Integrate Non Invaive Glucose Monitoring in Patient Monitoring Sytem With Alert Using IoT

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ABSTRACT

Abstract - Continuous glucose monitoring is crucial for diabetic patients. Integrating non-invasive glucose monitoring with patient monitoring systems can enhance patient care .To design and develop a noninvasive glucose monitoring system integrated with a patient monitoring system, tracking vital signs and providing real-time alerts and feedback to patients or healthcare providers using IOT. A noninvasive glucose sensor using near-infrared spectroscopy was integrated with a patient monitoring system, tracking glucose levels, heart rate, blood pressure, oxygen saturation, and respiratory rate. Abnormal readings triggered alerts, sent via SMS or email to patients or healthcare providers. The integrated system demonstrated high accuracy in monitoring glucose levels and vital signs, with timely alerts and effective feedback mechanisms. Patients and healthcare providers reported improved patient outcomes, enhanced patient engagement, and reduced hospital readmission. The integrated non-invasive glucose monitoring system enhances patient care by providing real-time, comprehensive patient data, timely alerts, and effective feedback mechanisms, improving patient outcomes and reducing healthcare costs.

KEYWORD: IOT, Sensors, Non-invasive glucose monitoring, Patient monitoring system Vital signs, Alerts.

INTRODUCTION

A patient monitoring system is essential for continuously tracking vital health parameters, including blood glucose levels, to prevent complications. Traditional invasive glucose monitoring methods cause discomfort and potential infection risks. To address this, non-invasive techniques using Near-Infrared (NIR) sensors offer a painless and reliable alternative. NIR light at specific wavelengths interacts with glucose molecules, allowing measurement without drawing blood.This paper presents a noninvasive blood glucose monitoring system utilizing a 940 nm NIR sensor to analyze glucose concentration through light absorption. An Android application is integrated to display and store real-time glucose readings. The proposed system aims to be portable, cost-effective,and user-friendly, improving Rate:

60–100 bpm.Blood diabetes management. This study explores the design, implementation, and effectiveness of this innovative approach.

VITAL PARAMETERS

This patient monitoring system continuously tracks vital parameters, including:

- Heart Rate (HR)
- Blood Pressure (BP)
- Oxygen Saturation (SpO2)
- Respiratory Rate (RR)
- Body Temperature
- Non-invasive Glucose Level (BGL)

COMPONENTS

- ECG/EKG sensor: Heart rate

- BP sensor: Blood pressure

- Pulse Oximeter : SpO2

- Temperature sensor
- Respiratory sensor: Airflow or chest expansion

- Blood Glucose Sensor : NIR sensor

- Arduino Uno

- Display and Feedback:

- LED or LCD display

- Buzzer and LED indicators for abnormal values

- Wi-Fi or Bluetooth for remote monitoring

- Cloud integration for data storage

Normal Range

- Blood Pressure: 120/80 mmHg
- Heart rate : 60-100bpm
- SpO2: 95–100%
- Respiratory Rate: 12–20 breaths/min
- Body Temperature: 36.5–37.5 °C
- Blood Glucose: Fasting : 70-100 mg/dL
- Post meal: <140mg/Dl

EXISTING WORK

Traditional patient monitoring systems are designed to track multiple health parameters, including:

- Heart Rate Monitoring – Using heart rate sensors.
- Oxygen Saturation (SpO2) – Measured with pulse oximeter.
- Blood Pressure Measurement – Using cuffbased or optical sensors.
- Body Temperature Monitoring – Through contact or infrared sensors.
- Blood Glucose Monitoring – Typically performed using invasive finger-prick glucometers.

These systems help in detecting early warning signs of medical conditions, but they lack a painless and continuous method for blood glucose monitoring. Additionally, existing systems often require manual data entry for glucose levels, making them less efficient.
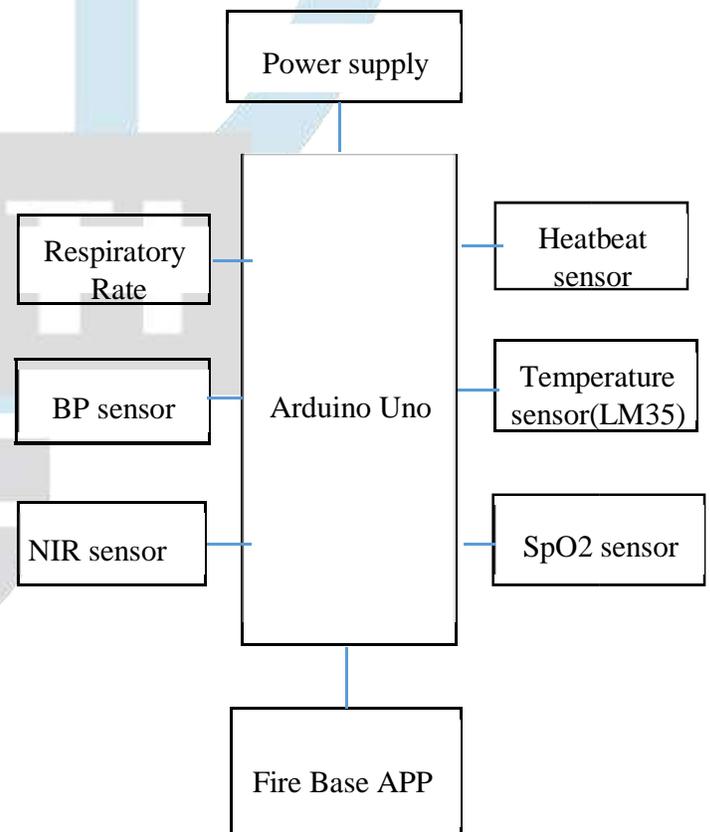
**Figure: Block diagram of Proposed Model**

CHALLENGES

- Patient Discomfort: Frequent finger-pricking or blood draws cause pain and inconvenience.

- Risk of Infection: Skin breaches increase infection risk, especially in critical care.

- Limited Sampling: Glucose levels are measured at discrete times, missing rapid fluctuations.

- Workflow Burden: Requires continuous manual intervention by nurses or caregivers.

- Cost: Consumables like test strips and lancets add ongoing costs.

- Without continuous glucose monitoring, hyperglycemia or hypoglycemia events might go unnoticed until symptoms appear.

- Excessive or non-specific alarms can overwhelm caregivers, leading to missed critical alerts.

- Some systems don't support continuous remote tracking or IoT-based alerts, limiting off-site supervision.

Proposed Work

This project incorporates non-invasive glucose monitoring into an IoT-based patient monitoring system. It tracks six vital parameters: glucose, heart rate, blood pressure, oxygen level, temperature, and ECG. The collected data is securely transmitted to a cloud platform for real-time evaluation.

An automated alert system notifies healthcare providers, caregivers, and patients of critical changes. A feedback mechanism analyzes trends to enhance patient care. This approach ensures continuous monitoring, early detection, and improved medical response.
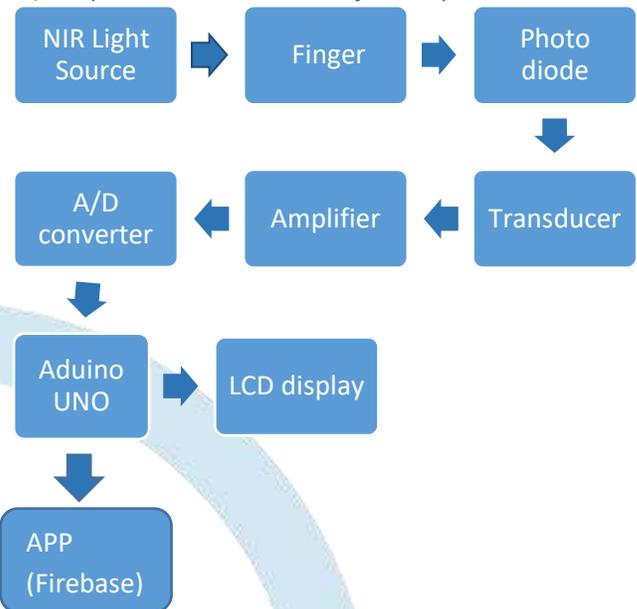
Figure: Block diagram of Non-invasive glucose Measurement

NIR SENSOR (GLUCOSE LEVEL SENSOR)

- In glucose monitoring, a Near-Infrared (NIR) sensor uses light in the near-infrared range to measure glucose levels non-invasively.

- The sensor directs NIR light onto the skin, where the light penetrates into the tissue and interacts with various molecules, including glucose.

- As the light passes through or reflects back, its intensity and specific wavelengths are altered depending on the glucose concentration.

- The sensor detects these changes and, through signal processing and calibration, estimates the glucose level in the blood or interstitial fluid. This method allows for glucose measurement without the need for direct blood samples.

WORKING PRINCIPLE

- NIR Emitter (Light Source)

Emits near-infrared (NIR) light onto the finger to interact with glucose molecules.

- Finger (Measurement Site)

Acts as a medium where NIR light is absorbed, reflected, or transmitted based on glucose concentration.

- NIR Receiver (Photo detector)

Detects the altered light intensity, which varies with glucose levels.

- Transducer

Converts the received optical signal into an electrical signal.

- Amplifier

Strengthens the weak electrical signal for accurate processing.

- Microcontroller

Processes the signal, extracts glucose information, and controls communication.

- Analog to Digital Converter (A/D Converter)

Converts the analog electrical signal into a digital format for microcontroller processing.

- LCD Display

Displays real-time glucose levels and alerts.

- Bluetooth Module

Sends glucose data wirelessly to a smartphone or doctor's system.

- App (Firebase)

Collects and analyzes glucose data for cloudbased monitoring .

ADVANTAGE

- Shows your sugar level all the time, not just once or twice a day.

- Family or doctors can check your health from far away.

- Gives alerts when sugar is too high or too low, so you can act fast.

- Simple display or app helps you understand your health better.

- Shows sugar along with heart rate, blood pressure, etc., in one system.

- Doctors can see the data and adjust treatment easily.

APPLICATION

- Used in hospitals to check glucose levels all the time.

- Alerts doctors and nurses if glucose is too high or too low.

- Helps patients at home check their glucose without finger pricks.

- Sends data to doctors even when patients are at home.

- Useful in ICUs for close watching of very sick patients.

- Can be used to watch people with prediabetes.

FUTURE SCOPE

- Connect with smartwatches or fitness bands for easier and continuous monitoring.

- Systems can automatically suggest food, insulin, or activities based on real-time readings.

- Doctors and caregivers can check patient data from anywhere using cloud and mobile apps.

- Make the system affordable and portable for people in remote or underdeveloped regions.

- Integrate with telehealth platforms for virtual consultations and faster treatment decisions.

- Develop smaller, more accurate, and comfortable sensors that last longer.

CONCLUCTION

Adding a non-invasive glucose monitoring system to a patient monitoring setup is an important improvement in healthcare. This system uses methods like optical, electromagnetic, or biosensor technology to measure glucose levels without needing to take blood, which makes it more comfortable and reduces the risk of infection. When connected to a patient monitoring system, it allows glucose levels to be tracked along with other important signs like heart rate, blood pressure, and oxygen levels, giving a complete picture of the patient's health.

One of the most useful parts of this system is the real-time alert feature. It quickly warns patients and healthcare workers if glucose levels become too high or too low. This fast response helps prevent serious health problems by allowing treatment to start right away. The system also gives regular updates and advice, which helps patients understand their condition better and follow their treatment plans more closely.

For doctors and nurses, the system collects continuous data that can be reviewed to see patterns and trends. This helps create care plans that are more suited to each patient's needs. Because the system can also send data wirelessly, it supports remote monitoring, making it easier to manage long-term conditions and reducing the need for hospital visits.

In summary, combining non-invasive glucose monitoring with alerts and feedback in a patient monitoring system makes glucose control more accurate and timely. It also improves patient comfort, safety, and involvement in their care. This is a big step forward in making healthcare more proactive and centered around the patient.

RESULT

Heart Rate (HR):
Measures the number of times the heart beats per minute. A normal resting heart rate for adults is typically between **60 and 100 beats per minute.**

Blood Pressure (BP):
Reflects the pressure of blood against the walls of the arteries. It's measured in two values: systolic (pressure when the heart beats) and diastolic (pressure when the heart rests). A typical reading is **around 120/80.**

Respiratory Rate (RR):
Counts the number of breaths a person takes per minute. A normal respiratory rate for adults is usually **between 12 and 20 breaths per minute.**

Oxygen Saturation (SpO2):
Indicates the percentage of oxygen-carrying red blood cells in the blood. Normal values are typically **95% or higher**.

Body Temperature:
Measures the core temperature of the body. A normal body temperature is generally considered to be **36.8°C (98.2°F) or 37°C (98.6°F).**

Glucose level:
Glucose Level: 195 mg/dL – Status: High – Alert Sent**.**
Glucose Level: 115 mg/dL – Status: Normal

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