et al., [2010] [12] showed that the Artificial word military performance is a leg of computation device science capable of analyzing composite medical information. The labor of medical diagnosis is a coordination compound one, considering the stage vagueness and uncertainty focusing, especially when the disease has multiple symptoms. Fuzzy logic restrainer (FLC) was used to invention a organization of linguistic rule of convention for the diagnosis of eosinophilia. Eosinophilia is a common disease which is prevalent in masses. The effectiveness of FLC depends on the ruler formed and Reading of Earth's surface data. The operation of our FLC was predicted about 82.5% and a minimum misapprehension was obtained as 10.0%.

Young Moon Chae, et al, [1992] [19] developed a DSS to diagnose Nasal allergy. This system has been developed as advance version of the existing rule based system. The authors used neural network as replacement of rules. Authors developed and compare three approaches i.e. statistical approach, rule based approach and hybrid approach. On evaluating the system, the hybrid approach performed the best. Author used the output of hybrid approach and developed a back propagation based neural network system. This system unlike other systems gives the output in the form of probabilities.

III. METHODOLOGY USED

Development Process of Various Type of Allergy Diagnosis Expert System

The medical diagnosis system process is classified into following categories

1. Collection of Symptoms Data: The most important information about the patient's medical record present in the hospitals and the symptoms that are present is gathered by the medical experts or physician. This

information considered as the 'subjective information'. This information is further helpful for diagnosis of particular disease.

2. Interaction with Expert: The next step is to interaction with the expert or specialist**.** The expert performs the everyday problems related with disorder of human body parts. It will tell you the more details of the common diseases which found in our daily life.

3. Categorization of Diseases and Symptoms: Afterward interacting with the proficient, system creates the list of diagnosis that represents the sign and symptom of patient. This phase show the classification of the sign and symptoms. Due to the presence of one symptom the disease can change. Giving help the medical diagnosing system for Human disease diagnosing, to preparing a knowledgebase environment is a complex work due to the specific importance of whole data of medical.

4. Rule Formulation: Fuzzy rules of the sign and symptom and the diseases are implemented here. In this phase we produced weighted fuzzy set rule to perform with the medical diagnosing matters from the training data. It is a causative rule (In which IF part truly causes the THEN part to happen a**s** an issue) based medical diagnosis expert system. The entire symptom is evaluated to make sure the correct symptom for the correct disease. Rule base is designed for the human disease using the symptom that is added to the database is correct. [9]

5. Expert Review of Rule Base: In this phase, we examined the rule viewer of the rule base. It gives to the result. On the basis of these symptoms particular disease is examined and suggests the patient to a particular specialist. The disease is evaluated on the basis of knowledge of expert.

6. Finalization of Rule Base: In this phase the final result is examined on the basis of the sign and symptom.

7. **Designing of User Interface for Interaction:** The last phase of the development process is designing of graphical user interface. This Graphic user interface will help to the user to deal with this expert to find the particular disease. This system the symptoms are input and a disease is output. After finding the disease it suggests the specialist for the treatment. The medical diagnosis system is designed using the MATLAB R2017a. The overall database is designed using the fuzzy logic. The complete flowchart for development of proposed system is shown in following figure 2:

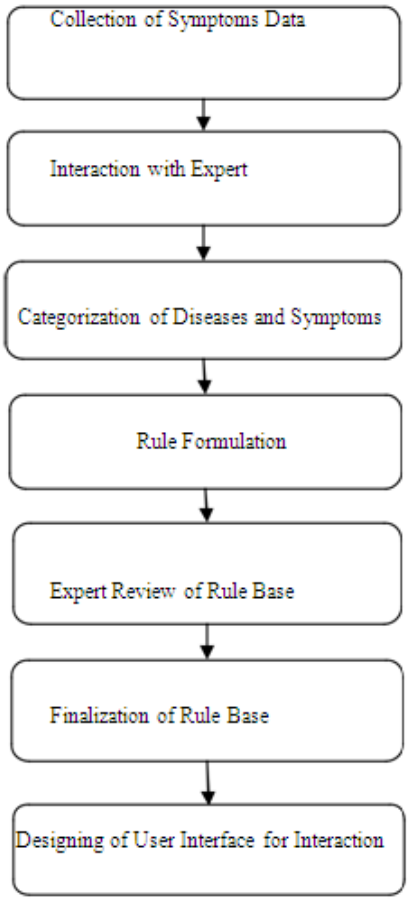

Figure 2 Development process of allergy expert system

Algorithm1. Fuzzy Expert system for Allergy

1. Inputs: - symptoms.
2. Output: - Diagnose the particular Disease with the stage of disease and suggest the specialist
3. Input variable allot with fuzzy variable. And has the membership function.
4. Rules are prepared on the basis of the membership function.
5. Concluded disease is verified on the basis of the weight age of input variable.

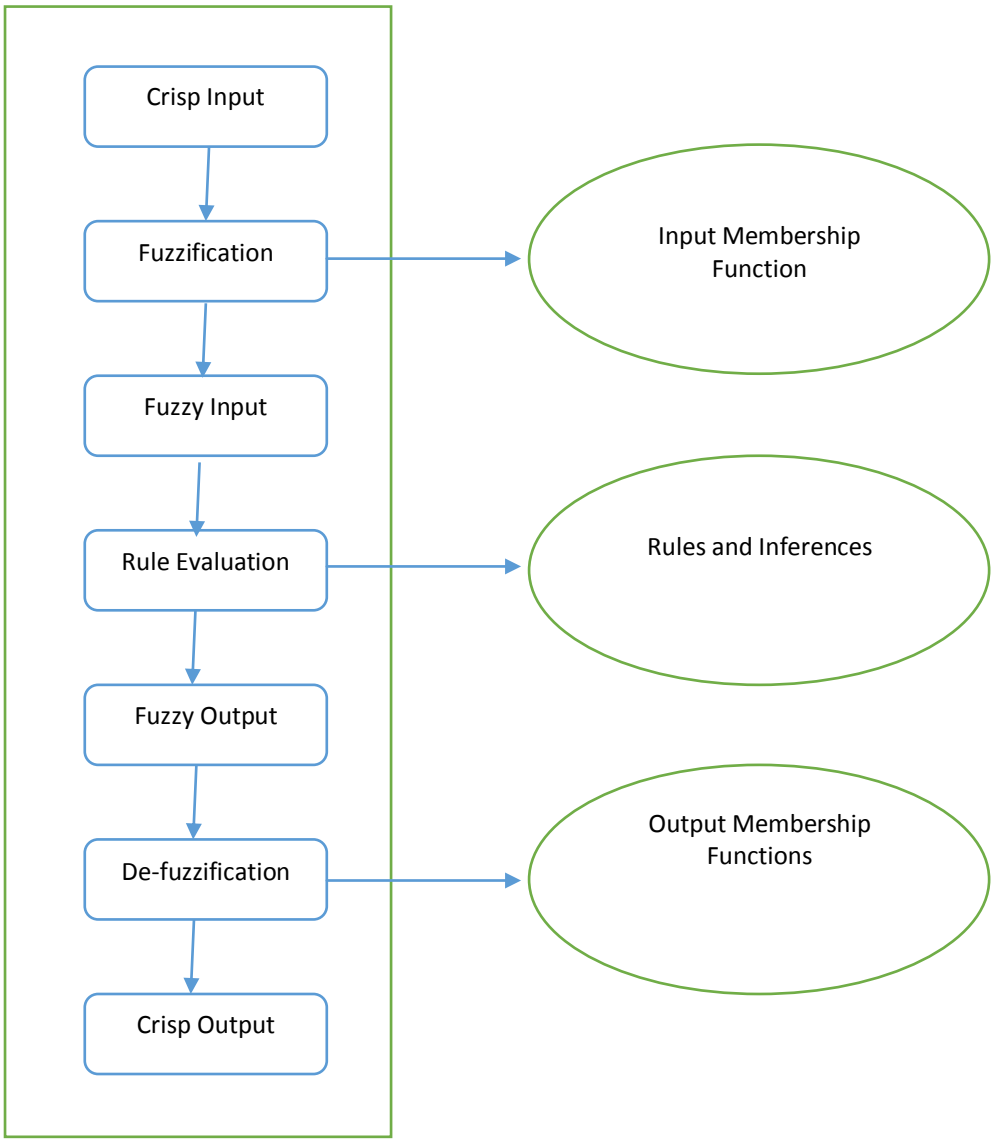

Figure 3: Flow of Present Work

5.1 Fuzzy Rules Methodology in Various type of Allergy Diagnosis Expert System

In this research, we diagnose the results from the experience or observation and the sign and symptoms of the patient. If we examine the procedure which is followed by the physicians to identifying the disease, that is the simpler method. Some symptoms are occurring at a high range or other are occur at low or moderate range. Example in figure4 illustrate the how to diagnosis the disease Diagnosis-B- (symptom-B is low & symptom-A is high & symptom-D is moderate)

Diagnosis B - (symptom-B is low & symptom-A is high).

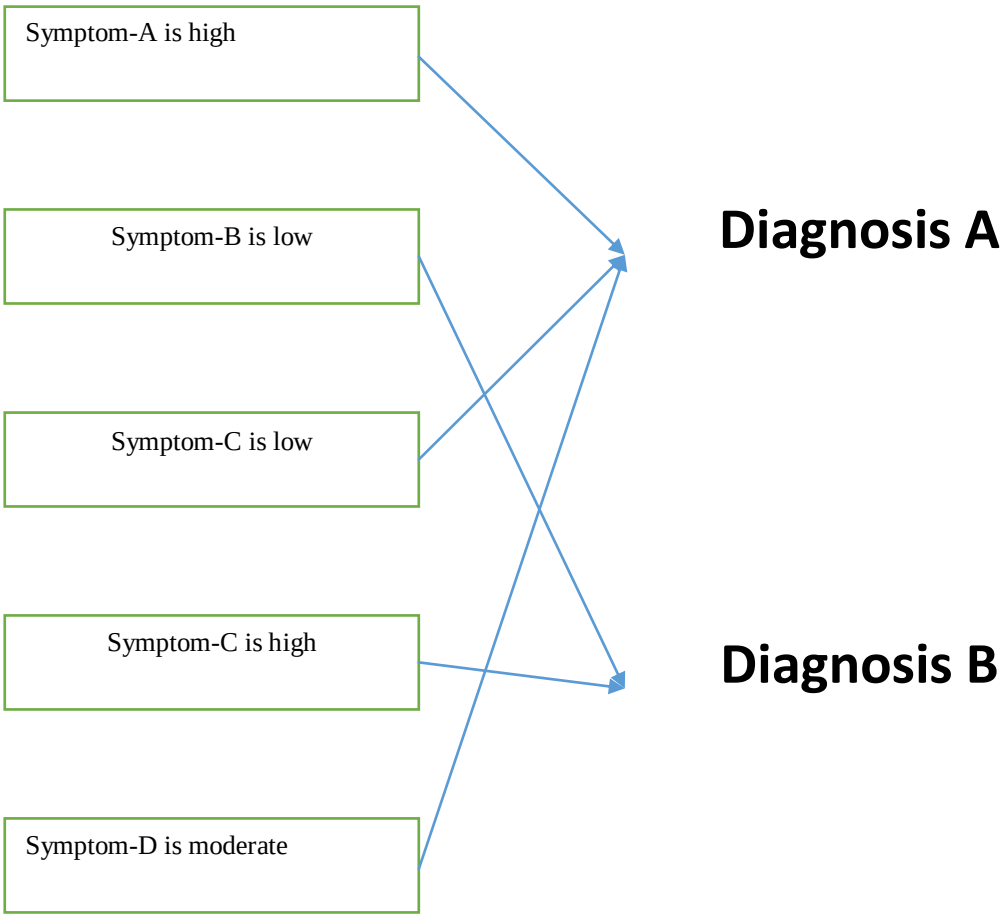

Figure 4: Disease diagnosis

Identification of parameters: This is the most important part to take into the consideration. The symptoms play significant role in cause of the disease. In this paper we find the different diseases that are associated with symptoms of each specialist.

Choice of membership function: The ability of system is calculate by the selection of membership function that is used for each input and output parameters. There are number of symptoms that do not have a specific values and the membership function are selected for each of the parameter that is used. These membership values are taken on the basis of acquisition method. Likewise the number of membership function used there are several more factors need to be take consideration and these factors are the conjunction, disjunction, aggregation, kind of parameters and the range of the parameters. The properties of every fuzzy variable are represented using triangular and trapezoidal (for the input variables such as symptoms) and the triangular (for the Outputs). The fuzzy set represented by a number of membership function. Author Designed rules for the various types of allergies to diagnosing the allergic disorder. This expert system deals with the Food allergy, Pet allergy, Dust allergy, Eye allergy, Skin allergy, Drug allergy, Asthma, Allergic rhitins, Insect bite allergy, Anaphylaxis, Sinus infection.

IV. RESULTS AND DISCUSSION

In this research, we have designed an Expert system for various type allergies. Diagnosis of disease is solely based on the symptoms of the allergy using Fuzzy Logic. Expert system is developed for the diagnosis of allergy on the basis of symptoms of allergy. For developing the Expert system for various allergies we have used fuzzy logic .The performance of the system was analyzed by comparing the result of various type allergy

expert systems with the clinical report of the patients. The result of 20 allergy patients tested by this system is presented in Table 1.

Table 1 Result of testing various type allergy expert systems

Variable Patient	HE	TIM	WNC	SLFT	AP	RP	SLDB	JE	RF	SYSTEM OUTPUT	RESULTS COMPARED WITH CLINICAL REPORT
Patient 1	3	4	5	0	0	0	0	0	0	Food allergy at mild to moderate stage	Correct
Patient 2	3	0	0	2	0	0	0	2	3	Insect byte and eye allergy at 1st stage	Correct
Patient 3	0	3	0	0	2	4	5	0	0	Drug allergy and anaphylaxis at mild to moderate stage	Correct
Patient 4	4	5	0	0	0	0	0	0	0	Skin allergy at 2nd stage	Correct
Patient 5	0	0	0	0	0	0	0	5	6	Eye allergy at 2nd stage	Correct
Patient 6	2	3	3	2	0	0	0	0	0	Food allergy at 1st stage	Correct
Patient 7	0	0	0	0	4	5	4	0	0	Anaphylaxis at 2nd stage	Correct
Patient 8	0	0	0	0	0	0	0	1	2	Eye allergy at 1st stage	Correct
Patient 9	3	4	2	3	4	0	0	0	0	Food allergy at mild to moderate stage	Correct
Patient 10	4	5	4	6	5	0	0	0	0	Food allergy at 2nd stage	Correct
Patient 11	0	0	0	0	0	3	4	2	4	Anaphylaxis and eye allergy at mild to moderate stage	Correct
Patient 12	0	0	0	0	4	4	5	0	0	Anaphylaxis at 2nd stage	Correct
Patient 13	7	6	8	7	0	0	0	0	0	Food allergy at 2nd stage	Incorrect
Patient 14	1	2	1	2	1	0	0	0	0	Food allergy at 1st stage	Correct
Patient 15	0	4	5	5	4	0	0	0	0	Insect byte and food allergy at 2nd stage	Correct
Patient 16	7	8	0	7	7	0	0	0	0	Insect byte and drug allergy at 3rd stage	Correct
Patient 17	0	0	0	0	0	0	0	7	8	eye allergy at 3rd stage	Correct
Patient 18	0	0	0	0	5	4	3	0	0	Anaphylaxis at 2nd stage	Correct
Patient 19	0	3	2	3	1	0	0	0	0	Food and insect allergy byte at 1st stage	Correct
Patient 20	4	5	3	4	3	0	0	0	0	Food allergy at first stage	Correct

In above table 1, HE=Hives and Eczema, TIM=Tingling and Itching in mouth, WNC=Wheezing and nasal congestion, SLFT=Swelling of lips, face and tongue, AP=Abdominal pain, RP=Rapid pain, SLDB=Sensation of a lump in your throat that make it difficult to breathe, IE=Itching in eyes, RE=Redness in eyes.

Out of 20 patients 19 patients result is correct.

Total patients (TP)=20, Correct result(CR)=19, Incorrect result(IR)=1
So overall accuracy of the system is given by
Accuracy = CR/CR+IR*100 = 19/20*100 = 95

V. CONCLUSION AND FUTURE SCOPE

This system can be used by the doctors, physician in our daily life. The proposed medical Diagnosis expert system, one can allow the physician to follow the same process to diagnose the diseases and he/she will able to suggest the specialist in easy way. A lot of research has been done in medical field but more research increase the accuracy of the system. So many properties of this system remain to investigate. Future application for the database should be good. Now a day's most of the modern hospitals use the computer based records than paper based. Now it would be more easily to acquisition the data from records for the machine diagnosis. An expert should evaluate the quality performance of this system.

In future this system can be used for diagnosing the diseases of child, disorder of the female reproduction system. This system can be implemented using neuro-fuzzy method for diagnosing the chronic diseases. And also can be combined with service-oriented architecture and soft-bus idea, could proposes a design solution of medical expert system based on service soft-bus architecture. According to the medical branch lifeline and rebuilding of the definition of medical expert systems forming a reasonable tree-Expert System has great significance to enhance the efficiency of query and diagnosis and reasonable classification of expert database. Innovation in Medicine & Healthcare is a conference covering innovative approaches to meeting the needs of both practitioners and patients internationally.

- Integrated medical systems to assist in delivering quality health care during spaceflight and exploration.
- Expert and case-based reasoning systems for medical diagnosis and decision support in medicine and healthcare.
- Medical data mining; medical informatics; smart patient record systems.
- To assist the physicians, doctors.

REFERENCES

[1]. Deshpande, A. P. A., and Gajbar Amruta.2016. Automated Detection of Skin Cancer and Skin Allergy. International Journal of Advance Research in Computer Science and Management Studies. Vol.(4). Issue 1. 248-261.

[2]. Ali.Adeli, Mehdi.Neshat, 2010. A Fuzzy Expert System for Heart Disease Diagnosis, international multi-conference of engineers and computer scientists (2010)

[3]. Cornelius T. Leondes. 2002. Expert systems: the technology of knowledge management and decision making for the 21st century. 1–22.

[4]. Hirosato Seki. 2010. Non linear medical Diagnosis system using Fuzzy Inference ,International Journal of Innovative Computing, Information and Control ICIC International c 2010 ISSN 1349-4198 Volume 6, Number 11,(November 2010)

[5]. Jackson, Peter. 1998. Introduction To Expert Systems (3 ed.), Addison Wesley, p. 2, ISBN 978-0-201-87686-4, (1998).

[6]. Mir Anamul Hasan, Khaja Md. Sher-E-Alam and Ahsan Raja Chowdhury. 2010. Human Disease Diagnosis Using a Fuzzy Expert System, Journal of Computing, Volume 2, Issue 6, ISSN2151-9617, JUNE 2010)

[7]. Zolnoori, Maryam, Mohammad Hossein Fazel Zarandi, and M. O. I. N. Mostafa. 2011. Fuzzy rule-base expert system for evaluation possibility of fatal asthma. Journal of Health Informatics in Developing Countries 5.1..

[8]. Munirah M. Yusof, Ruhaya A. Aziz, and Chew S. fei. 2013. The Development of Online Children skin Diseases Diagnosis System International Journal of Information and Education Technology, ISSN : 2230-7893 , Vol.3, No. 2.

[9]. Sharma C, Choudhary T.2015. A Web Based Fuzzy Expert System for Epistaxis Diagnosis, International Journal of Computer Science and Information Technologies, Vol. 6 (4).

[10]. Raad Alwan.2013. A Diagonstic Fuzzy Logic Expert System for Urology Diseases International journal of advanced Research in Computer Science and Software Engineering Volume 3, (October 2013).

[11]. St. Karagiannis, A.I.Dounis,T.Chalastras, P. Tiropanis, and D. Papachristos. 2007. Design of Expert System for Search allergy and Selection of the Skin Tests using CLIPS,International Journal of Medical, Health, Bioengineering and Pharmaceutical Engineering Vol:1, No:7.

[12]. S. Martha Merlyn, S. Shiney Valentina et al. 2010. Application of Artificial Intelligence in the Diagnosis of Eosinophilia, Journal of Health & Medical Informatics.

[13]. S. Krishna Anand, R. Kalpana et al. 2013. Design and Implementation of a Fuzzy Expert System for Detecting and Estimating the Level of Asthma and Chronic Obstructive Pulmonary Disease, World Applied Sciences Journal 23 (2): 213-223.

[14]. Smita Sushil Sikchi, Sushil Sikchi, Ali M. S. 2013. Fuzzy Expert Systems (FES) for Medical Diagnosis, International Journal of Computer Applications (0975 – 8887) Volume 63– No.11.

[15]. Saravanan Vijayakumar, Lakshmi P.T.V. 2014. Fuzzy Logic for Personalized Healthcare and Diagnostics: FuzzyApp—A Fuzzy Logic Based Allergen-Protein Predictor, OMICS A Journal of Integrative Biology Volume 18.

[16]. S. Leoni Sharmila, C.Dharuman et al.2016. A Novel Neuro-Fuzzy System for Classification, Global Journal of Pure and Applied Mathematics (GJPAM) ISSN 0973-1768 Volume 12,Number 1.

[17]. Swati Jain, Abhishek Pandey.2013. Soft Computing, Artificial Intelligence, Fuzzy Logic & Genetic Algorithm in Bioinformatics, International Journal of computational Engineering Management, Vol. 16 Issue 1.

[18]. Vijayakumar, Saravanan, and P. T. V. Lakshmi. 2013. A fuzzy inference system for predicting allergenicity and allergic cross-reactivity in proteins." 2013 IEEE International Conference on Bioinformatics and Biomedicine. IEEE.

[19]. A.V Senthil Kumar.2013. Diagnosis of heart disease using Advanced Fuzzy resolution Mechanism, International Journal of Science and Applied Information Technology (IJSAIT), Vol.2 , No.2.

[20]. Saravanan, Vijayakumar, and P. T. V. Lakshmi. 2014. Fuzzy logic for personalized healthcare and diagnostics: FuzzyApp—A fuzzy logic based allergen-protein predictor. Omics: a journal of integrative biology 18.9 (2014): 570-581.

[21]. Giordani, Paolo, et al. 2020. A study of longitudinal mobile health data through fuzzy clustering methods for functional data: The case of allergic rhinoconjunctivitis in childhood. Plos one 15.11.

[22]. Sowmiya, Mrs B., Rahul Ramaswamy, and Tanmai Shukla. 2019. Analysing Food Allergy Dataset to Predict Different Types of Allergies." Journal of Physics: Conference Series. Vol. 1362. No. 1.

[23]. Rajabi, Mina, Saeed Hossani, and Fatemeh Dehghani. 2019. A literature review on current approaches and applications of fuzzy expert systems. arXiv preprint arXiv:1909.08794 (2019).
[24]. Innocent, Fale Mantim, and Abdulsalam Ya'U. Gital. 2020. Dr. Flynxz–A First Aid Mamdani-Sugeno-type Fuzzy Expert System for Differential Symptoms-Based Diagnosis. Journal of King Saud University-Computer and Information Sciences (2020).
[25]. Deshpande, A. P. A., and Gajbar Amruta. 2016. Automated Detection of Skin Cancer and Skin Allergy. International Journal 4.1.
[26]. Tartarisco, Gennaro, et al. 2017. The soft computing-based approach to investigate allergic diseases: a systematic review. Clinical and Molecular Allergy 15.1.
[27]. Dai, Fu, et al. 2020. Artificial Intelligence Applications in allergic rhinitis diagnosis: Focus on Ensemble Learning. Authorea Preprints(2020).
[28]. DM, Mamatha. 2018. Feature Based Fuzzy Inference System Design for Squids Classification.
[29]. Badnjević, A., et al. 2016. Classification of asthma using artificial neural network. 2016 39th International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO). IEEE, 2016.
[30]. Finn, Alan M., and Ziyou Xiong. 2017. Systems and methods for image-based quantification for allergen skin reaction. U.S. Patent Application 15/069,251, filed September 14, 2017.
[31]. Ahmadi, Hossein, et al. 2018. Diseases diagnosis using fuzzy logic methods: A systematic and meta-analysis review. Computer Methods and Programs in Biomedicine 161 (2018): 145-172.
[32]. Morais, Sergi, et al. 2020. Biosensors for food allergy detection according to specific IgE levels in serum. TrAC Trends in Analytical Chemistry.
[33]. Tešendić, Danijela, et al. 2020. RealForAll: real-time system for automatic detection of airborne pollen. Enterprise Information Systems (2020): 1-17.
[34]. Pan, Kevin, et al. 2020. EczemaNet: Automating Detection and Severity Assessment of Atopic Dermatitis. International Workshop on Machine Learning in Medical Imaging. Springer, Cham, 2020.