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Diabetes Management System using Machine Learning

Priyanka Katare[1], Prof. P K Chande[2], Ms. Priyanka Bamne[3]
Master of Engineering Student, Dept. Of Computer Engineering S.G.S.I.T.S, Indore India, prikatare@gmail.com
Chairman CSMIND Indore and Former Prof. IIM Indore, India, pkchandein@gmail.com
Assistant Prof. Department of Computer Engineering, S.G.S.I.T.S, Indore, India, bamnepriyanka574@gmail.com

ABSTRACT

In today's scenario, people are so busy with their life, this result in increased stress level, unbalanced diet, irregular sleep patterns and it keeps them away from physical activities too, this may lead to obesity, it increases levels of fatty acids, leading to insulin resistance, which can turn into type 2 diabetes. Today's existing system is providing diabetes management in some way, but they are not concrete enough, although there is a lack of connectivity between doctors and patients. Today's need is a system that can connect patients and doctors so that patients can live care freely. Furthermore, the system should show patients' current health state along with helpful suggestions, to maintain a safe state. This is now becoming possible, we are introducing a system called DiaM for diabetes management. The proposed system is based on Machine learning and mobile technology, for describing one's health state and providing them suggestions. The proposed methodology uses Artificial Neural Network to state patient health state, and android is used as mobile technology to connect doctors and patients over a single platform. Proposed system act as an assistant for doctors to manage patients and provides mentoring for patients too.

Key words: Artificial Neural Network (ANN), Digital twin, Health care, Mental Model, Prognosis.

1. INTRODUCTION

In Today's generation, people are surrounded by so many facilities, this keeps them away from physical activities. Most people are now living unhealthy lifestyles, as a result, they get affected by diseases like diabetes, cardiovascular disease, etc. It is reported that a large section of people in India is being associated with Diabetes. According to International Diabetes Federation Type 2 diabetes is most commonly diagnosed in older adults, but is increasingly seen in children, adolescents and younger adults due to rising levels of obesity, physical inactivity and poor diet. From report it has shown that an estimated 463 million adults aged 20–79 years are currently living with diabetes. This represents 9.3% of the world's population in this age group. The total number is predicted to rise to 578 million (10.2%) by 2030 and to 700 million (10.9%) by 2045.This report shows that one needs a system that can provide Management of Diabetes, with efficacy. Furthermore, the previous study showed that Machine Learning is used as a growing technology to solve health care problems. Adding more [5] suggested artificial neural networks to predict whether a person is diabetic or not. Moving to the next, now day Digital Twin Technology is getting used in health care. According to twin health, Diabetes reversal is possible. They collect 3000+ data points from our bodies and create digital representation of patients, using Digital Twin technology. Adding further after diagnosed as a diabetic one can live a healthy life by practicing a healthy routine as taking a good diet, doing physical activities, keep away from stress. In this paper, we proposed a Mobile based application to manage diabetes over a digital platform with the connectivity of Doctors. This paper covers all the methodology and approaches used to create this application. Part 2 gives details about related work done in Artificial Neural Network.

2. RELATED WORK

[2] Proposed a system that can predict Diabetes, they have used artificial neural networks for prediction, and the categories the data as a state of health. They used 8 parameters as Pregnancies, Plasma glucose concentration, Diastolic BP, Tri-fold thick, Serum Ins, BMI, Diabetes Pedigree Function, and age to categorize whether a person is diabetic or not.
[4] Illustrated a hybrid neural network based on an optimization algorithm to diagnose diabetic patients. Overall it was an intelligent system with better accuracy which can assist the medical experts to better understand the patients.
[1] Introduced an Artificial neural network-based Machine Learning model for the prediction of diabetes. They elaborated different Machine Learning models for diabetes prediction using the Pima Indians Diabetes data set. They did a comparison of the different existing models with the ANN model.

[5] Performed classification of diabetes mellitus using Artificial Neural Networks and they show that some combinations of prepossessing and missing values can improve the accuracy of classification.
[3] Introduced a wearable health monitoring system It works on fuzzy regular language to generate prognosis of the health condition of the patient, they illustrated some example of fuzzy finite state machine through which health condition of the patient can be found. They also explained the architecture of WHMS to elaborate on how it works. They described that this methodology can be work very well with the Machine Learning approach hence to be done in the future.

3. PARAMETERS AND SYMPTOMS USED

In this system we have used some attributes to classify users. Obesity is related to diabetes, weight gain, and increased body mass index increases the risk of development of Diabetes. Furthermore taking too much stress, not having proper sleep, an unhealthy diet, lack of physical activity may also increase the risk of diabetes. Parameters taken for the proposed work are BMI, Age, and Stress, Eating habits, Sleep, Exercise, Smoking drinking, Symptoms like thirst, urination, and tiredness.

4. MODELING OF THE PROGNOSIS METHODOLOGY

We Introduced a Prognosis modeling to classify a patient into several health states. Initially, patients classified as Normal, Marginal, and Diabetic with genetic/family as yes or no based on two parameters blood glucose level and genetic. after this we get other parameters of a user/patient as eating habits, sleep, stress level, physical activity to know the habit of that patient, after getting habits of a person/patient, they classified among Good, avg and Bad. Furthermore, if a person is marginal or diabetic then we check whether a patient has symptoms like Thirst, tiredness, urination if yes then it classified as severity, and according to this suggestions will be provided to that patient. According to these suggestions, if a patient knows his health condition and follows suggested measures then they can improve his health state.

5. MENTAL MODEL

The mental model expresses someone's thought process, a person with strong emotions may think differently than a person with weak emotions and its effects related to their health conditions, for example, if a person is emotionally strong then if stress comes that person will behave better than the emotionally weak person.
We used this concept of the mental model to analysis that how people think differently and how they take any risk this will define the reflection against the disease. The mental model helps us to analyze how people will react when they have some disease. We used this concept of the mental model to analysis that how people think differently and how they take any risk this will define the reflection against the disease. The mental model helps us to analyze how people will react when they have some disease.

6. UNDERSTANDING MENTAL ATTRIBUTES

According to Mental model person may be Emotionally Strong, Emotionally weak, or disciplined. Let's suppose emotionally weak represents pw, emotionally strong represents ps, disciplined represents pd. Following are some examples through which we can understand mental attributes.
Example 1: suppose there is a stressed situation then the impact of stress over ps will be low because ps is an emotionally strong person. at time T2 risk of developing diabetes for ps will be low, and if ps follows a good diet, better sleep, and do physical activities then at time T5 ps can become healthy.
Example 2: suppose there is a stressed situation then the impact of stress over pw will be high because pw is an emotionally weak person. at time T1, pw will develop a high risk of diabetes, and if pw do physical activities then at time T3 pw comes at low risk of development of diabetes, at this stage if pw follows the good diet, better sleep, and do physical activities than at time T6 pw can become healthy.

7. MAPPING OF PROGNOSIS AND MENTAL MODEL

As discussed above Prognosis model is used to classify patients among states. After getting the state's suggestions get provided according to the state from the neural network, at this point mental model is used to give suggestions to that patient. The below diagram represents how we use Prognosis and mental model together for diabetes management. The prognosis model is used to group patients among classes based on health parameters like BMI, age, eating habits, etc. further based on this states, suggestions are provided using the mental model. In the above diagram mapping of a mental model is represented, here diabetes influencing parameters are mention in decreasing order of their influence on diabetes, as indicated among all the parameters stress is more influencing parameter than others, than comes exercise, and so on. Integer number presents the weight assign to that particular parameter, for example, the weight assigns to stress level is 5. It means when the patient classified among the states then if the patient is found to be stressed then weight (value 5) is assigned, otherwise no weight(value 0) is assigned after this total value assigned is checked if it is found large value or near to the maximum value of all the weights then it classified as Bad habits at first level, afterward user has to answer if they have any symptoms like thirst, urination, tiredness, if they answered yes then the patient is classified as Bad habits with severity. Here count =w1+w2+w3.....

W1, w2, w3 are weighted assign to each parameter, and the count is variable to assign additive values of weights. If count is near to the Maximum value ((w1+w2....)) then it comes to bad habit class, or if it is near to minimum value (value of the low influencing parameter) then it comes under good habits otherwise it is of avg habits class. Severity is find using symptoms.

After knowing the state of the patient, its management gets started. With an inbuilt mental model, the proposed system provides suggestions to the particular patient. if a person has stress then according to our proposed Prognosis model it will classify to one state where the impact of stress is 5 (value to represent stress), and if that patient is emotionally strong (always being joyful) then according to our mental model the stress parameter for that patient will be low value than 5 let's suppose 4, this will helps to give suggestions to that patient, in another case like for a neurotic patient, suggestions will be different. In this way, both Prognosis and mental model map together to manage diabetes.

8. ARTIFICIAL NEURAL NETWORK

We used Artificial Neural Networks to classify patients among health states, in part III all the parameters used in this work are presented using a diagram. Adding more to this supervised learning approach is used for this proposed work. This section describes the proposed artificial neural network in terms of learning, approach, an algorithm designed, and its results. Supervised Learning: Supervised learning approach is used when we have to map input vector to output vector. In this work, we have chosen this approach because supervised learning gives accurate results than unsupervised learning, and it's also easy to map the input to output when we have sufficient knowledge about how our input vector is related to the output vector. Unsupervised learning: Unsupervised learning does not map input vector to output vector as there is no class label assigned so that after the training process we need to do extra efforts to represents that clusters what we get after the learning process. Proposed artificial neural network is used to classify input data into multiple states, It is a fully connected dense network consist of 2 hidden layers. 8 neurons at the input layer represent the 8 parameters and 6 neurons at the output layer represents the states.

Preprocessing of data:

Diabetes data contains 8 parameters of integer type and 6 output classes, all classes are categorical values.

The steps of data preprocessing are as:

1. Collection of data.
2. Splitting of data into input and output.
3. Encoding of output class values.

9. PROPOSED ARCHITECTURE & MANAGEMENT APPROACH

As discussed in previous sections Classification of patients is done using the Machine learning approach. The management approach is discussed here:

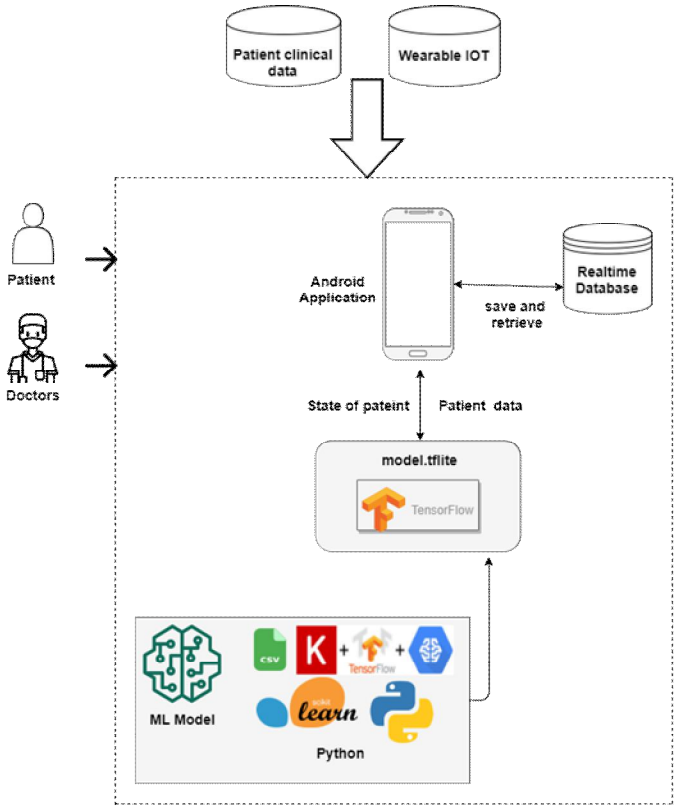

Figure 1: Proposed System architecture

The proposed system uses the mental model to manage patients, after getting the state of the patient our system provides suggestions to the patient using the mental model approach. We have created a knowledge base for the system which contains a list of suggestions, according to the health state our knowledge base provides suggestions to the patient. The patient should follow, suggestions provided to them for better treatment. As presented in the figure 1, we have provided connectivity between patients and doctors, patient can follow one doctor at a time, and the doctor is responsible to mentor that patient and patient. Connectivity between doctors and patients helps patients to manage diabetes with efficacy and ease. As mentioned previously, our proposed work provides user's health accurately so it helps doctors to understand the health condition of that patient, this leads to better mentoring of patients. Without any extra efforts, a registered but inexperienced doctor can also treat that patient effectively.

10. RESULTS AND DISCUSSION

It is known that the evaluation of a Diabetic patient by the doctor is based on crisp clinical data and the experienced outlook of the doctor on the patient's present state. The model

here typically used both inputs- like crisp data and data related to the available cases. A case consists of the physical and mental model of a patient, which is judiciously understood by the doctor based on his experience. Looking closely experience emanate from the neural system already trained with the doctor. In this work, we have considered these two aspects for designing and implementing the system. The standard clinical data is available, while the other data about patient condition and trends of such data are known for ex. to increase metabolism the patient has to invest energy and known as the BMI i.e Body Mass Index. we have used similar 8 parameters with their weighted value to train the neural network. Accordingly, the classes among the possible patient are determined. All these data are appropriately used to train the neural network, which classifies the patient category.

11.CONCLUSION

In this paper, we have presented a Prognosis based model for diabetes management. Adding more to this we have used an artificial neural network, our proposed model is described in previous sections. These proposed works help doctors to mentor patients and for patients, it helps to manage diabetes, this system works as assistance for doctors and as an advisor for patients. In the future wearable IOT device can be used to collect data from the human body, this will helps in improving the accuracy of inputs, and can improve the overall performance of the system, furthermore In future we will add some more mental attributes such as Workaholic, perfectionist, etc. after identifying are they useful for management perspective or not. This will increase the accuracy of our system, and doctors can understand the Patients more.

REFERENCES

[1] Nitesh Pradhana, Geeta Rania, Vijaypal Singh Dhakaa,Ramesh Chandra Poonia **"Diabetes prediction using artificial neural network"**, In book: Deep Learning Techniques for Biomedical and Health Informatics (pp.327-339).

[2] Nesreen Samer El Jerjawi and Samy S. Abu-Naser, **"Diabetes Prediction Using Artificial Neural Network"**, International Journal of Advanced Science and Technology Vol.124 (2018), pp. 1-10.

[3] Alexandros Pantelopoulos and Nikolaos G. Bourbakis **"Prognosis—A Wearable Health-Monitoring System for People at Risk: Methodology and Modeling"**. IEEE Transactions On Information Technology In Biomedicine, Vol. 14, NO. 3, MAY 2010.

[4] Sareh Mortajez, Amir Jamshidinezhad. **"Neural Network Model to Diagnosis of Type II Diabetes"**. Journal of Research in Medical and Dental Science 2019, Volume 7, Issue 1, Page No: 66-70.

[5] T.Jayalskshmi, Dr.A.Santhakumaran **"Impact of Preprocessing for Diagnosis of Diabetes Mellitus Using Artificial Neural Networks"** 2010, International Conference on Machine Learning and Computing, Page No: 109-112.

[6] Majid A. Al-Taee, Waleed Al-Nuaimy, Ali Al-Ataby, Zahra J. Muhsin, Suhail N. Abood, **"Mobile Health Platform for Diabetes Management Based on the Internet-of-Things"**, 2015 IEEE Jordan Conference on Applied Electrical Engineering and Computing Technologies (AEECT).

[7] Md Abul Basar, Hassan Nomani Alvi, Gazi Nowrin Bokul, M Shahriar Khan, Farzana Anowar, Mohammad Nurul Huda, Khondaker Abdullah Al Mamun, **"A Review on Diabetes Patient Lifestyle Management Using Mobile Application"**, 18th International Conference on Computer and Information Technology(ICCIT),2015, pp. 379-385.

[8] Adam Bouras, Kat Usop, Mihail Popescu, **"Empowering Diabetes Self-management by Gamifying Intelligent System: myTrybeCare Concept"**, 2018 IEEE 4th Middle East Conference on Biomedical Engineering (MECBME), pp 137-140.

[9] M. A. Al-Taee, A. M. Sungoor, S. N. Abood and N. Y. Philip, **"Web-of-Things Inspired e-Health Platform for Integrated Diabetes Care Management"**, IEEE Jordan Conference on Applied Electrical Engineering and Computing Technologies (AEECT'2013), Amman, 3-5 December, 2013, pp. 1-6.