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A Smart Novel Approach of Blood Glucose Monitoring System using Arduino Board

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Abstract*:* A noninvasive blood glucose measuring method, where use of Near Infrared Technique that uses light transmission and absorption to measure blood glucose level accurately instead of traditional invasive method which include finger pricking which is painful and have risk of infection. Along with glucose level this can also give temperature and heart rate measurements. Also the measured result is transferred to the server which can be analyzed and the final report along with the suggestion and remedies are intimated to users. Diabetes is type of condition affecting the pancreas, which makes the hormone insulin, is diabetes. Diabetes results in a body's improper use of pancreatic insulin or the pancreas' inability to produce insulin. Produces, excessive blood glucose levels can occur. However, since glucose gives the body the energy it needs to function, the human body does need some of it. The prevalence of diabetes, which was 8% in 2011, is expected to rise to 10%. Monitoring blood glucose levels is essential for diabetes mellitus patients who want to regulate their glycemia. In order to prevent this, people must perform capillary tests at least three times per day and an additional laboratory test once or twice per month. In order to measure the amount of glucose using these traditional methods, patients must prick their fingertips. which is difficult for them to do, unsettling and unpleasant It is astonishing to realize that low- or middle-income countries account for 90% of diabetes cases.

Keywords: *Blood glucose, Light transmission, IoT, Heart disease, Near infrared Technique.*

1. Introduction

One of the most prevalent ailments in our nation is diabetes. In India, diabetes has been diagnosed in about 40 million people. With heart disease, renal disease, nerve damage, and stroke as complications, diabetes is a dangerous, chronic disorder. To prevent complications, regular glucose level monitoring is crucial. The majority of glucose measurement techniques include invasive procedures like painful finger pricking with a needle that could result in infection.

Consequently, a noninvasive glucose measurement method needs to be developed. In this project, we employ light rays that pass through the skin, a blood glucose sensor to measure the level of glucose, a To measure body temperature and pulse, two sensors are used: a temperature sensor and a heart-rate sensor.

Diabetic individuals are required to check their blood sugar levels two to three times per day under the current method. The majority of commercially available glucose testing instruments require piercing the finger and estimating the glucose level using a drop of blood, or the patient must[19] visit a clinic to check their glucose level. The invasive techniques are uncomfortable, expensive over time, and risk spreading contagious infections, as shown in the report below. May not be accurate as this system fully based on human response where sometimes human error will occur.

Traditional medicine is no longer practised; instead, it is being replaced by telemedicine, connected health, e-health, mobile health, and smart health (sHealth)[1]. The healthcare industry has profited immensely from developments in IoT and information and communication technology. Innovative sensors are gathered by the smart healthcare system so that patients can receive assistance from a healthcare professional no matter how far away they are. The Healthcare Cyber-Physical System (H-CPS), which combines IoMT, electronic health records (EHR), and artificial intelligence (AI) derived from sensor data in addition to EHR, is making progress toward fully intelligent healthcare [2]. Smart healthcare is in demand because technology allows patients and specialists to communicate remotely for quick treatment [3].

Intelligent healthcare systems that deliver high-quality care and precise diagnosis have been revolutionised by the Internet of Medical Things (IoMT) [4]. The patient can identify the important circumstances for potential corrective steps with the help of ongoing monitoring. Real-time access to medical records is helpful for doing health analyses and determining the effects on society that will follow. Point-of-care services and medication administration have gotten simpler as a result of the healthcare sector's clever use of consumer technology.

A thorough review of the literature led to the identification of specific research initiatives based on the aforementioned technique, with the main goal of guaranteeing the correct insulin dosage and blood glucose level. The method that is most frequently used to assess blood glucose levels is intrusive, uncomfortable,

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expensive, and could result in the spread of dangerous illnesses. The tissues in the fingertips are also harmed by [25] continuously utilizing the intrusive treatment. Use of a non-invasive method that promotes routine examinations and decreases the pain and suffering brought on by frequent finger pricks is an alternative. a non-invasive technique using an NIR sensor to measure glucose levels The process transmits data through Bluetooth, displays the measured value on an LCD, sends it to an Android application, and stores [20] it. It is the location where a tool for non-invasively measuring blood glucose levels was created. The device displays the user's BMI, blood sugar level, and recommended insulin dose. According to the study, glucose detection should be accurate to within 4–16%. In a non-invasive, the blood glucose level and blood glucose concentration were measured by placing the fingertip into a Near-Infrared (NIR) LED.

One alarming finding is that people with diabetes are less conscious of their condition than adults and people in their middle years and neonates. In contrast to older and younger people, it has been shown that middle-aged adults are more aware of their health and are better able to understand their medical problems. As continuous blood glucose monitoring has become required, researchers' interest in non-invasive blood glucose monitoring methods is growing. The method presented in this article measures blood sugar levels using a Near-Infrared (NIR) light source with a wavelength of 940 nm. By measuring the amount of light travelling through the finger, blood glucose levels can be calculated.

By monitoring the amount of light that enters the finger, the blood glucose level can be determined. Using a 940 nm NIR LED, three separate probes—the arm, finger, and earlobe—were used to measure the blood glucose levels. The microcontroller delivers sensor data to a web server and an observer when an abrupt change in blood glucose level happens (any relative or person caring for the patient).In this approach, a person can constantly be aware of any potential threat in the event that such a situation arises. This device can continually monitor blood sugar levels and prompt patients to act appropriately for an initial course of treatment. The pillars of linear algebra, which would represent a mathematical model based on matrix algebra for the encryption method of this classical cryptosystem [7],[8].Through the development of the mathematical foundations based on matrix algebra and its implementation in encryption and decryption by means of the double transposition system, a new methodology is proposed for the generation of algorithms and encryption and decryption functions based on matrix factorizations or decompositions. [10],[11-12]. , as is the case of the PALU factorization. For this purpose, this article is divided in such a way that the reader can find in chapter two, the development of the transposition encryption system for the particular case of encryption by the method known as double transposition, based on matrix algebra. The additional considerations that allow to generate new applications of the special factorizations in matrices for the development of new encryption and decryption algorithms are treated in detail in chapter three, for the applied case of the PALU factorization. In chapter four are the conclusions.

Use a zero before decimal points: “0.25,” not “.25.” Use “cm^3,” not “cc.” Indicate sample dimensions as “0.1 cm × 0.2 cm,” not “0.1 × 0.2 cm^2.” The abbreviation for “seconds” is “s,” not “sec.” Use “Wb/m^2” or “webers per square meter,” not “$webers/m^2$.” When expressing a range of values, write “7 to 9” or “7-9,” not “7~9.”

A parenthetical statement at the end of a sentence is punctuated outside of the closing parenthesis (like this). (A parenthetical sentence is punctuated within the parentheses.) In American English, periods and commas are within quotation marks, like “this period.” Other punctuation is “outside”! Avoid contractions; for example, write “do not” instead of “don’t.” The serial comma is preferred: “A, B, and C” instead of “A, B and C.”

If you wish, you may write in the first person singular or plural and use the active voice (“I observed that ...” or “We observed that ...” instead of “It was observed that ...”). Remember to check spelling. If your native language is not English, please get a native English-speaking colleague to carefully proofread your paper.

2. Related Works

In 2020, make technology available so that people with diabetes can check their blood sugar. D-CARE: A Noninvasive Glucose Measuring Method for Diabetes Patient Monitoring However, young children or elderly diabetics might not understand how crucial blood sugar control is. Today's most popular "solution" is continuous patient monitoring. However, for continuous blood glucose monitoring, the usual method of measuring blood glucose[5] levels is insufficient. This intrusive method, while more accurate, is painful and carries a slight infection risk. Therefore, it is advisable to routinely check your blood sugar without using any instruments. Continuous intrusive surveillance can be replaced with a non-intrusive monitoring technique based on the Internet of Things. project will provide ongoing remote data collection and monitoring for diabetic patients using a system that has been developed in this group.

In 2018, technological advancements in blood glucose detection were use of a non-invasive approach for monitoring glucose based on electromagnets. Various types of electromagnetic sensors are used in this situation to solve problems. Blood glucose levels can be accurately detected by this sensor [3,4]. Depending on the electromagnetic wave used, this approach has both a significant disadvantage and an advantage. confirming which was difficult? It was unreliable to detect glucose.

In 2019, Antonio Alarcon created a Raspberry Pi-based IoT for diabetics. Discussion is held regarding the Framework for non-invasive blood glucose monitoring using the Internet of Things (IoT).A identified laser beam, a Raspberry Pi Camera, and a Raspberry Pi Zero (RPi) are all components of the system and are all powered by a battery bank. In order to acquire information for non-invasive monitoring, the RPi Zero creates histograms for each photo of the user's fingertip that it takes[11]. The output data is processed by processors built on top of a Flask microservice and the [16 Tensor flow library] artificial neural network (ANN). Clarke grid error for zone (90.32%) and mean absolute error for zone A (10.37%)were used in this investigation. to compare the outcomes to in vivo blood tests that were all conducted in the lab. The predicted glucose values can be collected and used for monitoring by an end device, like a smartphone.

In 2020, a new wearable called iGLU 2.0: A New Wearable for Accurate Non-Invasive Continuous Serum Glucose Measurement in IoMT Framework, will be made available a cutting-edge wearable, was released. Non-invasive, trustworthy, and reasonably priced blood glucose management devices are required. Serum glucose is a more precise method of measuring blood glucose when compared to[12] capillary glucose testing. Currently, serum glucose is measured using invasive laboratory equipment. Since it hurts, the invasive approach is not suggested for continuous glucose monitoring We advise adopting the new, non-invasive iGLU 2.0 wearable device for precise continuous blood glucose monitoring. The brief near-infrared (NIR) spectroscopy method we just created is the foundation of this device. The Internet of Medical Things (IoMT) serves as a channel for communication

between patients and medical practitioners for the aim of intelligent healthcare (IH). Caregivers have access to the medical data that is saved in the cloud. The system is calibrated and validated using research on the most effective regression model in healthy, prediabetic, and diabetic individuals.The average error (AvgE) and mean absolute relative difference (mARD), which are calculated as 6.09% and 6.07%, respectively, are used to determine capillary blood glucose. However, it is anticipated that AvgE and mARD will be 4.86 and 4.86, respectively, for serum glucose.

As a result of initiatives to create non-invasive glucose metres and systems, near infrared (NIR), Raman, and Fourier transform infrared (FTIR) spectroscopy are some of the optical technologies that have attracted the most research attention[1,2]. The three essential components of contemporary systems are a microcontroller or signal processor, a module with signal acquisition sensors, and a component where the result will be displayed [5]. These compounds operate as an energy source and interact with the target substance or area of the body. However, a variety of outcomes are produced [6] depending on the physical underpinnings of the system and the chosen component attributes. The data from the sensor that was used for this is examined using optical techniques.

In primary transdermal,[1] thermal, and optical technologies employed by devices for non-invasively monitoring glucose were discussed in prior publications. It is possible to determine the transdermal glucose[7] levels by sonophoresis, reverse iontophoresis, or ultrasonography.By analyzing the physiological reaction to thermal emissions as a result of glucose's consequences of heat radiation absorption that are directly related to its concentration,The thermal methods seek to estimate glucose concentrations. Using optical methods,[8,9] the process of absorbing, reflecting, or spreading energy of a light beam as it passes through human tissue can be used to calculate the glucose level. Because they are simple and may be utilized to create small, affordable systems using laser diodes, optical technologies are usually selected. For instance, compared to other technologies, transdermal sensors require a time-consuming calibration procedure and are more susceptible to uncontrolled surroundings. However, a number of factors, such as perspiration, the roughness of the skin, the surrounding temperature, and pressure, could affect glucose estimation. For this reason, scientists are still seeking for new, non-invasive methods that are more exact.

Additionally being developed are commercial non-invasive monitors. The Sugar BEAT, manufactured by the UK-based Nemaura Medical Inc., is one such. It analyses blood sugar levels using a reusable skin patch connected to a transmitter. Low-power radio waves are transmitted through the earlobe by the GlucoWise, which was developed by MediWise Ltd. in the UK [6]. The Google smart contact lens can also measure the amount of glucose in tear fluid. Less invasive glucometers have been created to solve this issue. Examples include the Gluco Track, a registered trademark of Integrity Applications Ltd. of Israel, which uses thermal and ultrasonic technology to measure glucose from the earlobe but requires the use of an electrode, and the Freestyle Libre, created by Abbott Diabetes Care Inc. of the United States. options available on the market Despite the fact that people with hypoglycemia frequently have false-positive adhesive patch and electrode levels. This problem has been resolved by the development of minimally invasive glucometers. The Abbott Diabetes Care Inc. USA-developed Freestyle Libre checks blood sugar levels in patients but commonly returns false-positive results for hypoglycemia. Using a combination of thermal and ultrasonic technology, The Gluco Track[6], a authorized trademark of Integrity Applications Ltd. of Israel, detects glucose from the earlobe.Mexico's diabetes mellitus (DM) epidemic is becoming a national emergency (WHO). The chronic, non-communicable form of the disease Diabetes mellitus (DM), a condition that has difficulty controlling blood glucose levels, shares this characteristic. The two main kinds of diabetes are type-1 and type-2. Type 1 diabetes develops when the pancreas produces either no or very little insulin. Controlling blood glucose levels is necessary. and turn carbs into energy, insulin is required. The development of type-2 diabetes results from inadequate insulin utilisation by the body, which spreads more rapidly than type-1 diabetes over the world. The levels of blood glucose are measured using invasive procedures.

An IBEACON technical resource was introduced with the concept of using the Facilities Navigation and Patient Monitoring System, where 90.9% of the resources are paperless. Use a cheap, dependable computer system for applications that are user-friendly. communicates with the user's computer and acts as a trustworthy backup solution. This work makes[29] use of a technique known as "Ibeacon Technology," which has been introduced in this regard. This study also described how the IBEACON technology functions and some potential uses for it in observing and assisting patient health. This technology will be clear-cut and cutting-edge for precise item tracking, system placement, and monitoring. Navigational technology is the sole foundation of this technology. Despite the system's placement being less precise than earlier technologies, it is more useful than the usual in many respects since it provides solutions for issues of this nature in contemporary culture. Because of this, the computing and electronics industries have a lot of prospective work opportunities. This lessens public social irresponsibility as well.

3. Proposed work

In new noninvasive method is presented in the system that is suggested. The patient's blood glucose level is being tracked by a sensor in this instance. The primary benefit of this device is the non-invasive blood glucose level measurement. The outcome can be viewed on a desktop computer or a smart phone using an app or webpage. Millions of people might feel more at ease and comfortable with blood glucose testing thanks to noninvasive glucose monitoring. The blood glucose concentration is detected using a non-invasive LED blood glucose sensor, and if any abnormalities are found, a smartphone notification is provided.

3.1. Interface of Sensor with Arduino

A blood glucose sensor is utilized to measure the glucose level, and an LED light that can penetrate skin will collect the RBC and WBC counts from the blood. The body temperature and heart rate are thus determined, respectively, by a temperature sensor and a heart rate sensor.

Sensors may sense the environment around them and either record information or make it visible, as their name suggests. Many sensors are available that can pick up on a variety of ambient elements, such as proximity, light, temperature, humidity, noise, and much more. We'll demonstrate today how PictoBlox, our graphical programming language, can be used to integrate sensors into Arduino projects, such an IR sensor. Infrared (IR) technology is used by a closeness sensor, often called a "proximity" sensor, to assess whether anything is nearby. If the sensor detects an object, it will turn ON; if not, it will remain off.

Two tiny driven pointers are included on an IR sensor: one serves as the device's power source and is constantly on, and the other serves as a situational indicator.

3.2. Measured Value are Displayed in LCD Display

As a result, the non-invasive method of measuring blood glucose is employed, allowing the user to check his blood sugar level, body temperature, and heart rate with no pain or discomfort and at a lower cost than the invasive method, which necessitates more time, money, and time away from work, carries a risk of infection and pain, and cannot be used on a regular basis. Anywhere, at any time, you can utilize this useful gadget with ease at home. Future Scope claims that other non-invasive health indicators, such as blood pressure, the quantity of red and white blood cells, and blood sugar, can also be measured.

3.3. Estimated Values Are Transferred to Server

Temperature, heart rate, and glucose levels are measured and then wirelessly uploaded to a server for analysis. A transmitter circuit and a receiving circuit make up the blood glucose meter's two circuits. A noise filter, a photodiode with a wavelength of 1550 nm, and an operational amplifier make up the transmitter circuit (lm358). An 800-1700 nm near-infrared device makes up the receiving circuit. Through the finger, the transmitter sends a continuous wave thread of light, which the receiver then receives with less intensity. The light has been amplified to strengthen the weak signal after noise filtering components reduced the noise frequency of the light. The intended signal is subsequently transformed into a value for the electric current. Arduino transforms the relative glucose value from the electric current's value.

3.4. Estimated Analysis and Report

The measured glucose level is stored in cloud is analyzed using prediction and classification algorithm. By comparing the measured value with the minimum and maximum value high sugar and low sugar is determined and corresponding causes and remedies are given to patients.

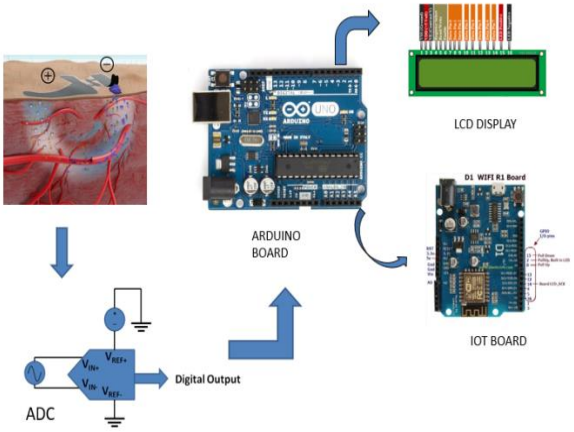


Fig 1. Proposed System Frame Work

The user model, which is posed in Fig. 1, can be accessed using the P's modular date. Having a reading of less than or equal to 50 mg/DL is considered to have dangerously low blood sugar. The glucose level can be determined using either an optical wave that reaches a photodiode or an attenuated light wave that the photodiode sensor detects and converts into a signal. The patient's finger is visible in the image wedged between the powered-up NIR sensor and the NIR sensor. The NIR signal's noise frequency is reduced using noise filtering, and the weak signal is amplified in a different way. Arduino converts the relative glucose value from the electrical current value of the signal. The result following a comparison using a list of predetermined criteria, the resulting glucose value is evaluated, and the generated five glucose levels are displayed on an LCD: very low, dangerously low, normal, and high.

Frequently checks the database of the user interface and maintain the glucose level of the patient and allow the user to login to frequently checked level of the user for medical conditions of the human body. The observer will receive a text message inquiring as to whether the sufferer has sought medical attention. A low blood sugar level is one between 51 and 70 mg/DL. The observer will also receive an SMS at this time asking them to give the patient a sweet treat as soon as feasible. If the blood sugar is between 71 and 179 mg/DL, it is regarded as normal. The reading will be reported as being extremely high if it is between 180 and 237 mg/DL, and the observer will this time receive an SMS instructing them to assist the patient as soon as it makes sense. A database is populated with all glucose readings before a monitoring cycle is finished.

3.5. Blood Glucose Sensor

A continuous glucose monitoring (CGM) system, which is implanted under the skin and tracks blood glucose levels, includes a glucose sensor. In order to follow glucose highs and lows over time and choose the optimal course of therapy, it wirelessly transmits your glucose readings to the system receiver or a comparable smart device.

3.6. CGM

A large number of CGM trials have begun as a result of research suggesting that strict glycemic control to Blood sugar levels managed as close to normal as is humanly possible, or euglycemia, may minimize the negative effects of diabetes and improve quality of life. The glucose levels in tissue fluid are measured by CGM devices using a small sensor that is implanted beneath the skin and remains there for some time. In order to warn patients to rapid changes in blood glucose levels, CGM systems should deliver information on blood glucose levels, such as the propensity, amplitude, frequency, length, and variability of variations. happen, especially when they're sleeping or exercising. Invasive and noninvasive approaches are both used in CGM research. Control continuous urine dipstick and finger prick glucometer samples using a glucose sensor. This strategy might have been able to distinguish between intrusive and non-invasive Modules by using the monitoring system. A few instances of the invasive state include micropores and microneedles, intravenous implanted devices, subcutaneous amperometry electrodes, and micro dialysis. Optical fluorescence, infrared spectroscopy, Raman spectroscopy, transdermal reverse iontophoresis, and other noninvasive methods are examples of the noninvasive state.

3.7. Glucose sensors Invasive State

Leland C. Clark, a scientist known as the "Father of Biosensors," invented the first oxygen electrode, often known as the "Clark electrode." Clark used glucose and the enzyme glucose oxidase to convert oxygen in order to analyses oxygen signals and calibrate the oxygen electrode. By using this method, a linear relationship between oxygen loss and glucose solution volume was found. In the end, Clark came to the conclusion that this straightforward device might be used to measure the levels of oxygen and glucose in blood, water, and other liquids. Modern glucose meters, the majority of which are based on Concepts, are used every day by millions of people with diabetes.

Four main methods are used in invasive continuous glucose sensor

research: Microdialysis, Intravenous implanted devices, micropores, and microneedles. Only research involving subcutaneous and microdialysis use currently accessible standards. Protected technologies are updated via subcutaneous needle-shaped sensors. When using a mediator, these sensors immobilize the mediator on a polymer membrane and an enzyme on the electrode surface. When glucose is broken down by the enzyme glucose oxidase, gluconolactone is created. Electrochemistry allows the concentration-dependent measurement of the current or voltage of a reduction-oxidation reaction.

The first CGM to earn FDA approval was Medtronic MiniMed (Northridge, California, USA), which creates the CGMS (FDA). The 3-day Continuous Glucose Monitoring System makes it feasible to analyses and understand blood glucose measurement data (CGMS). The Guardian Real-Time and MiniMed Paradigm Real-Time are two of Medtronic's newest products. After earning FDA approval, the DexCom-7The first real-time continuous glucose monitoring device has a seven-day battery life. Following five days of continuous glucose monitoring, the FDA granted the Freestyle Navigator, the most recent CGMS to get this approval, the thumbs-up.

Microdialysis probes are helpful auxiliary tools for analysing glucose trends. They consist of a hollow fibre that is implanted beneath the skin and a semipermeable membrane filter. For instance, glucose and other small molecules can permeate the membrane. Isotonic fluid perfuses the fibre as glucose from the interstitial fluid diffuses into it, pushing isotonic fluid in the direction of an electrode formed of an enzyme. The interstitial fluid's equilibrium has an impact on the glucose levels. One of this method's most common downsides is membrane blockage brought on by biofouling. In Europe, GlucoDay is the only commercial product that may be sold. This is true since all enzyme-based sensors in use today need to be calibrated using a finger prick blood sensor in the initial manufacture of intrusive CGMs. The primary areas for invasive CGM progress in the future will undoubtedly be accuracy, dependability, price, and simplicity.

3.8. Glucose sensors Noninvasive State

The level of living for diabetics has substantially increased as a result of the availability of glucometers for home usage. However, these monitors require brand strips for each test, and taking blood for analysis necessitates distressing finger pricks. The development of noninvasive continuous glucose sensors seems to be the solution to the limited lifetime and calibration requirements of the invasive continuous glucose system, as well as to increase patient compliance. The categories of optical and transdermal sensors encompass a wide range of technologies that are being developed as noninvasive sensor systems.

3.9. Transdermal sensors

A non-invasive transdermal continuous glucose monitor called GlucoWatch was given FDA approval in 2001. It is worn like a watch on the wrist and does not require extracting blood. GlucoWatch makes use of reverse iontophoresis. The electrode is protected from skin contact by an unique hydrogel cushion. Through the hydrogel-passing electrode that takes interstitial fluid from the skin and delivers a small amount of current to the iontophoretic electrode. The glucose oxidase catalytic system is used to identify the glucose concentration, which is 1000 times lower in the sampling fluid than in the interstitial fluid under the A rise in glucose levels indicates Large molecules are physically prevented from passing through the skin, which reduces both biofouling and electrochemically-active fouling. However, there are also significant drawbacks to this technology, the most significant of which are a lengthy warm-up period, challenging operation, a calibration requirement, and itchiness of the skin. This resulted in GlucoWatch being taken off the market.

Transdermal technology does not offer as many study possibilities as other optical technology, such as A few examples include optical coherence tomography, polarimetry, scattering/occlusion spectroscopy, Raman spectroscopy, fluorescence, photo-acoustic spectroscopy, and polarimetry. Currently, optical continuous glucose monitoring is not available on the medical market.But because diabetes is so widespread, scientists are focusing more on optical technologies. Fluorescence, which is utilised in all other types of glucose sensors, is the technique that has the best possibility of developing the ideal glucose sensor.

3.10. Optical sensors Based glucose sensors

Unique among photolum in escences is fluorescence. A densely organized molecule must first absorb light energy from the ground state to an excited state before producing light from several singlet states at an energy level lower than the one it was stimulated at. When compared to the traditional ultraviolet-visible spectrophotometry used in sensing, fluorescence-based technology has many advantages. Due to fluorescence spectrophotometry's high sensitivity, the host sustains less damage. Fluorescence can be noticed, together with its intensity and usual duration of 10-5 seconds. Fluorescence spectrophotometry also provides details on the surroundings and behaviors of biomolecules under healthy and pathological conditions.

The fluorescence-based architecture, and it was created in 1984. Con A is a homotetramer made up of four plant lectins, which are proteins that bind carbohydrates and each have four sites for the molecule of glucose. Con A can be attached to microscopic, hollow fibers and detected using fluorescent. The fiber has been fluorescently marked using a different polysaccharide called dextran. Rodamine or malachite green are employed as fluorescence sensors. Con A has opposing ligands in the fiber system, glucose and dextran. Fluorescence resonance energy transfer (FRET) occurs as a result of the interaction between dextran and Con A, going from the fluorescent donor to the fluorescent receptor. In its place, more or dextran glucose, which leads in a commensurate drop in FRET.

3.11. Heart Rate Sensor

A digital output of the heartbeat is created when a finger is placed on a heartbeat sensor. Optoelectronic principles are used in its operation. The heart rate is measured using two LEDs, an LDR connected to the microcontroller, and an LED that produces infrared light. Reverse leakage current is produced when the reflected light from the surface hits the IR sensor and flows through a resistor to produce a matching voltage.

3.12. Temperature Sensor

RTD or thermocouple temperature sensors are classic examples. The measurement of temperature uses an electrical signal. A thermocouple (T/C) is a device that converts temperature changes into electrical voltage by using two different metals. When the temperature changes, an RTD (Resistance Temperature Detector) variable resistor will adjust its resistance in a nearly linear manner.

4. IoT Board

IoT refers to a situation in which data can be transferred over a network without a person or a computer being involved.

Microcontroller units (MCUs), a prototyping tool with low-power processors that enable many programming environments, collect sensor data, and deliver it to a cloud-based server, are part of the Internet of Things (IoT).

5. Arduino Board

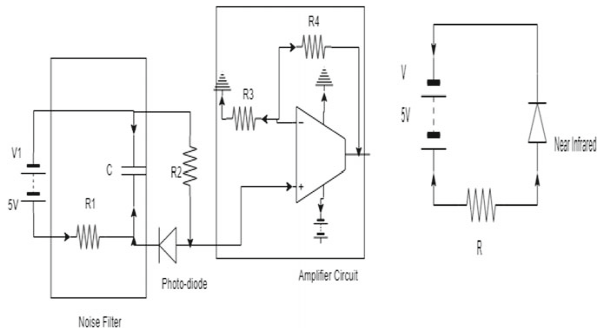
Electronic crafts are made using the open-source Arduino platform. It is made up of a microcontroller, which is a hardware-programmable circuit, and an IDE, which is computer software used to write and upload code to the actual board. With an Arduino, we can upload code to the board via a USB cable as opposed to a separate piece of hardware.

6. LCD Display

A flat panel display technology called "Liquid Crystal Display" is frequently utilized in televisions and computer displays. It is also utilised in mobile device displays, such as those found in laptops, tablets, and smartphones. In addition to looking different from hefty CRT displays, LCD screens also operate very differently from them. An LCD has a backlight that delivers light to each pixel placed in a rectangular grid, as opposed to an LCD, which projects electrons at a glass panel.

7. Monitoring Unit

In addition to the patient's blood glucose reading, a smartphone app will also show the reader's blood glucose reading on an LCD screen (GSM module circuit diagram). The SIM808 GSM module version 3.2 has a GPRS and GSM shield. General Packet Radio Service, or GPRS, is a radio service that connects to the internet. Using the straightforward GET technique, the microcontroller delivers the value it has obtained to the server. These values are obtained by the Android application from that server. When a patient's blood sugar level is critical, the SIM808 GSM shield further sends an emergency SMS to the observer's phone.



(a) Receiver circuit (b) Transmitter Circuit

Fig 2. Monitoring Unit of blood glucose

In the block diagram, many of the components that are used to measure glucose level are shown. The electrode functions as a sensor. Copper electrodes are used to measure sweat produced by human bodies. The conductivity of perspiration increases because it contains salt. There will therefore be some voltage. The amplifier receives the voltage and uses it to boost the voltage of low-level signals. The Arduino kit is exposed to a high voltage. A third party provides electricity to the Arduino starter kit. Analog signals are transformed into digital signals using the Arduino. An LCD display is affixed to the Arduino starting kit. Figure 8 shows a block diagram for estimating sweat glucose levels.

8. Result and Discussions

The outcome and analysis demonstrate the precision of the heartbeat, temperature, and blood glucose level. With that level of accuracy, it may be possible to draw conclusions about the patient database and treat the patient based on their glucose level. Temperature and glucose levels may be maintained while the date and time are stored in the database.

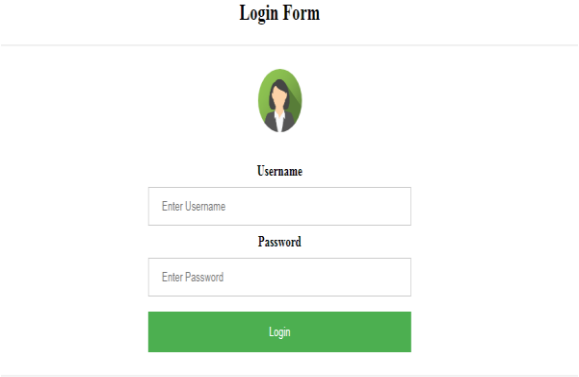


Fig 3. Login Form

An patient first logs in with their username and password using their login ID. The user model can be modified in order to accurately measure and identify the blood's glucose rate. When employing the precise way of the now in use technology, a patient's temperature and glucose level can be determined.

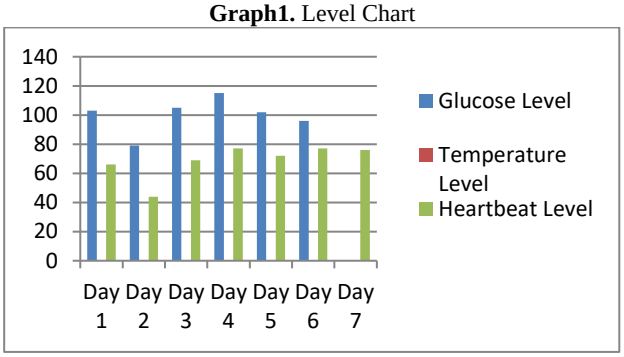
Table 1. Patient data Table

Days	Glucose Level	Temperature Level	Heartbeat Level
1	103	100c	66
2	79	99c	44
3	105	98.4c	69
4	115	101c	77
5	102	98c	72
6	96	103c	77
7	0	99c	76

Table 1. shows the content of the patient and stored database The patient database can be kept and maintained in the user login with time and date, as shown in Fig. 3.

A patient's finger must now be inserted between the photodiode and NIR sensors in order to measure blood sugar. The photodiode sensor receives an optical wave from the NIR sensor, attenuates it, measures it, and then transforms it into a signal. The NIR signal's noise frequency is then lowered using a The signal is amplified using an amplification approach to strengthen the weak signal and is filtered using a noise filtering technique. Arduino transforms the relative glucose value of the signal into a value for the electrical current. The computed glucose level is compared using a set of specified parameters, and the results are then displayed in an LCD panel with categorized levels.

Graph1. Level Chart



Graph 1 show the level chart of the patient for example, if a patient's temperature is 100°C, their glucose level can be maintained at 103.

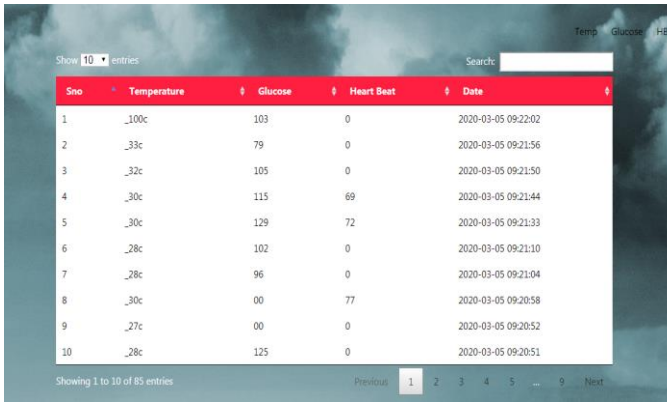


Fig 4. User Database

Patient's glucose reading on the LCD displays to the reader the reading from a smartphone. The technology is also meant to deliver an emergency alert when a patient's condition is in danger. Demonstrates the emergency message alert. For demonstration purposes, the glucose reading was manually provided in order to show the viewer the emergency alarm.

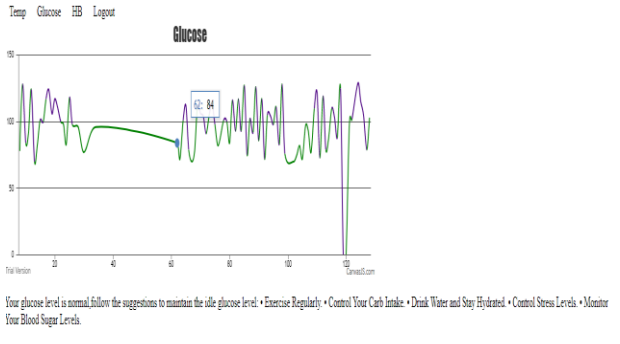


Fig 5. Glucose level

The graph in Fig. 5 depicts the glucose level when it reaches a stable temperature ratio, demonstrates the requirement for database content that has been recorded, and demonstrates how the model's spike level can both increase and decrease the high level of the model technique. If the user login material that is stored in the database is checked using the data model's addiction method.

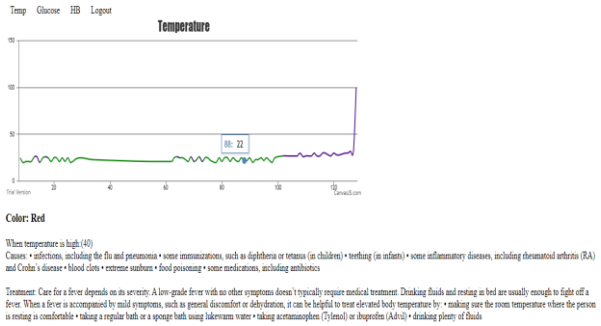


Fig 6. Temperature level

The presence of the flu and pneumonia viruses, as well as some immunizations and antibiotic use, may all be indicators of a high fever of 40 degrees, as well as the red colour of the spike. Sunburns, life-threatening blood clots, crohn's disease, diphtheria, and tetanus are side effects of immunization. The data modules in Fig. 6 identify the temperature setup.

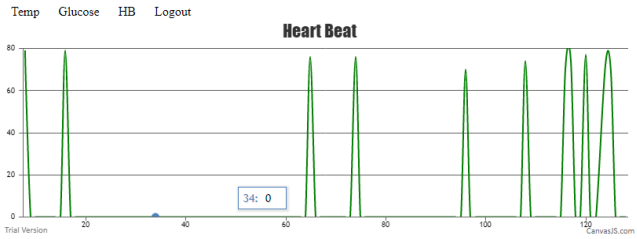


Fig 7. Heart Beat rate

Figure 7 Heart rate diagram when compared to conventional methods, the developed system offer accuracy that is, on average, close to 94.32%. The proportion of each test utilizing our suggested procedure that is inaccurate compared to invasive method is not larger than 8.56%, according to the table, which is based on the testing of 20 people. A glucose reading is considered clinically accurate if its error is less than 20%.

9. Conclusion

Thus, the non-invasive method of measuring blood glucose is used, allowing the user to check his blood sugar level, body temperature, and heart rate with no pain or discomfort and at a lower cost than the invasive method, which requires more time, money, and risk of infection and pain and cannot be used on a regular basis. This practical tool can be used at home with ease anywhere, at any time. Other health indicators including blood pressure Non-invasive methods can also be used to measure blood pressure, red and white blood cell counts, and blood sugar, according to Future Scope. The continual remote collection of the patient's glucose levels will give any doctor the ability to make that decision depending on the patient's health if the patient or the observer chooses to share the information with the doctor. Despite potential errors, the goal was achieved. The technology will be improved to reduce these errors and produce more accurate results. The addition of components like a meal plan for diabetic another proposal for future development is to categories people based on their blood glucose level.

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