

Neurofuzzy Expert System in e-Health Monitoring For Disease Diagnosis

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Abstract- Power of neuro-fuzzy system has been presented in this paper to propose a model for those people who cannot afford to consult the expert doctors owing to their high fees and unavailability in rural areas. This work has a promising future in the field of the Neural Network and Fuzzy Logic in designing of a complete model comprising of the analysis of a number of common diseases in India. Once globalized, this study will help to reduce the global burden of typical diseases. Proposed real time architecture of neuro-fuzzy integrated system for intelligent decision-making has been given in this paper.

Keywords – e-Health Monitoring, medical advice, neuro-fuzzy, fuzzy concepts, asthma, cancer, SMS advisory system, brain tumor, knowledge based methodology.

I. INTRODUCTION

Neural networks are very rich in decision making as well as in diagnostic power. Neural networks are useful in many tasks of our everyday life. Diagnosis of a problem is always a big issue in reference to find the solution. Similarly if a disease is diagnosed properly and perfectly, we can say that solution will become very easy. In case of human life, it is a big issue to discover the actual level or stage of any disease. The decisions of diagnostic also depend upon expertise, experience as well as on perception of practitioner. It is not easy to follow a correct path of diagnosis without any mistake as the complexity increases [1]. Fuzzy logic presents powerful reasoning methods that can handle uncertainties and vagueness. The Fuzzy Expert Systems define imprecise knowledge and offers linguistic concept with excellent approximation to medical texts [2][3].

The problem of health monitoring has been taken as it one of the challenging problems in rural areas where people many times do not get proper treatment and are not financially sound to visit doctors in city [4]. 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 [5]. This leads to a huge number of deaths in rural due to lack of proper medical diagnosis followed by proper treatment [5].

This work presents a model for diagnosing the stage of a disease by taking the different parameters affecting the person and by utilizing the decision and diagnostic power of neural networks. A practice has been made for formulating the parameters mathematically and such type of neuro fuzzy expert system based model has been proposed by which doctors as well as any general patient or guardian or least experienced doctors of rural can also be beneficial.

The rest of the paper is organized as follows. Required constraints for the proposed model have been explained in section II. Proposed model has been presented section III. Discussion about the model is explained in section IV. Concluding remarks are given in section V.

II. DECISIONS FOR A NEURO FUZZY MODEL

Human reasoning and decision making is fuzzy, involving a high degree of vagueness in evidence and concept utilization and requires a high level of uncertainty management in medical diagnosis [6].

Some of constraints are recommended according to the analysis for neuro fuzzy system to achieve the defined target as

- A perfect discussion with authorized doctors must be taken before initialization of the system [1]. A good level of agreement with doctor's opinions using neuro-fuzzy integrated systems must be achieved.
- Attention must be for a human.
- Simplicity of the system must be there.
- Human beneficial system must be there.
- Minimized inputs must be taken and perfect matched output must be provided to the user.
- An understandable system also must be for computer expert as well as non experts.

Design of adaptive neuro-fuzzy systems for the detection of cancer, tuberculosis, or of other disease, electrocardiographic changes in patients and more are the applications reported using neuro-fuzzy approach [7].

III. PROPOSED MODEL

There are the multiple areas of technology by using which a neuro fuzzy system can serve public very easily among of which a proposed model is being presented at here. Total processing, as shown in figure 1, will be in a manner of a system of 3 steps-

- Input
- Processing
- Result

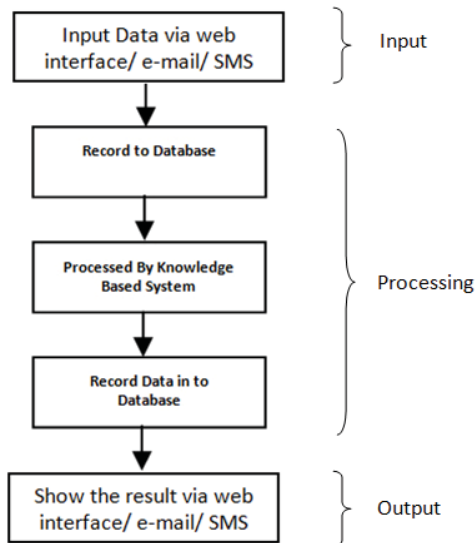


Figure 1. Block diagram of proposed model

A. Inputs

Analyzing the inputs for a particular disease is a separate research work. A proper discussion with doctors as well as deep knowledge of disease is required to gather the information about possible symptoms as input parameters in mathematical form. As for example in case of asthma, there are following parameters [4]-

- Age
- Gender
- Economic status
- Tobacco and smoke consumption

Inputs can be taken by using many of the ways. Some of the proposed ways are as-

1) Via interface of website, as shown in figure 2 in reference of asthma, for each input parameter a separate block has been considered. After pressing the submit button, data will be saved in database.

* First Name	Shashank	Middle Name	
* Last Name	Bhardwaj	* Phone No.	9897644693
* Email ID	shashank12swe@gmail.com		
Age	32	Gender	1
Economic_Status	2	Tbacco_and_Smoke	0

Figure 2. Web interface for taking the input parameter for diagnosing the asthma

2) Via e-mail, a user can send the related problem to the defined e-mail address through which data will be saved to the database.

3) Via SMS in defined format the parameters can be collected. For example a received SMS in reference of cancer may be in the following format-
 <name>, <age>, <lesionSize>, <nodesEffected>, <bodypartEffected:Y/N>
 Example: Shashank_Bhardwaj, 33, 1, 4, Y

B. Processing

With the proper details as mobile number and received parameters will be stored in database for defining as queue to be processed.

The fuzziness of a fuzzy membership permits us to handle the problem of disease prognosis, we have to define various membership functions based upon the factors that are responsible for respective diseases. A Sugeno model will have to be developed in MATLAB simulink by defining the inputs and output for the system. Figure 3 shows the proposed concept for applying the disease symptom numeric parameters to the Sugeno model with a set of different analyzed rules. In reference of the asthma, figure shows the implementation of the symptoms on the FIS (fuzzy logic inference) Editor which is the high-level display for fuzzy logic inference system.

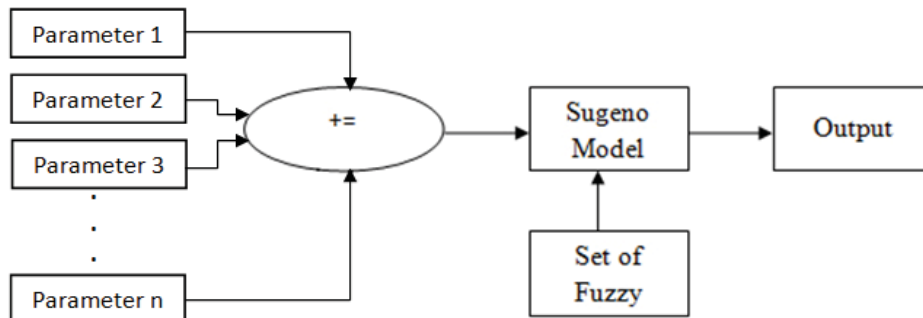


Figure 3. Proposed model for applying the disease symptom to the Sugeno model with a set of analyzed rules

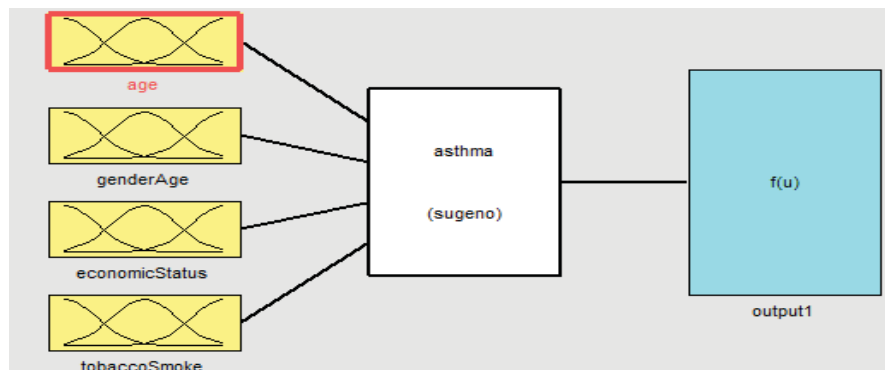


Figure 4. FIS Editor

By combining the various research data and discussed facts with doctors about the diseases, we have to define linguistic fuzzy rules for the disease [4]. For example in case of asthma, some of rules are as-

Rule 1: If (age is young_ones) and (gender_age is female) and (economic_status is low) and (tobacco and somke is low) then (output is low).

Rule 2: If (age is young_ones) and (gender_age is female) and (economic_status is low) and (tobacco and somke is high) then (output is high).

Rule 3: If (age is young_ones) and (gender_age is female) and (economic_status is high) and (tobacco and somke is high) then (output is high).

Rule 4: If (age is young_ones) and (gender_age is male) and (economic_status is low) and (tobacco and somke is low) then (output is medium).

Rule N: If (age is young_ones) and (gender_age is male) and (economic_status is low) and (tobacco and somke is high) then (output is high).

After being processed in neuro fuzzy rules based knowledge system, a result (for example, given below) will be stored in database. Example of generated message by Knowledge based system-

“Dear Shashank_Bhardwaj, Your Cancer Stage is 4.”

C. Output

New queued message can be shown on the web interface or can be sent via e-mail or can be broadcasted via SMS to the related user respectively based on the input taken way.

IV. DISCUSSION

On behalf of given and explained proposed model, it can be easily realized that integration of fuzzy logic and neural networks to facilitate e-health monitoring in remote rural areas to provide medical advice and assistance, is possible. Any system either SMS advisory or e-mail advisory or web interface [9] can be easily implemented. This work can also be helpful in differential diagnosis, image analysis, text analysis, multi-valued logic, fuzzy relations, therapy etc [1].

V. CONCLUSION

Many of the problems can be easily solved by using the power of adaptive methods of neuro-fuzzy systems. The computer based diagnostic tools and knowledgebase helps for fast and perfect diagnosis of diseases. We have shown how the neuro fuzzy base expert system can be built for providing the solution to any patient or doctor. In rural and tribal areas [9][10], where the economy crises and illiteracy forces people to take wrong decisions and advice regarding healthcare, this research work can prove very useful.

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