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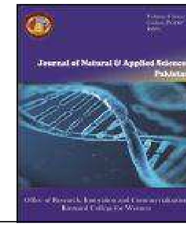
Journal of Natural & Applied Sciences Pakistan

Journal homepage: http://jnasp.kinnaird.edu.pk/



A VIRTUAL REALITY BASED CLINICAL MOBILE ASSISTANT IN REMOTE AREAS OF PAKISTAN

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Keywords

Virtual Reality, Tropical Diseases, VRCMA, Fuzzy Logic, Holographic Image.

Abstract

Innovation and Technology is playing a substantial role in improving the health and providing medical facilities globally. Improving healthcare sector is to provide better personal satisfaction and well-organized social welfare. There is a less amount of medical facilities in remote areas. Diagnosing a human disease correctly is the most complex task which demands advanced skills with years of experience from specialists. Fuzzy logic plays a vital role as a trustworthy tool in developing such decision-making systems comprises on professionals' knowledge and experiences. Any attempt of developing a fuzzy logic-based expert system dealing with human disease diagnosis must experience various challenges. We aimed to provide a virtual reality based mobile clinical health with the help of fuzzy for diagnosing human diseases in distinct areas. We are creating a virtual environment in clinical mobile within which we are providing interaction between patient and doctor. Patient gives symptoms and a virtual doctor generates the report and prescribes medicines according to the symptoms. There are some rules defined in the knowledge base on the bases of if else statements. Virtual reality based mobile clinical health will significantly benefit patients in remote areas.

1. INTRODUCTION

Pakistan is a third world country with increasing population. With the increasing rate of population, providing the basic health facilities is a huge challenge in distinct areas that depends on availability of basic health infrastructure. The ultimate reason behind visiting a doctor is to get enough treatment in a best possible way without delay. Patients do not want to be a specimen when it comes to life and death situation, as doctors have not upgraded their knowledge gain since higher education. On the other hand, the delay in treatment for whatever reason is not acceptable by the patients.

Some patients also find it difficult to communicate with doctors to describe them about poor heath and meanwhile doctors do not have enough time to ask feasible questions due to many patients. The Basic facility of Health Units is set up by the government in villages but mostly have no doctors. Moreover, the young specialists would prefer not to work in these areas because of there is absence of legitimate nursing homes and other infrastructure. The scenario is very common in many distinct areas, especially in developing countries [1] [2].

There are in like manner instances of patients that don't care for taking off to the doctor's facility and health units due to different excuses, for example, the odor of pain killers, unfriendly attendants and waiting in long queues for doctors or merely sluggishness. It winds up discouragement as the passing rate in under developed nations like Pakistan increment even because of minor illness that could have being dealt with [3] [11].

As the technology progresses, patient to doctor communication has been replaced with patient to machine interaction. With the passage of time advancement in technology offers new opportunities in human computer interaction which opens a way to strengthen medical science. Diagnose a disease is essential part to cure it. In this advance era of information technology many techniques are utilized to identify the disease i.e. professional system.

An expert system is a program-based structure that performs its functionalities to act like a medical expert. Expert system makes a derivation to recognize the illness depended on the reality and standards given by the human specialists. Expert systems are for the most part used to empower non-professionals in environment where a human expert is not accessible, for example it may be unnecessarily expensive, making it difficult to designate specialist, or it might be difficult to achieve clinic or wellbeing center.

Expert systems have ability to duplicate a human expert thinking for analysis. The reality and standards to analyze the diseases' symptoms are maintained in the information base of the framework [8]. Expert systems analyses the issues based on expertise, specialists and view of the consultants. With the expansion in the unpredictability of such systems, it is difficult to pursue a specific way of determination with no error. Fuzzy Expert systems are implemented with the fuzzy logic which consist of membership function and rules that can handle uncertainties and vagueness by powerful reasoning methods. Fuzzy logic is a technique to find the accurate results which are inaccurate in the medical field. FES plays a vital role in world of medicine for symptomatic analytic cures [5] [9] [10]. VR is a technology that creates a dynamic, three-dimensional stimulated environment to provide a platform for human computer interaction [18]. The applications of virtual reality are Virtual Reality Assistances (VRAs). The concept of VRA was proposed by Joseph Weizenbaum [19] of MIT in late 60's. VRA is a technological enhancement which assists humans in real time scenarios in different location such as hospitals and airports. In international conference on simulation in 1998, a VRA was introduced for airports [20].

With the technological development Andreas Schmeil and Wolfgang Broll have been proposed an augmented reality based personal reality assistant MARA in 2006 [21]. This virtual assistant has an interface familiar to human person. With the incorporation of Holography technique, a 3-D image was produced known as holograms. This technique was originated by Husain Ghuloum in 2010 particularly for learning environment [22]. The aim of this research is to introduce a Virtual Reality Based Clinical Mobile Assistant (VRCMA) to facilitate peoples in distinct areas of Pakistan. The VRCMA will provide first-aid to the patient by diagnosing the disease and prescribe medicine on the basis of information provided.

The model of VRCMA will be proposed in this paper to assist the patients in distinct areas. We will use fuzzy expert system by incorporating Artificial Intelligence which will help VRCMA to diagnose disease.

2. Objective

The objective of this research is to use developing advancements such as virtual reality assistance to upgrade effectiveness of tasks in rural zones of Pakistan (RAP) with the following goals:

- Understanding the technology and potential of Virtual Reality Assistant (VRCMA)
- Analyzing and evaluating the need of VRCMA in rustic areas
- Proposing a roadmap to implement VRCMA in rustic areas of Pakistan (RAP)
- Satisfying the patients by involving VRCMA

3. Litrature review

Telemedicine

Pakistan is a developing country which has more than half of its population living in distinct areas. Providing medical care facilities in these areas is a critical challenge for government. There are two possibilities to deliver medicinal treatment to the huge population existing in rustic areas. One is the development of more hospitals in these areas with all essential facilities which require more investment and is more difficult while the other effective possibility is to introduce the telemedicine facility to utilize the limited resources.

With the enhancement in technology, telemedicine is continuously facilitating the people of rural areas around the world. In Pakistan, Exilir technology introduces the telemedicine service named TelMEDPAK first time in 1998 [26] at Taxila and Gilgit, developed by a USA based company. In Texla project, computer system and scanner facilities are provided in Ali Family Hospital to provide tele consultation using email service. The Ali Family Hospital is linked with Holy Family hospital of Rawalpindi where patients' data reports are transmitted to the authorized doctors for their consultation.

In Gilgit project, district headquarters are linked with medical area of Holy Family Hospital in Rawalpindi and experts are made available with voice talk facility due to severe environment conditions of Gilgit. All telemedicine services like X-rays, images transmission, ECGs, CT scans and voice chats are interchanged between doctors utilizing the telemedicine facility at its full. The successful results of telemedicine implementation in above regions upgrade the standards of diagnosing disease.

Another project based on telemedicine is introduced in Pakistan named as PAKSAT-HealthNET which linked the Holy Family hospital and Meo hospital in Punjab province and all hospitals resided in rural areas of Attack, Khushab, DG Khan, Pindi-Gheb, Gujrat, Sahiwal, Rajanpur, Jhang and JPMC hospital in Sind province with rural hospitals in Shikarapur, Mirpurkhas, Ghambat, and Jacobabad [24].

As the time passes, there is lot of contribution required by government and IT experts to provide more telemedicine-based architectures in different needed areas of country. There are no such systems in remote areas of country to fulfill the needs of patients in severe emergency. It is need of time that seminars and conferences should be conducted to aware the people with the need and importance of telemedicine systems.

Virtual Reality Assistant

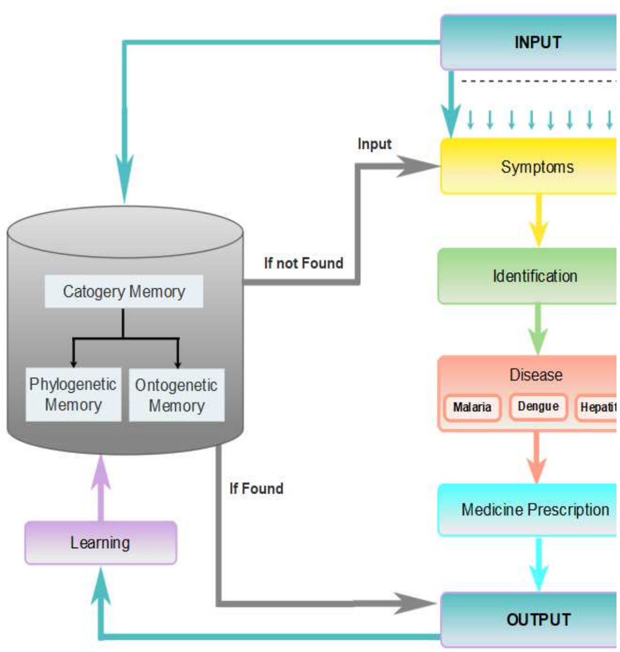
Virtual Reality Assistant (VRA) is a holographic picture [22] delivered a 3D delusion as a virtual body ordinarily, a human character with man-made consciousness. The principle goal of 3D Holographic Technology is to assist as an associate (Virtual Agent) to give solutions like a human associate for a variety of tasks or requests that are made by users. VRA has the benefit of giving exact responses to a demand and in giving arrangements in impressively lesser time than a human. VRAs can be modified with abilities which incorporate giving a conversational interface where it can have smart talks with clients and some additionally have the capacity of self-learning.

Further, VRAs replicate human activities, appearances, human developments and natural speech. Because of which, they can be expected to perform well in energetic network environment. The idea of VRA was widespread in 1960s and it was first created by Joseph Weizenbaum as he made the first chat bot called 'ELIZA' which regenerates dialogues between a psychotherapist and a patient. Different VRAs with artificial intelligence have been presented around the world to serve the humans in various fields.An HD VRA is projected at the Dubai International Airport which assists the passengers through answering the passengers' queries related to flights timings, departure gates, rest rooms and other updates about the flights. This VRA has the capability to make promotions and understand multiple languages from which huge revenue can be generated.

Another VRA known as Shanice [25], a receptionist has been implanted at Liverpool Women's National Health Service (NHS) Foundation Trust with no language barrier. This VRA provides the patients and visitors, the information about self-check in treatments and hospital services with the advanced feature of getting a feedback from all visitors to further improve and maximize the health checking services. Shanice also has some limitations; it does not support multicultural language and have only predetermined recorded information which is not suitable for uncertainty conditions.

An intelligent and dynamic VRA has been used by Shell group of company to advice customers with specialized perspectives concerning Shell's oils [27]. Canal Digital a major television wholesaler and broadband merchant in Norway, a VRA known as Even has been introduced to answer queries related to internet of things [26].

Similarly, when a Virtual Reality Based Clinical Mobile Assistant (VRCMA) will introduce in medical regime, it will not only provide first-aid to the patient by diagnosing the disease and prescribe medicine based on information provided in real time with complete patient satisfaction in remote areas. The VRCMA will have the capability to translate the text into voice and will support multicultural languages of Pakistan to act more likely human in rustic areas with the ability to support even uncertain cases.



Adaptive Control System for VRMCA

MOTIVATION TO USE VIRTUAL REALITY

Unfortunately, medical facilities have not been provided in remote areas of Pakistan due to improper infrastructure. The availability of doctors cannot be assured in these areas due to inadequate residential facilities. No human doctor can provide first aid facilities 24/7 with insufficient resources and low salaries. Moreover, patient satisfaction cannot be achieved through old telemedicine methods. The patients of these areas are mostly illiterate with the psyche to get a treatment and advice from the physically present doctor only. Hence, VR has pulled a lot of enthusiasm of individuals in most recent couple of years to provide a simple, influential, natural method of human-computer interaction. The user can watch and control the virtual environment in the same way we act in the reality, with no compelling reason to figure out how the complicated user interface works.

Hence, medical facilities provided by VR technology is the future of telemedicine in these areas which are not only optimizes the cost of infrastructure but also be able to provide a complete satisfaction to patients with the 24/7 availability of first aid facilities in these remote areas.

4. PROPOSED SYSTEM

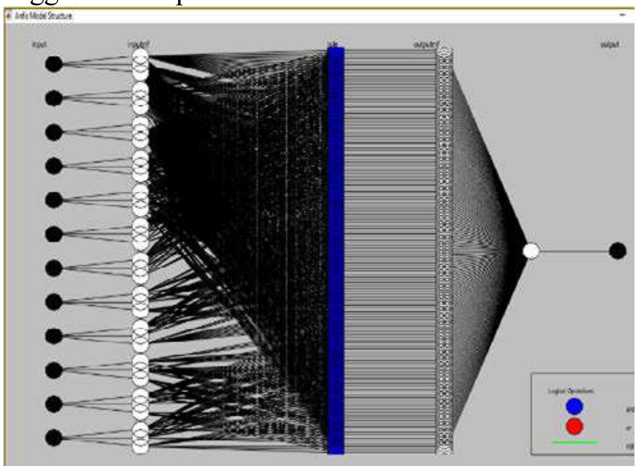
Each component of proposed model is described as follow:

Virtual Reality Clinical Mobile

A virtual reality based mobile clinical assistant is implemented in VR clinical mobile and it is referred to as "VRMCA" to provide first aid facilities to the people living in rustic areas of Pakistan. VR clinical mobile is parked in some hospital of Pakistan with at least one staff member to drive the VR clinical mobile to rustic area when there is need of first aid. The VR clinical mobile is equipped with basic vitals monitoring tools like thermometer and blood pressure (BP) monitor etc. to examine the 4 basic vitals, the pulse rate, the BP level, respiration rate and body temperature of a patient and a holographic device which projects the virtual body of the doctor to have a same responder as human.

Virtual Reality Based Mobile Clinical Assistant

"VRMCA" will be a middle-aged male doctor having a very warm and calm personality for a friendly interaction with his patients. He will welcome his patients with gratitude in the VR clinical mobile. He will listen and ask questions from patients about their health to effectively diagnose the disease. He will gather the all information provided by patients in the voice form which is passed to the embedded adaptive control system which will generate results through calculations and prescribe medicines and give suggestions to patients.



Neuro-Fuzzy Structure

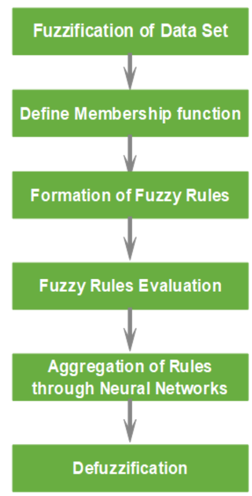
Adaptive Control System in VRMCA

Information about patients' symptoms is gathered through voice recognition, and then processed through neuro fuzzy inference system based on defined rules of expert doctors. The outputs are generated in the form of medicine prescriptions and suggestions. Suggested prescription results are learned by the system and stored in the memory module. Artificial intelligence is incorporated in a memory module of the system to enhance the adaptive capabilities of control system to handle the uncertain situations. Memory module is the database module of our VRMCA which is categorized as ontogenetic memory and phylogenetic memory. Whenever inputs passed to control system, he will first check his memory category either he has already diagnosed the similar conditions. If he found results, he trained himself once more on the same results and stored the calculated results in ontogenetic memory. When same situation repeats, the ontogenetic memory is converted to phylogenetic memory (permanent memory).

Each time, input data is passed to control system; it is first checked in memory. If no similar queries found in each of memory category, the inputs are passed to neuro fuzzy inference system to deal with new inputs through defined rules by expert doctors. VRMCA will train on newly data and results will be learned and stored in memory for next time processing. The model for VRMCA is given in Figure-1.

5. ANFIS FOR VIRTUAL REALITY BASED MOBILE CLINICAL HEALTH

Adaptive neuro fuzzy inference system is initially introduced in 1990 by Jang as the combination of fuzzy logic and neural networks [17]. ANFIS uses the fuzzy logic and neural networks processing approach to analyze the multiple inputs to produce single required output. ANFIS involves six layers with one input layer, four interior layers, and one output layer. Every layer forwards the signals to its next layer. Figure-2 represents the ANFIS model



ANFIS Expert System

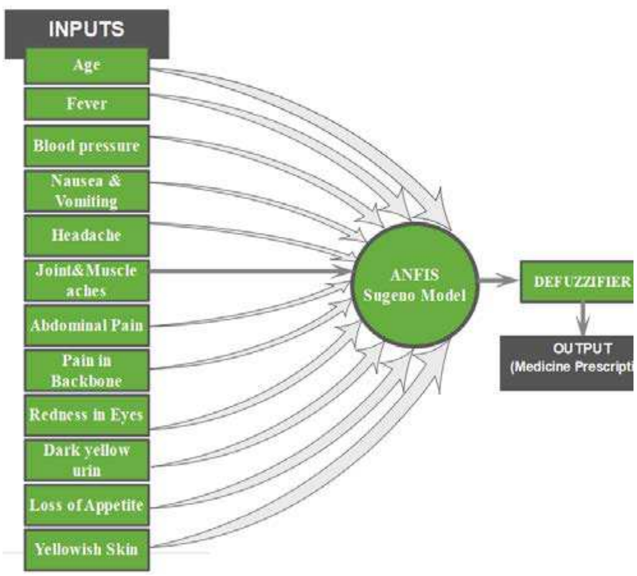
Virtual Reality based Mobile Clinical Health; an expert system embedded adaptive neuro fuzzy inference system, meant to provide first aid through medicine prescriptions to patients in rustic area. In 1960's, Dr. Lotfi Zadeh firstly introduced the fuzzy logic as an efficient computational approach for qualitative data which claims the degree of truth approach. It uses the membership functions instead of conventional Boolean logic "true or false" [16]. The fuzzy inference system can be used as an efficient expert system to diagnose the tropical diseases such as malaria, dengue and hepatitis [14] [15] [16].

The diseased area is diagnosed based on input parameters, the symptoms for the dengue, malaria and hepatitis. Virtual reality based mobile clinical health embedded expert system examines the input parameters through sugeno model of adaptive neuro fuzzy inference system and prescribes the medicine as output following below phases

- Symptoms of diseases are taken as crisp inputs and converted into fuzzy values or

fuzzy set using triangular, Gaussian or fuzzifiers also known as fuzzification process [12].
- The fuzzy set is used to evaluate the number of rules in ANFIS which are combined to form a conclusion.
- The conclusion is another fuzzy set which must be defuzzified into crisp output for understanding purpose.

Virtual reality based mobile clinical health expert system is developed for diagnosing and medicine prescription using triangular fuzzifier. There are various input parameters which plays core role for malaria, hepatitis and dengue. The architecture of proposed model is shown in Figure-3 in which symptoms of malaria, hepatitis and dengue are taken as input parameters and their connection with sugeno model, fuzzy inference system which prescribes the medicines to patients as output.



Diagrammatical Representation of ANFIS Model

6. Materials and Methodology

In this section, we discuss the ANFIS Expert System. It consists of 5 main steps Figure-3. Fuzzification of data set, defining membership functions, forming fuzzy logic rules, analysis of fuzzy logic rules and defuzzification are the steps of our system. To diagnose malaria, dengue and hepatitis expert system use the data of patients comprises the important attributes that signifies that a person is suffering from these diseases. In the expert system; age, fever, blood pressure, nausea and vomiting, joint muscle aches, abdominal pain, pain in backbone, redness in eyes, dark yellow urine and jaundice, loss of appetite and yellowish skin are used as input variables and medicine prescription for respective disease is used as an output variable. Membership function helps us in find the most precise results. The Diagrammatical Representation of ANFIS Model is given in Figure-4.

Fuzzification of Data sets

Age

- Child: 0-16
- Young: 15-45
- Old: 40-90

Fever

- Mild 98-100
- Moderate 100-102
- Severe 102-106

Blood Pressure

- Mild 100-120
- Moderate 115-141
- Severe 135-161

Nausea and Vomiting

- Mild 0-3
- Moderate 3-5
- Severe 5-7

Headache

- Mild 0-41
- Moderate 35-69
- Severe 65-99

Joint Muscle Aches

- Mild 0-41
- Moderate 35-69
- Severe 65-99

Abdominal Pain

- Mild 0-41
- Moderate 35-69
- Severe 65-99

Pain in Backbone

- Mild 0-41
- Moderate 35-69
- Severe 65-99

Redness in Eyes

- Mild 0-41
- Moderate 35-69
- Severe 65-99

Dark Yellow Urine due to Jaundice

- Mild 0-41
- Moderate 35-69
- Severe 65-99

Loss of Appetite

- Mild 0-41
- Moderate 35-69
- Severe 65-99

Yellowish Skin

- Mild 0-41
- Moderate 35-69
- Severe 65-99

Membership Function

Age

$$\mu_{child}(x) = \begin{cases} 0, & x < 2 \\ \dfrac{x-2}{7}, & 2 \le x \le 9 \\ \dfrac{16-x}{7}, & 9 \le x \le 16 \\ 0, & x < 16 \end{cases}$$

$$\mu_{young}(x) = \begin{cases} 0, & x < 15 \\ \dfrac{x-15}{15}, & 15 \le x \le 30 \\ \dfrac{45-x}{15}, & 30 \le x \le 45 \\ 0, & x > 45 \end{cases}$$

$$\mu_{old}(x) = \begin{cases} 0, & x < 40 \\ \dfrac{x-44}{25}, & 40 \le x \le 65 \\ \dfrac{90-x}{25}, & 65 \le x \le 90 \\ 0, & x > 90 \end{cases}$$

Fever

$$\mu_{mild}(x) = \begin{cases} 0, & x < 98 \\ \dfrac{x-98}{1}, & 98 \le x \le 99 \\ \dfrac{100-x}{1}, & 99 \le x \le 100 \\ 0, & x > 100 \end{cases}$$

$$\mu_{moderate}(x) = \begin{cases} 0, & x < 100 \\ \dfrac{x-100}{1}, & 100 \le x \le 101 \\ \dfrac{102-x}{1}, & 101 \le x \le 102 \\ 0, & x > 102 \end{cases}$$

$$\mu_{severe}(x) = \begin{cases} 0, & x < 102 \\ \dfrac{x-102}{2}, & 102 \le x \le 104 \\ \dfrac{106-x}{2}, & 104 \le x \le 106 \\ 0, & x > 106 \end{cases}$$

Blood Pressure

$$\mu_{mild}(x) = \begin{cases} 0, & x < 100 \\ \dfrac{x-100}{10}, & 100 \le x \le 110 \\ \dfrac{120-x}{10}, & 110 \le x \le 120 \\ 0, & x > 120 \end{cases}$$

$$\mu_{moderate}(x) = \begin{cases} 0, & x < 115 \\ \frac{x-115}{13}, & 115 \le x \le 128 \\ \frac{141-x}{13}, & 128 \le x \le 141 \\ 0, & x > 141 \end{cases}$$

$$\mu_{severe}(x) = \begin{cases} 0, & x < 135 \\ \frac{x-135}{13}, & 135 \le x \le 148 \\ \frac{161-x}{13}, & 148 \le x \le 161 \\ 0, & x > 161 \end{cases}$$

Nausea and Vomiting

$$\mu_{mild}(x) = \begin{cases} 0, & x < 1 \\ \frac{x-1}{1}, & 1 \le x \le 2 \\ \frac{3-x}{1}, & 2 \le x \le 3 \\ 0, & x > 3 \end{cases}$$

$$\mu_{moderate}(x) = \begin{cases} 0, & x < 3 \\ \frac{x-3}{1}, & 3 \le x \le 4 \\ \frac{5-x}{1}, & 4 \le x \le 5 \\ 0, & x > 5 \end{cases}$$

$$\mu_{severe}(x) = \begin{cases} 0, & x < 5 \\ \frac{x-5}{1}, & 5 \le x \le 6 \\ \frac{7-x}{1}, & 6 \le x \le 7 \\ 0, & x > 7 \end{cases}$$

Headache

$$\mu_{mild}(x) = \begin{cases} 0, & x < 1 \\ \frac{x-1}{20}, & 1 \le x \le 21 \\ \frac{41-x}{20}, & 21 \le x \le 41 \\ 0, & x > 41 \end{cases}$$

$$\mu_{moderate}(x) = \begin{cases} 0, & x < 35 \\ \frac{x-35}{17}, & 35 \le x \le 52 \\ \frac{69-x}{17}, & 52 \le x \le 69 \\ 0, & x > 69 \end{cases}$$

$$\mu_{severe}(x) = \begin{cases} 0, & x < 65 \\ \frac{x-65}{17}, & 65 \le x \le 82 \\ \frac{99-x}{17}, & 83 \le x \le 99 \\ 0, & x > 99 \end{cases}$$

Joint Muscle Aches

$$\mu_{mild}(x) = \begin{cases} 0, & x < 1 \\ \frac{x-1}{20}, & 1 \le x \le 21 \\ \frac{41-x}{20}, & 21 \le x \le 41 \\ 0, & x > 41 \end{cases}$$

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Abdominal Pain

$$\mu_{mild}(x) = \begin{cases} 0, & x < 1 \\ \frac{x-1}{20}, & 1 \leq x \leq 21 \\ \frac{41-x}{20}, & 21 \leq x \leq 41 \\ 0, & x > 41 \end{cases}$$

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Pain in Backbone

$$\mu_{mild}(x) = \begin{cases} 0, & x < 1 \\ \frac{x-1}{20}, & 1 \leq x \leq 21 \\ \frac{41-x}{20}, & 21 \leq x \leq 41 \\ 0, & x > 41 \end{cases}$$

$$\mu_{moderate}(x) = \begin{cases} 0, & x < 35 \\ \frac{x-35}{17}, & 35 \leq x \leq 52 \\ \frac{69-x}{17}, & 52 \leq x \leq 69 \\ 0, & x > 69 \end{cases}$$

$$\mu_{severe}(x) = \begin{cases} 0, & x < 65 \\ \frac{x-65}{17}, & 65 \leq x \leq 82 \\ \frac{99-x}{17}, & 83 \leq x \leq 99 \\ 0, & x > 99 \end{cases}$$

Redness in Eyes

$$\mu_{mild}(x) = \begin{cases} 0, & x < 1 \\ \frac{x-1}{20}, & 1 \leq x \leq 21 \\ \frac{41-x}{20}, & 21 \leq x \leq 41 \\ 0, & x > 41 \end{cases}$$

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Dark Yellow Urine due to Jaundice

$$\mu_{mild}(x) = \begin{cases} 0, & x < 1 \\ \dfrac{x-1}{20}, & 1 \leq x \leq 21 \\ \dfrac{41-x}{20}, & 21 \leq x \leq 41 \\ 0, & x > 41 \end{cases}$$

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Loss of Appetite

$$\mu_{mild}(x) = \begin{cases} 0, & x < 1 \\ \dfrac{x-1}{20}, & 1 \leq x \leq 21 \\ \dfrac{41-x}{20}, & 21 \leq x \leq 41 \\ 0, & x > 41 \end{cases}$$

$$\mu_{moderate}(x) = \begin{cases} 0, & x < 35 \\ \dfrac{x-35}{17}, & 35 \leq x \leq 52 \\ \dfrac{69-x}{17}, & 52 \leq x \leq 69 \\ 0, & x > 69 \end{cases}$$

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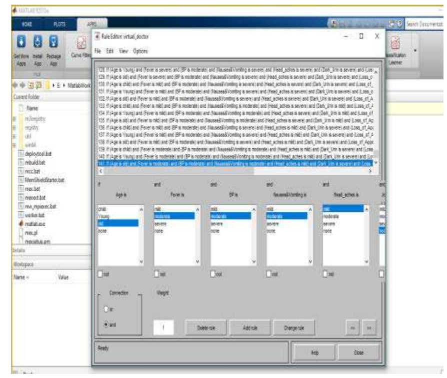
Yellowish Skin



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ANFIS Rule Define

Defining Fuzzy Logic Rule Base

We design certain predefine rules for information based fuzzy inference system to diagnose tropical diseases in distinct areas are prescribe medicine accordingly. Figure-5 shows the defined fuzzy rules to incorporate expertise knowledge in expert system

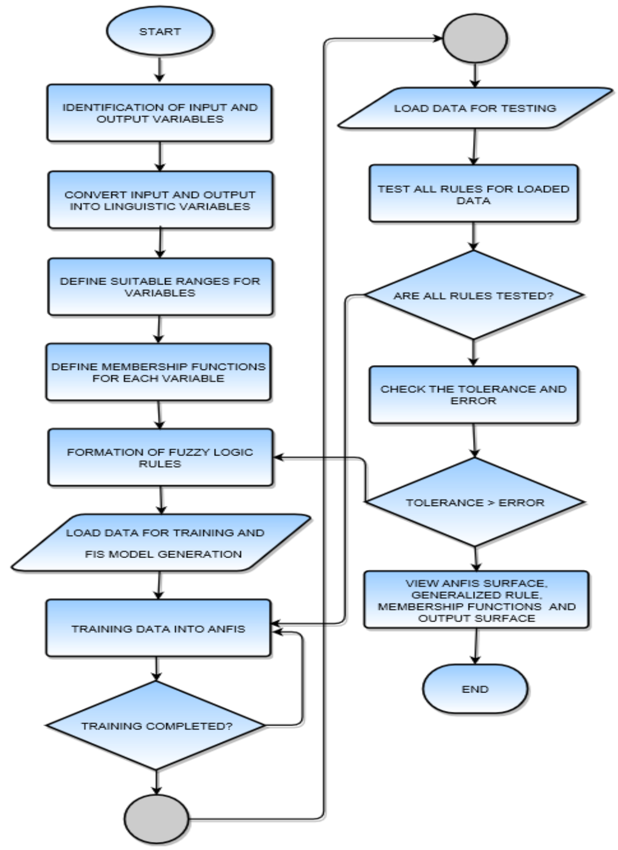
.

7. FLOW OF PROPOSED MODEL

The flow of proposed model has been portrayed in Figure-6. The symptoms of malaria, dengue and hepatitis are identified as input variables and prescription of medicine against respective disease as output.

The input and output variables are converted into linguistic variables using range of inputs through membership functions. Membership functions are of triangular type. From the inputs fuzzy logic rules base are defined for each fuzzy set. Once the rules are created, data is loaded to train the system. When training of system is done, different sets of data from file is loaded for testing procedure to evaluate the performance of system. All rules must be tested against a fixed tolerance rate and if there are some rules which are not tested, repeat the training procedure for such rules. When the system is fully trained and tested for all data sets, error rate is produced and compared with possible tolerance rate. When the tolerance rate is greater than error rate, the fuzzy logic rules are revised above all steps.

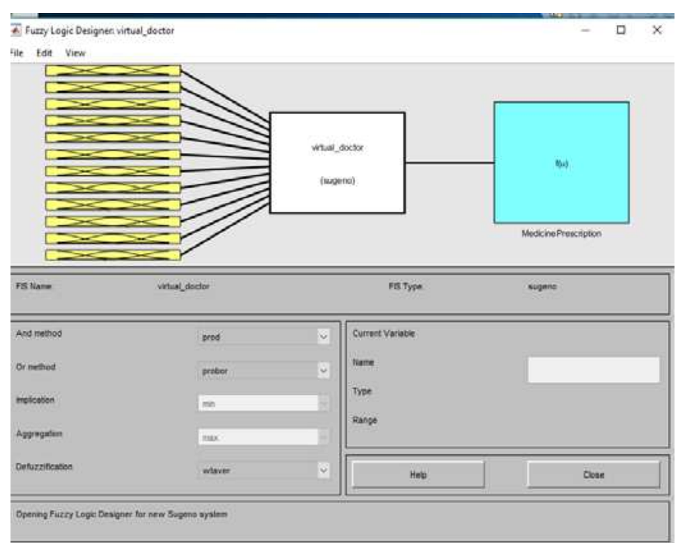
To end, we found the proposed model of neuro fuzzy inference system. The joined work process can be seen from the MATLAB fuzzy ruler viewer. From that point the surface plot of the framework is seen utilizing surface viewer.



Flow of Proposed Model

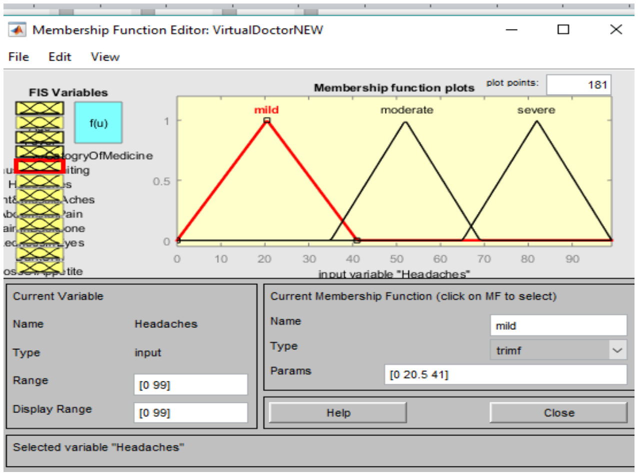
SIMULATION BASED RESULT AND DISCUSSION

ANFIS Sugeno Model:



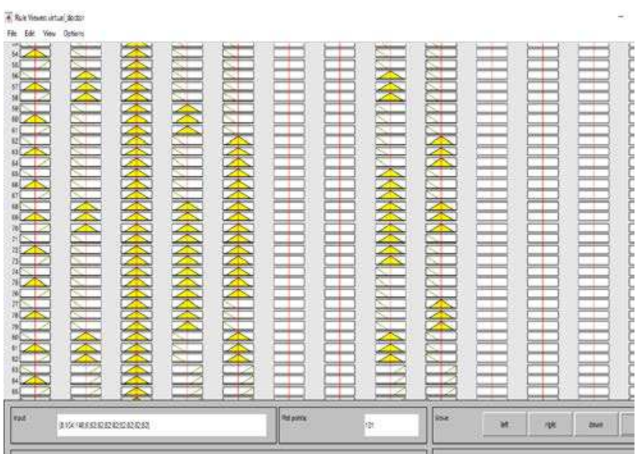
ANFIS Sugeno Model

Membership function plot



Membership associating inputs with output Sdsd

Rule Viewer



Rule Viewer for proposed model Dsdsd

8. Limitations

The proposed model is not designed for all tropical diseases; it only categorized the top three tropical diseases the in Pakistan. We have divided the medicines into three classes; mild, moderate and severe. Our system only tells from which class our medicine belongs to. In future we will design interface for this proposed model where we can describe which medicine is prescribed for which situation.

9. Conclusion

Neuro fuzzy inference system based virtual reality assistant have been proposed in this paper which uses the idea of virtual reality technology with neuro fuzzy inference system to diagnose the tropical diseases and prescribe the medicines to patients of rustic areas where health care facilities are not available. The proposed VRA can efficiently detect the tropical diseases providing fast and inexpensive healthcare facilities with complete patients' satisfaction. Hence, the marvelous results have raised the standards of life in distinct areas of Pakistan.

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