REVIEW PAPER

COMPARATIVE REVIEW OF ARTIFICIAL NEURAL NETWORK MACHINE LEARNING FOR DIAGNOSING ANEMIA IN PREGNANT LADIES

By

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ABSTRACT

Nowadays, it becomes more elusive for doctors to deal with diseases due to lack of proper specialists. Surveys conducted by reputed institutions revealed that Anemia is the most occurring deficiency in pregnant females. With the advancements in artificial computing, the machines are putting best efforts for diagnosing various diseases. The major objective of this paper is the comparative analysis of Artificial Neural Network and fuzzy expert system for the better efficiency in diagnosing anemic patients. Finally, on the basis of reviewed researches, the authors have concluded the best technique for diagnosing anemic patients [6, 16, 23].

Keywords: Anemia, Artificial Intelligence, Artificial Neural Network, Fuzzy Expert System.

INTRODUCTION

1. Anemia

Most people misconceive that Anemia is a disease, but after a brief study on Anemia it been concluded that it is a kind of disorder or medical condition which occurs due to reduction in hemoglobin concentration of blood in the body [5,14].

1.1 Causes

There are many causes that give rise to Anemia in some of them and they are discussed below:

- Lactation stage after pregnancy.
- Lack of green vegetables in diet.
- Lack of iron consumption.
- High blood loss during mensuration.
- Excessive intestinal blood loss [18,14,16].

Anemia widely occurs to people in age group of 21-50 years and females as in gender categorization. Pregnant ladies have more chances to suffer from Anemia during neonatal or lactation period, which may affect the growth of their child [18,14].

1.2 Symptoms

Major symptoms which help to analyze an anemic person are Weakness, Irritability, Memory weakness, General fatigue, Dizziness, etc [1].

1.3 Types of Anemia

Anemia affects the development of nation through various types like, Sickle Cell Anemia, Vitamin B12 Anemia, Folic acid Anemia, and the most common Iron Deficiency Anemia (IDA) [12].

1.3.1 Iron Deficiency Anemia (IDA)

IDA is the most common type of Anemia [22], which widely occurs owing to iron deficiency in the body owing to the dearth of hemoglobin [9,14].

1.3.2 Vitamin Deficiency Anemia

It is also one of the major occurring Anemias caused in pregnant ladies owing to the dearth of vitamins, where they are known to be vitamin B12 anemic if a person suffers from the deficiency of vitamin B12 or vitamin A [14].

1.3.3 Sickle Cell Anemia

Sickle Cell Anemia occurs when special and abnormal cells exist in the body. This disorder generally is inherited

from parents while birth [14].

2. Artificial Intelligence

The velocity of increase of various diseases is really making people disquiet. Since, due to the rise of diseases and insufficiency of medical specialists, rate of mortality also gets increased day-by-day. As it should be acknowledged now that insufficiency of medical specialists cannot be fulfilled promptly. So why to wait for such things which have very drastic result that affect the population. Some diseases are not communicable, but needs proper treatment of the specialists, and due to lack of these specialists, patients may sometimes die or even it can happen because of huge amount of money required for the treatment. While on the other hand, some of the diseases are very communicable that lacking of specialists cannot control the patients coming into contact with the same. So keeping in mind the entire factors, researchers have started implementing artificial intelligence in medical diagnosis and the result is really good. As artificial intelligence is used to generate system which is being learnt by humans or say, during medical diagnosis through medical specialists only. Hence further systems behave like an expert and also diagnose the disease, and further help the patients to generate a report. This assists in reducing the burden of a medical specialist, and also the patients to get cured easily at low. There are several different fields in artificial intelligence through which various diseases can be diagnosed. In this paper, few of them are discussed in later sections [3,21].

3. Artificial Neural Network

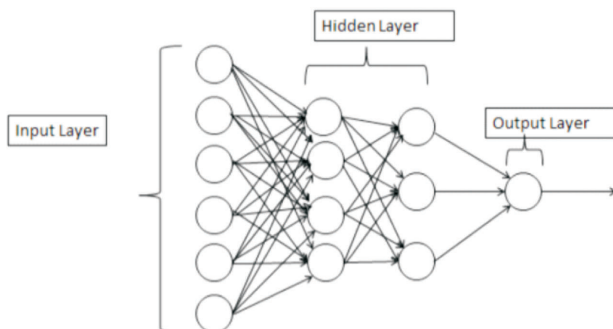Artificial Neural Network (ANN) is developed to perform real world tasks and generate the new information using computer generated system automatically from the learned features without using human brain. ANN consists of 2 phases; training and testing, where under testing phase, the system is trained to learn the relationship between the data to be used, while the testing phase is hence used to test the new data by taking decision that has been generated from the learned data. ANN comprises of various types of network architectures and training algorithms that can be used to analyse and solve the problem in different disciplines [4, 5].

ANN works like a human brain where each neuron is connected to its neighbor with a coefficient value, which is represented as a weight of that neuron. Each neuron consists of different weight. It can be analyzed from Figure 1 that the model is divided into three layers. Initial layer is the input layer x, where the data from the source is being taken and passed to the hidden layer h without any change. Hidden layer acts as the middle layer, where the data is being processed using different activation functions [5].

Initially, the input layer x receives the input data and transfers it to the intermediate layer, that is hidden layer that comprises of various activation functions h to process the data received from the initial layer. Hence, the processed data are then passed to the output layer y that acts as the last layer [4,5].

4. Fuzzy Expert System

Fuzzy expert system has the ability to analyze and generate the output according to the knowledge of an expert. Expert system helps to analyze the presence or absence of the disease using proper technique. The input and the output variables are determined. Hence, the number of inputs define the symptoms related to the
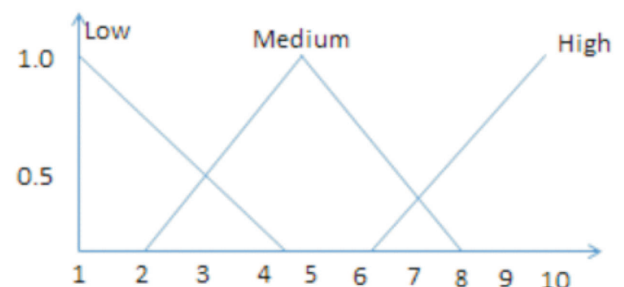

Figure 1. Workflow of ANN [5]

Figure 2. Member functions for Fuzzy Expert System [7]

disease. Then the symptoms of the disease are well studied and the range that is called as associative fuzzy set is described and hence the output is being analyzed on the basis membership functions. While membership functions are generated according to the deviation in the associated fuzzy set [7,15], as depicted in Figure 2.

Fuzzy expert system takes clinical or medical parameters as an input during the disease diagnosis and gives output according to the set of membership functions [7,17,19].

4.1 Fuzzy Knowledge Representation in MedFrame

- Representation of medical concepts.
    - a. Medical entities.
    - b. Medical data.
- Data-to-entity conversion.
- Representation of relationships between medical concepts [19].

5. Literature Survey

According to Igor Kononenko, (2001), all the artificial machine learning systems were very useful in solving medical diagnostic tasks. The author has also introduced some basic fundamentals for selecting the system. A deep study of Machine Learning (ML) system based on the features discussed about the neural network was analyzed as the most acceptable one by the physicians when they were unable to explain or justify themselves as the system works as a 'black box', where only the input that had been taken and the output was being generated with the help of transfer functions which lie in hidden layer. Inputs as medical parameters must be analyzed for the ML system analysis from the patient's reports which were collected from the particular hospital departments to run the learning algorithms [21].

S. Patel, et al. (2009), dedicatedly inspected Anemia and explored that Anemia was the deficiency that occurs when the body has reduction of hemoglobin concentration in blood below the normal value. For each person depending upon age, sex, and physiological condition, the normal value may vary for Anemia. Although Anemia occurs when a body suffers from the loss of blood due to different reasons, it has more chances to cover females due to high blood loss during periods or pregnant ladies during the lactation stage. This is the reason why it has been mainly focused on women all over the world. They also lighten up the most affected age group which ranges between 21-30 years. After being surveyed on one hundred Anemia patients from a respective hospital, the most common type of Anemia was Iron Deficiency Anemia, which occurs when a body is deficient of iron and widely has more changes to cover vegetarian population [14].

Christopher V. Charles, et al. (2012), explains the main common causes and types of Anemia. Anemia was the global health issue which affects the human health and also the economic development of the country. According to the survey it has been concluded that around 1.62 million population of the world were affected with Anemia, where the most affected age group and gender was young age and females, respectively. Pregnant ladies during the neonatal period needs high amount of iron, else leading to the cause of Anemia as further it has been analyzed that iron deficiency was the most effective reason for the cause of Anemia, which may also give rise to various problems in neonates. After birth also, it has wide chances of occurrence of Anemia in females due to regular lactation and periods [11].

Wan Hussain, et al. (2008), describes the factor of increasing diseases and lack of medical specialista rapidly give rise to mortality rate. Due to lack of medical specialists or high amount required for the tests, may sometimes lead to patient's to death. Medical specialists cannot be engaged quickly with the rate of increased disease so artificial intelligence is being implemented for medical diagnosing [20].

Esra Kaya, et al. (2015), elaborates that deficiency of red blood cells was referred as Anemia. Anemia can occur at all age groups, but it most widely occurs to women and children. Iron was the most widely occurring cause of Anemia. According to them, Red blood cell, HGB, HCT, MCV, MCH, MCHC datum were some of the medical parameters which were widely taken to diagnose the disease using different neural networks. Further network model was developed using 3 layers; input layer, hidden

layer, and the output layer, where all 5 medical parameters discussed above were taken as the inputs. First of all, the network model was divided into two parts known as training and testing. Training part helps network model to learn using data of 30 patients and data of another 20 patients were used to test the generated model. Tangent sigmoid used as activation in hidden layer data was being processed and the result was being generated as healthy or anemic. As a result, they have concluded that the neural network model generated is 90.909% accurate [5]

Qeethara Kadhim Al-Shayea (2011), investigated the Artificial Neural Network (ANN) accuracy for diagnosing the disease. Data of 2 different diseases were taken and ANN model was applied on it using MatLab toolbox. ANN model works in 2 different phases; testing and training. ANN model use various classifiers to classify the data into different categories. In this paper, Feed Forward Back Propagation Neural Network was used to distinguish between infected and non-infected patients. As a result after diagnosing both the diseases, the model classifies the data with 99 percent and 95 percent accuracy, respectively [13].

Javad Aramideh, and Hamed Jelodar (2014) diagnosed Anemia using fuzzy expert system. They explained the occurrence of Anemia and the most affected age and sex groups. To determine the disease diagnosis, the user must analyze the most vulnerable symptoms of disease as input parameters for the fuzzy expert system. Fuzzy based system use if-else fuzzy rule sets to enable experts to interpret. Irritability, Tachycardia, Memory weakness, nose bleeding, and chronic fatigue were the five parameters as the inputs for the fuzzy expert system. Expert system, generate three outputs each of which elaborates the severity of each type of Anemia. The model was implemented using matlab FIS toolbox. The output of the system arises with four different categories which were low, normal, high, and very high. At last, they concluded that fuzzy expert system was more complicated to implement during medical diagnosis [7].

Smita Sushil Sikchi, et al. (2012), prepared fuzzy expert model to diagnose liver disease. As per the model requirement, general parameters of the disease with their normal ranges were being selected as Mean Corpuscular Volume (MCV), Alkaline Phosphate (ALP), Gamma Glutamyl Transpeptidase (SGPT), Serum Glutamyl Transpeptidase (SGOT), Serum Glumatic Oxaloaacetic Transaminase (GGTP), and DRINK. Inputs and outputs were represented using the set of 3 membership functions, low, medium, and high [10].

Iman Azarkhish, et al. (2012) developed ANN and Adaptive Neuro-Fuzzy Inference System (ANFIS) to diagnose iron deficiency Anemia as measuring serum iron was more time consuming and expensive. Both models were implemented using MatLab toolbox. Models were tested for accuracy using data of 203 patients, where in case of ANN, 143 random patient data were used for training the model, while other 56 patient data were being used to test the model using RBC, HCT, MCV, MCH, and MCHC as major medical parameters. While during ANFIS model, there were 4 input membership functions and 2 output functions. As a result it was being analyzed that ANN model is 96.29 percent accurate while ANFIS model was 90.74 percent [9].

Ziynet Yilmaz, and Recep Bozkurt (2012), deeply studied the Anemia disease and compared the diagnosis using neural network and fuzzy expert system. While Neural networks FFN, CFN, TDDN, TDN, PNN, LVQ models were developed to diagnose the disease. Also the authors define that most suffering age group and gender for Anemia was 21-50 years and females, respectively. According to the paper, data of 2600 patients had been taken, where 2000 data was being used for training the model and left 600 was used for testing trained model. Neural network with medical parameters as Red Blood Cell (RBC), Hemoglobin (HGB), Hematocrit (HCT), Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), Mean corpuscular Hemoglobin Concentration (MCHC), and back propagation as a classifier was being implemented. Prepared neural network model was 99.16% accurate and 97.60% sensitive. During comparative study of neural and fuzzy model, it was being analyzed that neural network model for medical diagnose was more accurate [8].

Overall Findings

At the end, the Artificial Neural Network is analyzed as the best for diagnosing Anemia [8,9]. Accuracy of different tested models were comparatively analyzed for determining the best percentage.

Conclusion

It is being concluded that Anemia is the most occurring deficiency, which give rise to various factors in children and females. There are various kinds of Anemias, which affects the development of the country, but the most common is IDA. Hence measuring serum iron level is very expensive and time consuming, so various models were generated to diagnose it. A deep study on ANN and ANFIS models were done and also they have been compared for better accuracy. So as a result it is been concluded that ANN model is more accurate than ANFIS for medical diagnosis.

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