IJBPAS, April, 2023, 12(4): 1586-1595

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

AUTOMATIC HEALTH MONITORING PATIENT'S MEDICAL DEVICE

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Received 10th May 2022; Revised 18th June 2022; Accepted 29th Aug. 2022; Available online 1st April 2023

https://doi.org/10.31032/IJBPAS/2023/12.4.7032

ABSTRACT

Diabetes affects a large number of people all around the world. While contemporary therapies for diabetes, such as insulin injections and insulin pump devices, are successful, they still necessitate a physical effort that, if not addressed quickly enough, can result in death. This project develops and installs an artificial pancreas to help diabetics enhance their quality of life by managing blood glucose levels and easing the burden of insulin therapy. It shows a portable artificial pancreas system that uses a continuous glucose monitor (CGM), an insulin pump, and a CPU to develop a control algorithm for automatic insulin dosage injection. By delivering a regular report to the health care centre and triggering an alarm in the event of any severe issue, the system also serves as an effective tool for monitoring the patient's situation. When compared to commercially available systems, the provided system is more cost-effective.

Keywords: Health Monitoring System, Diabetics, Medical Device

1. INTRODUCTION

According to a 2016 report by the World Health Organization (WHO), diabetes affects 422 million people worldwide and has become one of the main causes of mortality each year. Diabetes Mellitus is a long-term condition that arises when blood glucose levels are too high. Type 1 and Type 2 diabetes are the two most common forms. Type 1 diabetes is characterised by an autoimmune reaction in which the body destroys the pancreas' insulin-producing beta cells, resulting in insufficient insulin **[1]**. As a result, Type 1 diabetes necessitates lifetime insulin therapy. The body can manufacture insulin in Type 2 diabetes, but it is either insufficient or the body is resistant to its effects.

As a result, the cells develop insulin resistance, and the body cannot benefit from the insulin produced **[1]**. The body's cells cannot convert glucose into energy without insulin. The patient will always be at danger of hypoglycemia (low blood sugar) or hyperglycemia (high blood sugar). Patients with Type 1 diabetes require multiple doses of insulin throughout the day to maintain control of their illness because their bodies do not produce insulin. Type 2 diabetes can be managed by following a balanced diet and increasing physical activity, or by taking medication such as tablets or insulin injections under the skin.

Diabetics must therefore keep track of their blood glucose levels at all times, as this will help them calculate and modify their insulin dose to avoid complications. Self-monitoring of blood glucose (SMBG) and continuous glucose monitor (CGM) are the two main methods used by diabetics to measure blood glucose levels **[2]**. To avoid difficulties, type I diabetics must keep their blood glucose levels under control. The majority of patients will treat themselves with standard methods such as insulin injections and insulin pens, but those with severe problems may need an islet transplant **[4]**. Although current therapies for diabetes, such as insulin injections and insulin pump devices, are successful, they still necessitate a human effort that, if not addressed quickly enough, can result in death.

As a result, technology-based alternatives like as insulin pumps **[3]** and artificial pancreas systems **[4, 5]** have evolved as a replacement. In general, an artificial pancreas attempts to improve diabetics' quality of life by automatically managing blood glucose levels and easing the burden of therapy for insulin-dependent patients. Artificial pancreas devices come in a variety of configurations, with some being completely automated closed-loop systems and others being open-loop systems. They’ve gone through a number of changes, and the Juvenile Diabetes Research Foundation (JDRF) has divided them into six stages.

The goal of this project is to create a portable, cost-effective prototype of an artificial pancreas that administers hormones to the patient automatically. Both the user and the health care centre will be able to receive updated information from the system. In comparison to past work, such as the ones presented in **[6, 7]**, the key contribution of this is to give a lower cost solution based on affordable components. This study is structured in such a way that the methods used to design the artificial pancreas is explained.

2. Health Monitoring System

A portable artificial pancreas system employing a continuous glucose monitor (CGM), a microprocessor, and an insulin pump was presented in this work. Based on continuous blood glucose readings, the microprocessor included an algorithm for managing the automatic administration of insulin dose. A phone app that displays the glucose level every five minutes was also developed, allowing patients to quickly recognise their glucose pattern. The suggested artificial pancreas system was constructed utilising commercially available parts that were assembled and connected to one another, resulting in a system that is far less expensive than commercially available full artificial pancreas systems.

3. Diabetic Patients: A Non-Invasive Health Monitoring System

The creation of multiple apps has been aided by the advancement of the digital era. The growing population has resulted in an increase in the number of persons suffering from a variety of ailments. Diabetes is one of the most frequent diseases that affect the majority of individuals throughout the world. It is vital for them to assess the level of glucose in their bodies using a variety of invasive procedures. Patients who use these methods experience a great deal of discomfort. To get rid of these methods, we proposed a model in this work that uses light transmission to estimate the level of glucose in the body.

Because Li-Fi technology is speedier and more efficient than regular Wi-Fi systems, it is employed. Patients in remote places do not have easy access to hospitals, and this model will help to solve this problem. Because a patient is monitored 24 hours a day, 7 days a week, the model is efficient and reliable. When compared to other traditional health monitoring systems for patients in hospitals, the system's performance is analysed and shown to be substantially more efficient.

Sensors are a relatively new technology that is widely employed in a variety of fields. Smart homes, smart classrooms, health care, and many more are among them. When connected to the internet, sensors are in charge of connecting with a variety of devices .When it comes to health care, there are many individuals who are admitted to hospitals for various reasons and treated. All of the duties could be completed manually, but this would take a lot of personnel and time.

The use of sensors in health care has decreased many manual procedures and duties that were previously conducted manually in order to make work easier and deliver higher accuracy while spending less time. Health monitoring is one of the upcoming research projects in which many academics are attempting to automate patient monitoring and give it with high accuracy and performance.

The proposed device is intended for use by a variety of diabetic patients who do not have access to hospitals and who want to monitor their glucose levels without using intrusive methods. Every diabetic patient must keep track of their blood glucose levels on a regular basis. Invasive procedures are most usually utilised, which are both painful and risky, as they can lead to other disorders. The proposed method takes use of Li-Fi technology to detect the quantity of glucose in the body by passing light through the patient.

The suggested monitoring system's efficiency is analysed and tested in real-time scenarios, and it is found to perform better than earlier standard health monitoring systems. The remainder of the paper is laid out as follows. The literature review is outlined in Section II. The proposed approach is discussed in Section III, and the findings and conclusion are presented in Sections IV and V.

4. Connected Works

Various research projects are being carried out by a number of researchers in order to keep track of a patient's health. Narasimha Rao created a methodology that primarily focused on remote health monitoring and utilised sensors connected to the Adriano microcontroller. The data collected by the entire system was processed and analysed using the cloud created a wearable ECG that combines HBC and LCS. According to the findings of the experiments, the proposed model produced an efficient result. Rapin *et al.,* **[8]** proposed a work in which a wearable sensor for frequency-multiplexed EIT was built.

The architecture was created specifically for the planned system and was built on cooperative sensors to reduce the amount of wiring required. Javier Hernandez created a low-cost motion sensor that measured opportunistic heart rate readings .The security paradigm for health-care applications in which data security is critical. Christy *et al.,* proposed a detection technique for essential healthcare data that was very effective .A method for classifying Diabetes Mellitus using algorithms such as ANN, Nave Bayes, and KNN **[10]**. The model produced a number of the most common assessments, all of which claimed to be extremely accurate. When compared to other commonly used systems, the model demonstrated to be more practicable.

Shaikh and colleagues devised a dependable and scalable personal health-care system. It made use of a number of embedded sensors that were utilised to dynamically monitor the patient's health **[11]**. The data was processed and analysed using the Raspberry Pi. After the data was analysed, it was saved to a cloud server for further processing. Venkatasubramanian *et al.,* created a secure health monitoring system for sensor applications aimed at securing the health-care system **[14]**. Beacons were utilised to broadcast and receive messages from the nodes in this system. A patient health management system has been designed by Mukherjee.S. The design consists of nodes that are utilised to communicate with patients and medical personnel **[12]**.

In the event of an emergency, the patient or family members might readily speak with one another and gain a better understanding of the situation. Gao *et al.,* **[13]** devised a patient monitoring system that used antenna radar for health management. Bisen *et al.,* created an android application that displayed the output of their model .This allowed people to keep track of their own health from the comfort of their own homes. Trivedi *et al.,* built an android-based health monitoring system in which the sensors were connected to a microcontroller board and the data was transmitted wirelessly to a Bluetooth-enabled Smartphone .

The patient's readings and other information were saved on a cloud server, where they could be easily retrieved by both the patient and the doctor as needed. The main goal of Saha *et al* 's **[14]** work was to use sensors and the internet to monitor a patient's health, paving the way for an IoT-based health monitoring system .The proposed using Multicriteria Decision Making (MCDM) methodologies to assess the influencers on a social media site and compared the findings Attempted to extract semantic implications and applied them to the development of the vector space, resulting in the detection of irregularities .

5. A Properly Secure and Effective Monitoring System

In this research, we present a model that entails constructing an equipment for assessing a diabetic patient's glucose level without the need of invasive procedures. The heartbeat sensor and the temperature sensor are fixed in the model, which is made with an AT89S52 microprocessor. The phototransistor, RC filter, Pulse Generator, and IR LED are among the other hardware components used in the creation of this model. The complete model is then connected to the Li-Fi RX, which acts as a generator for the light, which is subsequently directed into the patients.

The model is made up of a number of sensors that are linked together via a wireless media. The sensor is intrusive and detects systolic and diastolic arterial pressure. For proper performance, the sensors also track the precise times when the changes in the body occur. The sensor is often affixed to the patient's finger and uses infrared rays to detect the quantity of glucose in the body.

6. Results of Experimentation

The system was put to the test in real time.A large number of people, both with and without diabetes, were asked to use the gadget and monitor the amount of glucose in their bodies. Various parameters were used to assess the application's efficiency. The speed, calculation time, fault tolerance, and packet loss, as well as the computation of miss and hit rates of signal transmission through the sensors, were some of the characteristics.

One of the most crucial aspects of one's life is one's health. We utilise a variety of technologies and programmes in our daily lives, but we often neglect to monitor our own health. In this study, we present a health monitoring system based on several sensors that allows a diabetic patient's glucose level to be examined on a frequent basis. The proposed method makes advantage of current Li-Fi technology to measure numerous bodily parameters by passing light through the human body. Traditional Wi-Fi technology appears to be slower and less efficient than this alternative.

The model is assessed based on a number of parameters, including computation time and sensor transmission speed. The proposed technology could be easily implemented in real-time health monitoring systems because it is non-invasive. Future work could include the use of security protocols to improve the security of data transmission and storage.

7. Machine Learning-based Intelligent Architecture for Diabetic Patients

An increasing number of Diabetes mellitus infected families as a result of its ever-expanding event. Almost of diabetic patients are unconcerned about their quality of life or the risks they face when they are examined. We proposed a unique paradigm for predicting type 2 diabetes mellitus using data mining techniques in this study (T2DM).The main problems we're seeking to solve are improving the consistency of the figure model and making the model adaptable to multiple datasets. Given the mobility of pre-processing systems, the model is divided into two regions: improved SMO with RF estimation and RF estimation.

The Waikato Setting for Knowledge Analysis instrument compartment and the Dataset from PIMA Indians Dataset for Diabetes study were used to learn about our findings and the findings of other studies. The model achieved a 3.04 percent higher speculation accuracy than those of different scientists, according to the results. In addition, our approach ensures that the dataset's accuracy is appropriate. To properly test the introduction of our model, we extended it to two other diabetes datasets. The results of the two tests suggest that the execution was satisfactory. As a result, the concept has been shown to be beneficial to the reasonable well-being of diabetic executives.

8. IoT Application for Diabetic Patient Environmental monitoring Segmentation

The Internet of Things (IoT) is being utilised to develop a variety of applications, especially as the amount of data available grows. IoT can be used in a variety of industries, including patient health monitoring. For example, in the realm of health, we can utilise IoT to analyse data and give it to doctors and paramedical staff. We can identify ways to live longer and healthier lives by analysing, processing, and exploiting the knowledge and information contained in Big Data with respect to health issues and illness trends in a certain community. In many ways, big data analytics enhances health care insights. Diabetes is one of the most frequent health issues around the globe.

Early detection of diabetes, we feel, contributes in better diagnosis and treatment. For this, we plan to develop a system that can automatically send blood glucose readings to the doctor via Short Message Service (SMS).The correctness of the test was subsequently demonstrated by the validation of sensor measurement data and SMS output data.

9. Elements Of Patient Monitoring

A. A digital blood glucose metre is a device that measures the amount of glucose in the blood. One of the most important skills for successful diabetes management is the ability to test blood sugar with a blood glucose metre. Each person's diabetes necessitates a distinct blood glucose testing strategy, and some will need to test blood glucose more frequently than others. The use of an electronic device called a blood glucose metre to monitor the level of hyperglycemia in the blood is known as blood glucose measurement. A tiny needle is used to prick your fingertip and a drop of blood is placed on a test strip. In the blood glucose metre, the strip is placed.

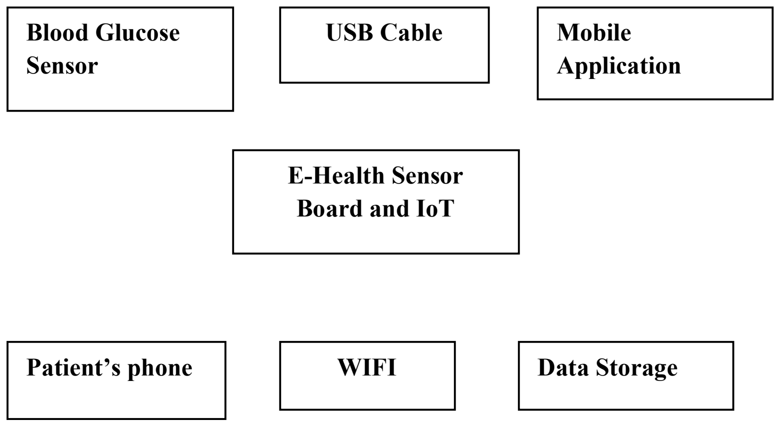

Figure 1: Block diagram Patient Monitoring

Shortly after, the digital monitor displays your blood sugar level. On the market, there are many different types of blood glucose metres. Some metres are made for ease of use, while others are made for portability or connectivity, and yet others have complex features like USB software or multi-strip testing. Digital Blood Glucose B.Sensor Shield for E-Health. The E-Health sensor shield is a unique module created to fulfil the needs of medical device designers working with Arduino. It contains data gathered from nine distinct biometric sensors. As a result, the biometric e-Health Sensor Shield v2.0 can be utilised for both real-time monitoring and data collection for subsequent analysis. The captured data can be sent via the shield's different interfaces (Wi-Fi, GPRS, Bluetooth, and so on).

10. Final Thoughts

The Internet of Things can be used to power a real-time diabetes monitoring system (IoT). It has been proven that personal diabetes monitoring via a mobile application database is effective. In this research, we offer a telemonitoring implementation of a blood glucose measurement system with a GSM module. The results of the evaluation revealed that the system could function properly. The data from the measurements was transmitted and received by SMS with a valid value. The average transmission delay was 48.27 seconds. When the data collecting procedure by the microcontroller was going, the connection between the blood Glucose sensor and Arduino could not run simultaneously. The cable between the sensor and the e-health shield must therefore be manually attached when a data gathering operation is done. Simulation experiments have been used to assess the suggested prediction model, and the findings show that it enhances prediction accuracy. This model will enable for self-disease management and improved glucose control as a form of prevention.

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