5G-SMART DIABETES: TOWARD PERSONALIZED DIABETES DIAGNOSIS WITH HEALTHCARE BIG DATA CLOUDS

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ABSTRACT

This project uses today's 5G technology to monitor condition of diabetic patients with low cost. Now-a-days many peoples are suffering with diabetic disease due to work stress or unhealthy lifestyles and peoples will not know about the current health condition till symptoms appear or diagnosis through medical check-up and the condition of disease will be severe by that time and there is no possible way to get that intimation prior. Diabetes will be of two type's diabetes-1 and diabetes-2. Diabetes-2 require hospitalization and in diabetes-1 condition we can monitor patient and alert him or doctors about his current condition.

Keywords: 5G-smart diabetes, ensemble classifier, diabetes 2.

1. INTRODUCTION

Diabetes is an extremely common chronic disease from which nearly 8.5 percent of the world population suffer; 422 million people worldwide must struggle with diabetes. It is crucial to note that type 2 diabetes mellitus makes up about 90 percent of the cases [1]. More critically, the situation will be worse, as reported in, with more teenagers and youth becoming susceptible to diabetes as well. Because diabetes has a huge impact on global well-being and economy, it is urgent to improve methods for the prevention and treatment of diabetes. Furthermore, various factors can cause the disease, such as improper and unhealthy lifestyle, vulnerable emotion status, along with the accumulated stress from society and work. However, the existing diabetes detection system faces the following problems:

- The system is uncomfortable, and real-time data collection is difficult. Furthermore, it lacks continuous monitoring of multidimensional physiological indicators of patients suffering from diabetes.
- The diabetes detection model lacks a data sharing mechanism and personalized analysis of big data from different sources including lifestyle, sports, diet, and so on [2].
- There are no continuous suggestions for the prevention and treatment of diabetes and corresponding supervision strategies.

To solve the above problems, in this article, we first propose a next generation diabetes solution called the 5G-Smart Diabetes system, which integrates novel technologies including fifth generation (5G) mobile networks, machine learning, medical big data, social networking, smart clothing, and so on. Then we present the data sharing mechanism and personalized data analysis model for 5G-Smart Diabetes. Finally, based on the smart clothing, smartphone, and big data healthcare clouds, we build a 5G-Smart Diabetes testbed and give the experiment results.

Furthermore, the "5G" in 5G-Smart Diabetes has a two-fold meaning. On one hand, it refers to the 5G technology that will be adopted as the communication infrastructure to realize high-quality and continuous monitoring of the physiological states of patients with diabetes and to provide treatment services for such patients without restraining their freedom. On the other hand, "5G" refers to the following "5 goals": cost effectiveness, comfortability, personalization, sustainability, and smartness.

Cost Effectiveness: It is achieved from two aspects. First, 5G-Smart Diabetes keeps users in a healthy lifestyle to prevent users from getting the disease in the early stage. The reduction of disease risk would lead to decreasing the cost of diabetes treatment. Second, 5G-Smart Diabetes facilitates out-of-hospital treatment, thus reducing the cost compared to on-the-spot treatment, especially long-term hospitalization of the patient.

Comfortability: To achieve comfort for patients, it is required that 5G-Smart Diabetes does not disturb the patients' daily activities as much as possible. Thus, 5G-Smart Diabetes integrates smart clothing [3], mobile phones, and portable blood glucose monitoring devices to easily monitor patients' blood glucose and other physiological indicators.

Personalization: 5G-Smart Diabetes utilizes various machine learning and cognitive computing algorithms to establish personalized diabetes diagnosis for the prevention and treatment of diabetes. Based on the collected blood glucose data and individualized physiological indicators, 5G-Smart Diabetes produces personalized treatment solutions for patients.

Sustainability: By continuously collecting, storing, and analyzing information on personal diabetes, 5G-Smart Diabetes adjusts the treatment strategy in time based on the changes of patients' status. Furthermore, to be sustainable for data-driven diabetes diagnosis and treatment, 5G-Smart Diabetes establishes effective information sharing among patients, relatives, friends, personal health advisors, and doctors.

With the help of social networking, the patient's mood can be better improved so that he or she is more self-motivated to perform a treatment plan in time.

Smartness: With cognitive intelligence toward patients' status and network resources, 5G-Smart Diabetes achieves early detection and prevention of diabetes and provides personalized treatment to patients. The remaining part of the article is organized as follows. We first present the system architecture of 5G-Smart Diabetes. Then we explain the data sharing mechanism and propose the personalized data analysis model. Furthermore, we introduce the 5G-Smart Diabetes testbed.

2. LITERATURE SURVEY

Chen et al. proposed the 5G-Smart Diabetes system, which combined the state-of-the-art technologies such as wearable 2.0, machine learning, and big data to generate comprehensive sensing and analysis for patients suffering from diabetes. Then this work presented the data sharing mechanism and personalized data analysis model for 5G-Smart Diabetes. Finally, this work builds a 5G-Smart Diabetes testbed that includes smart clothing, smartphone, and big data clouds. The experimental results showed that the system can effectively provide personalized diagnosis and treatment suggestions to patients.

Rghioui et al. presented an intelligent architecture for monitoring diabetic patients by using machine learning algorithms. The architecture elements included smart devices, sensors, and smartphones to collect measurements from the body. The intelligent system collected the data received from the patient and performed data classification using machine learning to make a diagnosis. The proposed prediction system was evaluated by several machine learning algorithms, and the simulation results demonstrated that the sequential minimal optimization (SMO) algorithm gives superior classification accuracy, sensitivity, and precision compared to other algorithms.

Venkatachalam et al. motivated to develop a diabetes motoring system for patients using IoT device in their body which monitors their blood sugar level, blood pressure, sport activities, diet plan, oxygen level, ECG data. The data are processed using feature selection algorithm called as particle swarm optimization and transmitted to nearest edge node for processing in 5G networks. Secondly, data are processed using DBN Layer. Thirdly, this work shared the diagnosed data output through the wireless communication such as LTE/5G to the patients connected through the edge nodes for further medical assistance. The patient wearable devices are connected to the social network. The Result of this proposed system is evaluated with some existing system. Time and Performance outperform than other techniques.

Prakash et al. introduced a neural network-based ensemble voting classifier to predict accurately the diabetes in the patients via online monitoring. The study consists of Internet of Things (IoT) devices to monitor the instances of the patients. While monitoring, the data are transferred from IoT devices to smartphones and then to the cloud, where the process of classification takes place. The simulation is conducted on the collected samples using the python tool. The results of the simulation show that the proposed method achieves a higher accuracy rate, higher precision, recall, and f-measure than existing state-of-art ensemble models.

Tsoulchas et al. proposed a model to monitor the health of people with diabetes melitus, a disease with high incident rates mainly at the elderly but also in younger people. Specifically, a study about the existing medically approved technologies for continuous measurement of diabetes is described. Subsequently, the model for monitoring patient's blood glucose levels is described. Whenever a patient's blood glucose levels are Low or High, the model triggers an alarm to a Cloud infrastructure in order remote medical staff to provide immediate cure to the patient. Furthermore, to assure the immediate response of the remote medical staff, the proposed model is deployed upon a 5G wireless network architecture.

Huang et al. proposed a 5G-based Artificial Intelligence Diabetes Management architecture (AIDM), which can help physicians and patients to manage both acute complications and chronic complications. The AIDM contains five layers: the sensing layer, the transmission layer, the storage layer, the computing layer, and the application layer. We build a test bed for the transmission and application layers. Specifically, this work applied a delay-aware RA optimization based on a double-queue model to improve access efficiency in smart hospital wards in the transmission layer. In application layer, this work builds a prediction model using a deep forest algorithm.

3. PROPOSED SYSTEM

In proposed work, we are using Decision Tree, SVM, Artificial Neural Network algorithms from python to predict patient condition from his data. To train these algorithms we are using diabetes dataset. To predict data efficiently author is using Ensemble Algorithm which is combination of Decision Tree, SVM and ANN algorithm. Training model of all these three algorithms will be merging inside Ensemble Algorithm to get better accuracy and prediction.

1) Personalization: In this technique one patient can share his data with other patient based on distance between cloud servers they are using to store data. Here we are using dataset so sharing is not possible but i am making all predicted test data values to be open so all users can see or share it.
2) Smartness: this technique will be considered as smart as its require no human effort to inform patient about current condition.

Here we have designed two applications to implement above technique

1) Cloud Application: This application act like a cloud server and storage and train dataset model with various algorithms such as decision tree, SVM and ANN and Ensemble algorithms.
2) User Application: In this application we will upload some test data and will be consider as user sense data and this data will be sent to cloud server and cloud server will apply decision and SVM and ANN model on test data to predict patient condition and send resultant data to this application. As we don't have sensors to sense data, so we consider uploaded test data as sense data. Here we don't have user details to share data so i am keeping all predicted data to be open so all users can see and share.

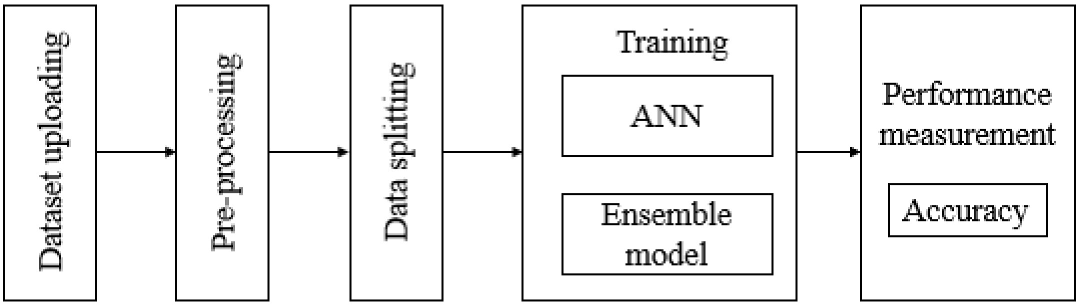

Fig. 1: Block diagram of cloud application.

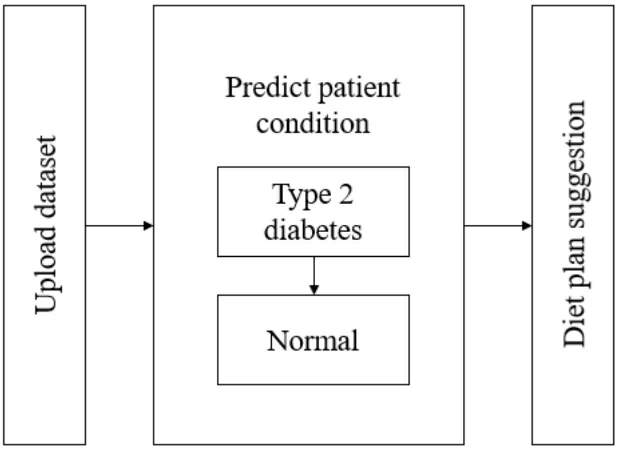

Fig. 2: Block diagram of user application.

3.1 Artificial Neural Network (ANN)

The term "Artificial Neural Network" is derived from Biological neural networks that develop the structure of a human brain. Similar to the human brain that has neurons interconnected to one another, artificial neural networks also have neurons that are interconnected to one another in various layers of the networks. These neurons are known as nodes.

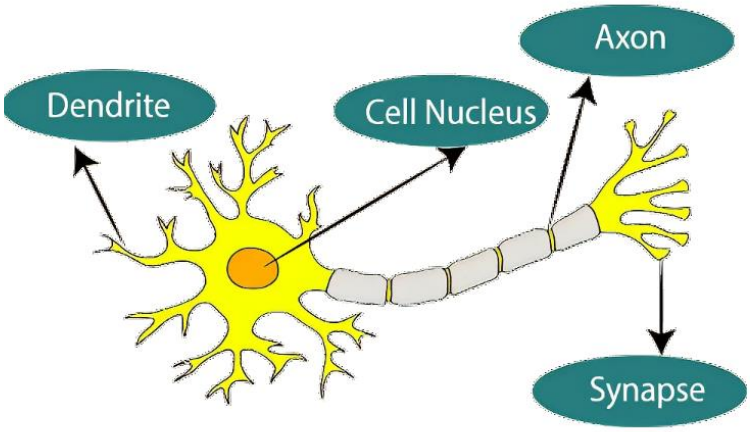

Fig. 3: Typical diagram of biological neural network.

The given figure illustrates the typical diagram of Biological Neural Network.

The typical Artificial Neural Network looks something like the given figure.

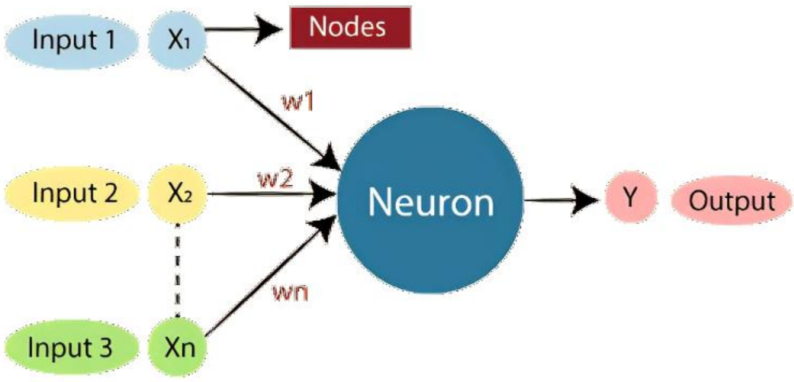

Fig. 4: Typical artificial neural network.

Dendrites from Biological Neural Network represent inputs in Artificial Neural Networks, cell nucleus represents Nodes, synapse represents Weights, and Axon represents Output.

4. RESULTS AND DISCUSSION

Dataset description

Pregnancies,Glucose,BloodPressure, SkinThickness, Insulin,BMI, DiabetesPedigreeFunction, Age, Outcome

6,148,72,35,0,33.6,0.627,50,1

1,85,66,29,0,26.6,0.351,31,0

8,183,64,0,0,23.3,0.672,32,1

1,89,66,23,94,28.1,0.167,21,0

In above dataset values first record contains dataset column names and other records are the dataset values. All dataset records in last column contains class values as 0 and 1. 1 value indicates patient values show diabetes 1 symptoms and 0 value indicates patient has normal values but indicates diabetes 1 symptoms. Above dataset is used for training and test data will have only patient data but no result values such as 0 or 1. This test data will be applied on train model to predict as 0 or 1.

Below are test values and these values are inside 'users.txt' file inside User/data folder

6,148,72,35,0,33.6,0.627,50

1,85,66,29,0,26.6,0.351,31

8,183,64,0,0,23.3,0.672,32

1,89,66,23,94,28.1,0.167,21

In above test records we can see there is no 0 and 1 values and cloud server will receive and predict values for above test records

Fig. 5: Prediction results on test data with diet plan suggestion.

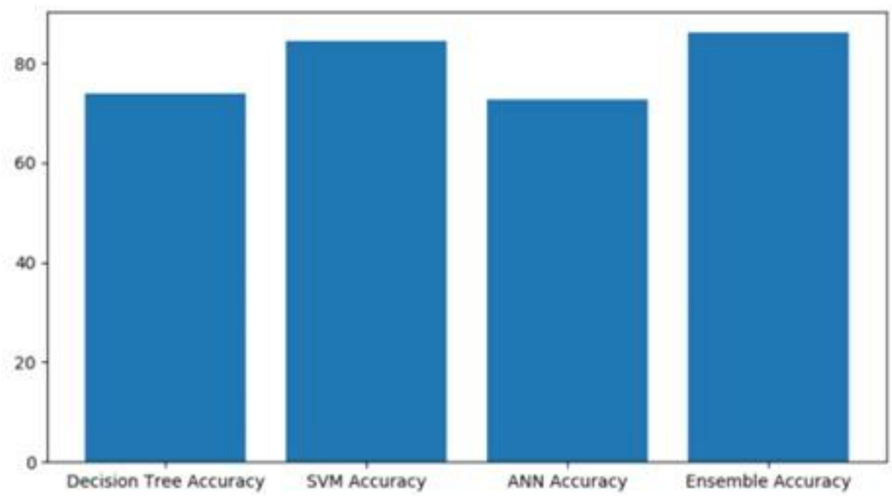

Fig. 6: Performance comparison of accuracy obtained using existing and proposed classification approaches.

5. CONCLUSION AND FUTURE SCOPE

In this article, we at first propose a 5G-Smart Diabetes structure that joins a distinguishing layer, an altered end layer, and a data sharing layer. Appeared differently in relation to Diabetes 1.0 and Diabetes 2.0, this system can achieve supportable, viable, and understanding diabetes assurance. By then we propose a very financially savvy data sharing framework in social space and data space. Besides, using AI procedures, we present a tweaked data examination model for 5G- Smart Diabetes. Finally, considering the shrewd dress, wireless and server ranch, we gather a 5G-Smart Diabetes testbed. The preliminary outcomes exhibit that our structure can give tweaked finding and treatment proposals to patients.

Future Scope

This work extended with an intelligent architecture for monitoring diabetic patients by using machine learning algorithms. The architecture elements included smart devices, sensors, and smartphones to collect measurements from the body. The intelligent system collected the data received from the patient and performed data classification using machine learning in order to make a diagnosis. The proposed prediction system was evaluated by several machine learning algorithms, and the simulation results demonstrated that the sequential minimal optimization (SMO) algorithm gives superior classification accuracy, sensitivity, and precision compared to other algorithms.

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