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Data Sharing and Personalized Analysis Model for 5G-Smart Diabetes

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ABSTRACT

Recent advances in wireless networking and big data technologies, such as 5G networks, medical big data analytics, and the Internet of Things, along with recent developments in wearable computing and artificial intelligence, are enabling the development and implementation of innovative diabetes monitoring systems and applications. Due to the life-long and systematic harm suffered by diabetes patients, it is critical to design effective methods for the diagnosis and treatment of diabetes. Based on our comprehensive investigation, this article classifies those methods into Diabetes 1.0 and Diabetes 2.0, which exhibit deficiencies in terms of networking and intelligence. Thus, our goal is to design a sustainable, cost-effective, and intelligent diabetes diagnosis solution with personalized treatment. In this article, we first propose the 5G-Smart Diabetes system, which combines 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 we present the data sharing mechanism and personalized data analysis model for 5G-Smart Diabetes. Finally, we build a 5G-Smart Diabetes testbed that includes smart clothing, smartphone, and big data clouds. The experimental results show that our system can effectively provide personalized diagnosis and treatment suggestions to patients.

1. INTRODUCTION

Diabetes is an extremely common chronic disease from which nearly 8.5 percent of the world population suffer; 422 million people worldwide have to 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 [2], with more teenagers and youth becoming susceptible to diabetes as well. Due to the fact that diabetes has a huge impact on global well being and economy, it is urgent to improve methods for the prevention and treatment of diabetes [3]. 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 multi-dimensional physiological indicators of patients suffering from diabetes [4, 5]. 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 [6, 7]. • There are no continuous suggestions for the

prevention and treatment of diabetes and corresponding supervision strategies [8, 9]. 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 [10], 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, comfort ability, personalization, sustainability, and smartness.

2. LITERATURESURVEY

Min Chen [SM'09] (minchen2012@hust.edu.cn) has been a full professor in the School of Computer Science and Technology at Huazhong University of Science and Technology (HUST), China, since February 2012. He is Chair of the IEEE Computer Society STC on Big Data. His Google Scholars Citations have reached 12,000+ with an h-index of 53. He received the IEEE Communications Society Fred W. Ellersick Prize in 2017. His research focuses on cyber physical systems, IoT sensing, 5G networks, SDN, healthcare big data, and so on.

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3.SYSTEM ANALYSIS

A. EXISTING SYSTEM

Diabetes is an extremely common chronic disease from which nearly 8.5 percent of the world population suffer; 422 million people worldwide have to 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 [2], with more teenagers and youth becoming susceptible to diabetes as well. Due to the fact that diabetes has a huge impact on global wellbeing and economy, it is urgent to improve methods for the prevention and treatment of diabetes [3].

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 multi-dimensional physiological indicators of patients suffering from diabetes [4, 5]. • 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 [6, 7]. • There are no continuous suggestions for the prevention and treatment of diabetes and corresponding supervision strategies [8, 9].

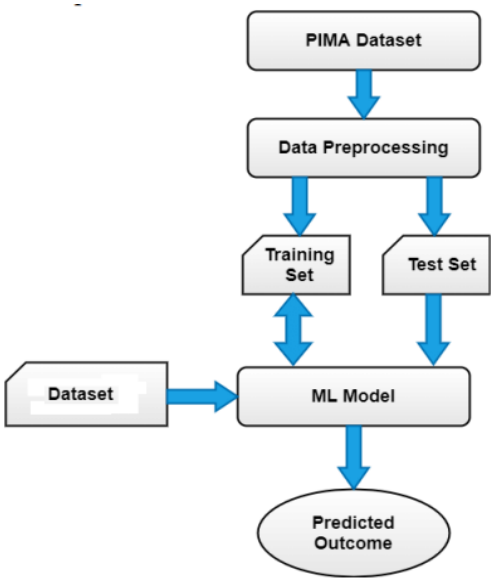
B. PROPOSED SYSTEM

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 [10], 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, comfort ability, personalization, sustainability, and smartness. Cost Effectiveness: It is achieved from two aspects. First, 5G-Smart Diabetes keeps users in a healthy lifestyle so as 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, in order 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. Finally, the conclusion of this article is given.

4.SYSTEM DESIGN

SYSTEM ARCHITECTURE

Below diagram depicts the whole system architecture of Data sharing and personalized analysis model for 5g-smart diabetes.



5. SYSTEM IMPLEMENTATION MODULES

1.SENSING LAYER
2.PERSONALIED DIAGNOSIS LAYER
3.DATA SHARING LAYER

1. Sensing Layer

This layer collects blood sugar, physiological information, diet information, and sport information through a blood glucose monitoring device, a wearable 2.0 device (i.e., smart clothing), and a smartphone. The blood glucose monitoring device can be equipped to conduct individual home-based blood glucose monitoring. For the monitoring of the physiological indicators of users, smart clothing is employed to collect a user's real-time body signals, such as temperature, electrocardiograph, and blood oxygen. With respect to exercise and diet monitoring, a smartphone can collect the activity data from a patient and record the statistics of his or her diet. Furthermore, we also collect data from users when they are in the hospital. All the collected data are offloaded to the healthcare big data cloud through the 5G network.

2. Personalized Diagnosis Layer

In this layer, healthcare big data of the patients are jointly processed by utilizing modern machine learning methods to build efficient personalized models for analyzing and predicting the disease. This layer includes data fusion of blood sugar, physiological information, diet and sport information, data preprocessing, and the proposition of a cognitive intelligence model based on machine learning, deep learning, and cognitive computing.

3. Data Sharing Layer

This layer includes users' social space and data space. Specifically, in the social space, as illustrated in Fig. 1, both Eva and David are diabetes patients. Through online social networks, they share their information on diabetes with each other, then motivate each other to fight against diabetes. As Cindy and Bob are Eva's family members, Eva shares her disease information with them in order to handle a possible emergency situation. Meanwhile, the disease information is also shared with Jack, who has a long history of suffering from diabetes with successful experience in curing the disease. Jack can trace Eva's and David's status in time to help them as
their personal healthcare advisor if needed. In the data space, different patients live in different regions and store their personalized data in different clouds. Eva and Cindy have strong social relationships; however, they store data onto different clouds, which are far away. Thus, when Eva and Cindy share data, the communication cost needs to be considered. Table 1 shows a comparison of the advantages and disadvantages of Diabetes 1.0, Diabetes 2.0, and 5G-Smart Diabetes. Seven features are compared, including cost, comfort, network support, personalization, sustainability, scalability, and treatment pattern. we can see that 5G-Smart Diabetes is better than Diabetes 2.0 in the following four aspects: • 5G-Smart Diabetes adopts social networking services to realize treatment supervision of the patient by relatives and friends. • Since the blood glucose index is associated with physiological indices, 5G-Smart Diabetes utilizes physiological data, food consumption data, and exercise data to increase the efficiency and performance of the diagnosis and treatment of diabetes.

6. RESULTS AND DISCUSSIONS

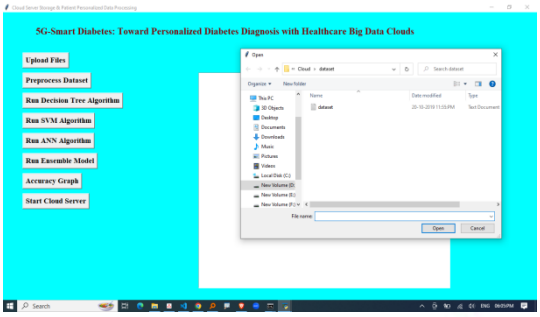


Fig 1. Uploading Dataset

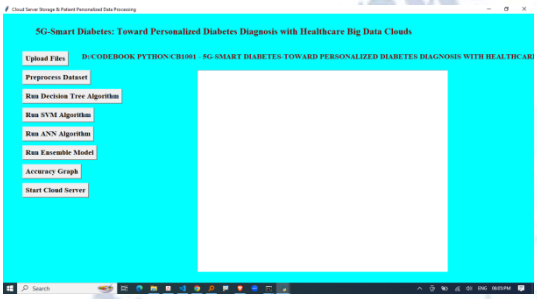


Fig 2 Prepossessing ofdataset

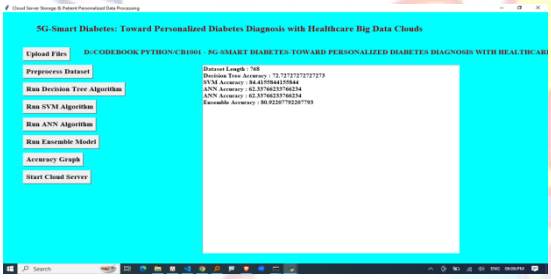


*Fig 3*This Fig Shows The Ensemble Accuracy

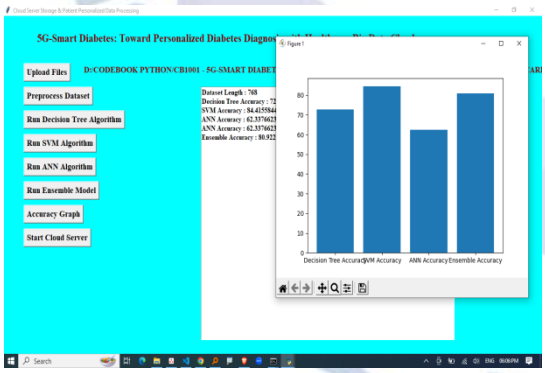


Fig 4 This Fig Shows TheAccuracy Graph

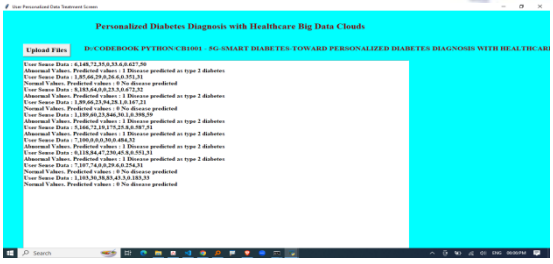


Fig 5 This Fig Shows The prediction results

7 .CONCLUSION AND FUTURE WORK

In this article, we first propose a 5G-Smart Diabetes system that includes a sensing layer, a personalized diagnosis layer, and a data sharing layer. Compared to Diabetes 1.0 and Diabetes 2.0, this system can achieve sustainable, cost-effective, and intelligence diabetes diagnosis. Then we propose a highly cost-efficient data sharing mechanism in social space and data space. In addition, using machine learning methods, we present a personalized data analysis model for 5G-Smart Diabetes. Finally, based on the smart clothing, smartphone and data center, we build a 5G-Smart Diabetes testbed. The experimental results show that our system can provide personalized diagnosis and treatment suggestions to patients.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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