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Wellness - IoT based Health Monitoring System Using Blynk Application

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Abstract:A paradigm shift towards personalized and proactive patient monitoring has occurred in healthcare as a result of the Internet of Things (IoT) technology's rapid advancement. The revolutionary IoT-based health monitoring system described in this study is intended to improve patient outcomes and wellness. The suggested system makes use of real-time data processing, networked devices, and comprehensive health insights to give timely interventions.

The IoT-based health monitoring system incorporates multiple sensors to gather a variety of physiological information, including heart rate, blood pressure, temperature, and activity levels, among others. These devices have seamless communication with a central monitoring center, which processes the data in real-time.

Keywords: Internet of Things, Sensors

1. INTRODUCTION

The fusion of the Internet of Things (IoT) and healthcare has transformed patient health monitoring, enabling real-time data collection and improved care delivery. IoT-based solutions offer remote vital sign monitoring, allowing healthcare providers and caregivers to respond promptly to critical health events. This research centers on an IoT-based patient health monitoring system using the ESP32 microcontroller and the Blynk application for data visualization and alerting.

Historically, patient monitoring occurred primarily within clinical settings, limiting data collection frequency. However, IoT technologies have helped in remote monitoring, enabling patients to receive necessary care within familiar surroundings. The ESP32 microcontroller serves as the system's core, providing data processing and transmission capabilities. Data is sent to the user-friendly Blynk application, empowering caregivers, healthcare providers, and patients to monitor vital signs and environmental conditions in real time.

An essential feature of this research is the Blynk application's alert mechanism. It promptly notifies designated caregivers and healthcare professionals when data exceeds predefined thresholds or deviates from established norms, facilitating rapid responses to critical health events. This research holds the potential to enhance patient outcomes, healthcare quality, and healthcare system efficiency. The development of an effective, user-friendly IoT-based patient health monitoring system contributes to the evolving landscape of remote healthcare.This paper explores the system's design, implementation, and evaluation, shedding light on its performance, security, and impact on healthcare practices.

2. WELLNESS–IOT BASED HEALTH MONITORING SYSTEM

2.1 Portable Sensors

The proposed wellness monitoring system is an IOT device that can be fitted inside the house to monitor the patient's physiological parameters. Variety of sensors in the market today such as Temperature sensors to sense the body temperature, Pulse oximeter monitors to measure the oxygen level (oxygen saturation) of the blood. The cost of the sensors varies according to their size, flexibility, and accuracy.

The ESP32 which is a cheap, flexible, entirely customizable, and programmable small computer board brings the advantages of a PC to the domain of sensor network.

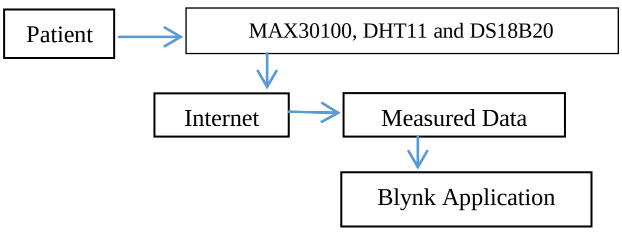


Fig.1 Architecture of the Wellness – IoT Based Health Monitoring System

WELLNESS monitoring system provides individualized, proactive, and patient-centered treatment through remote monitoring, chronic illness management, preventive care, care coordination, patient involvement, and ongoing quality improvement.

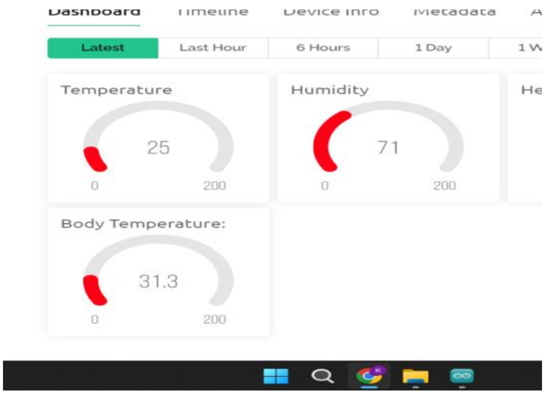


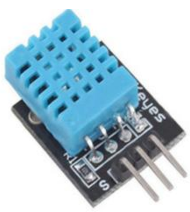
Fig 2. Data Measured in Blynk application.

The primary objective of the project is to develop an IoT-based patient health monitoringsystem that cancontinuously monitor the patient's vital signs,including heart rate, blood oxygen level, and body temperature, in real-time.

ESP32 Microcontroller

MAX30100/102

Pulse Oximeter sensor



DHT11

Humidity & Temperature

Sensor

DS18B20

Temperature Sensor

Fig.3System Components

In this proposed system patient's parameters (Temperature and Pulse) are measured with different sensors as shown in the fig 3. These sensors collect the data i.e Biometric information is given to ESP32 and then it is transferred to the Blynk application. The proposed method monitors the patient's health parameters using sensors and ESP32. After connecting the internet to the ESP32 it acts as a server. Then the server automatically sends data to the mobile.

These IoT-based projects have the potential to revolutionize the way we manage our health and well-being. Additionally by collecting and analyzing data about our physical activity, sleep, diet, and other factors, these projects can help us to identify potential health problems early on and make changes to prevent them. Additionally, wellness IoT-based projects can help us to improve our overall well-being by providing us with insights into our daily habits and making recommendations for improvement.

2.2 An Analysis of Wellness - IoT based Health Monitoring System

Wellness IoT-based projects use the Internet of Things (IoT) to collect and analyze data about a person's health and well-being. This data can then be used to provide insights and recommendations to help the person improve their overall wellness. Many supportive tools are available to improve the adherence of patient's health. These supportive systems are used for timely monitoring of the patients, and generate useful information about the behavior of the patients and monitor the health of patients. A large number of systems are developed that make use of monitoring and tracking techniques in various health-related projects, including patient health monitoring.

3. EXISTING SYSTEM

Existing health monitoring systems encompass manual recording by medical professionals, wearable devices like fitness trackers and smartwatches, and hospital telemetry systems. Traditional methods involve intermittent vital sign measurement, lacking real-time monitoring and being labor-intensive, potentially causing delays in detecting critical health changes. Commercial wearables offer basic health insights, but may not provide comprehensive medical data or continuous monitoring. Hospital telemetry systems utilize wireless sensors for continuous monitoring, providing real-time data to central stations for prompt emergency response. However, they are costly and unsuitable for home-based monitoring.

4.PROPOSED SYSTEM

WELLNESS monitoring systemprovides individualized, proactive, and patient-centered treatment through remote monitoring, chronic illness management, preventive care, care coordination, patient involvement, and ongoing quality improvement. The primary objective of the project is to develop an IoT-based patient health monitoring system that can continuously monitor the patient's vital signs, including heart rate, blood oxygen level, and body temperature, in real-time. The work aims to enable remote access to the patient's health data through an ESP32 microcontroller. Healthcare providers or caregivers can access the patient's body temperature, pulse rate, and blood oxygen level from anywhere using a local IP address.

4.1 System Components and their Functions

ESP32

The ESP32 is a versatile microcontroller and Wi-Fi/Bluetooth module developed by Espressif Systems. It's part of the ESP family, which also includes the ESP8266 module. The ESP32 is widely used in various IoT (Internet of Things) applications due to its powerful features and capabilities. The ESP32 features a dual-core TensilicaXtensa LX6 processor, which can be individually controlled for power optimization and handling multiple tasks simultaneously.

The ESP32 typically comes with several megabytes of flash memory for storing program code and data. It can be programmed using the popular Arduino IDE, making it accessible to a wide range of developers. It is a powerful and versatile microcontroller module with integrated Wi-Fi and Bluetooth capabilities.

MAX30100/102 Pulse Oximeter sensor

The MAX30100/102 is a compact, integrated pulse oximeter and heart rate sensor used in wearable devices and medical applications. It operates based on the principle of photoplethysmography (PPG), which measures changes in blood volume in the microvascular bed of tissue. The sensor measures the ratio of oxygenated hemoglobin (O2Hb) to deoxygenated hemoglobin (HHb) in the blood by analyzing the differential absorption of Red and IR light. The sensor detects variations in blood volume in the microvascular bed with each heartbeat, allowing it to calculate the heart rate (in beats per minute).

DS18B20 Temperature Sensor

The DS18B20 is a widely used sensor in various applications due to its accuracy, simplicity, and ability to communicate digitally over a single wire. The DS18B20 is a digital sensor, which means it communicates temperature data in digital format. This digital communication makes it easy to interface with microcontrollers and digital systems. One of the key features of DS18B20 is its one-wire interface, which means it only requires a single digital pin on a microcontroller for communication. Its digital interface and wide temperature range make it a preferred choice in many temperature sensing applications.

DHT11 Humidity & Temperature Sensor

The DHT11 is a widely used digital sensor for measuring temperature and humidity. The DHT11 is a digital sensor, meaning it provides digital signals representing temperature and humidity values. This digital output simplifies the interfacing process with microcontrollers and other digital devices. The DHT11 sensor is relatively inexpensive, making it accessible for hobbyist projects, educational purposes, and cost-sensitive applications.

The DHT11 is energy-efficient and consumes very low power during operation, making it suitable for battery-powered applications. Its ease of use and low cost make it a popular choice for a wide range of applications, especially in projects where basic environmental monitoring is required.

4.2 Data Collection Process

The data collection process in IoT-based healthcare monitoring involves gathering relevant health-related information from various sensors and devices, transmitting this data to a central system using the Internet of Things (IoT) technology, and subsequently processing and analyzing the collected data for healthcare purposes.

4.3 Sensor Integration

Portable Sensors

Patients wear wearable devices equipped with sensors such as heart rate monitors, accelerometers, temperature sensors, and pulse oximeters. These sensors continuously collect data related to vital signs and activities.

Data Sensing and Acquisition

Continuous Monitoring: Sensors continuously monitor the patient's vital signs and health parameters, capturing real-time data.

Data Accuracy: Sensors are calibrated to ensure accurate and reliable data collection.

Data Transmission

Wireless Connectivity: The sensor data is transmitted wirelessly using communication protocols like Wi-Fi, Bluetooth, or cellular networks (3G/4G/5G) to a gateway device or directly to the cloud.

Secure Transmission: Data is encrypted to ensure secure transmission, protecting patient privacy and preventing unauthorized access.

Alerts and Notifications

Threshold Monitoring: Predefined thresholds are set for vital signs. If a patient's parameters deviate from the normal range, alerts are generated.

Alert Delivery: Alerts are sent to healthcare providers, caregivers, and patients through various channels such as SMS, email, or web apps, ensuring timely intervention in case of emergencies or deteriorating health conditions.

Patient and Healthcare Provider Interaction

Patient Access: Patients can access their health data through dedicated apps or web portals, promoting self-monitoring and awareness about their health conditions.

Healthcare Provider Access: Healthcare providers can access patient data through secure portals. They can remotely monitor multiple patients, make informed decisions, and provide timely interventions based on real-time data.

Data Visualization

Dashboard: Data is presented to healthcare providers through user-friendly dashboards and visualizations. Graphs, charts, and trends help in easy interpretation of the data.

Patient Reports: Patients may receive regular reports summarizing their health status and progress, encouraging them to actively participate in their healthcare management.

4.4 Patient Health Monitoring System

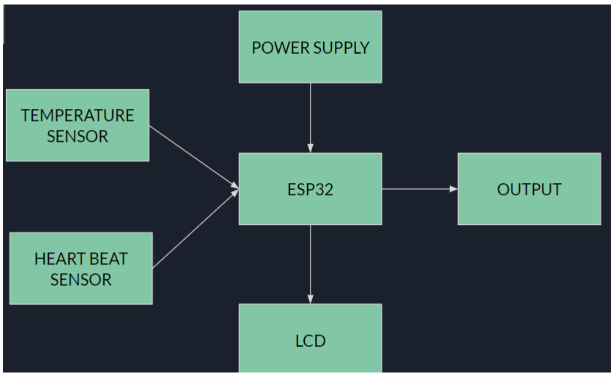


Fig 4: Block Diagram of the Patient Health Monitoring System

Sensors: The sensors used in a patient health monitoring system can be either invasive or non-invasive. Invasive sensors are inserted into the body, such as an arterial line for blood pressure monitoring. Non-invasive sensors are placed on the body, such as a pulse oximeter for heart rate and oxygen saturation monitoring.

Microcontroller: The microcontroller is the brain of the system. It is responsible for processing the data from the sensors, applying any necessary algorithms, and sending the data to the display unit.

Display Unit: The display unit can be a simple LCD screen or a more complex touchscreen interface. It allows healthcare professionals to view the patient's vital signs in real time.

Communication Module: The communication module allows the system to transmit data. This can be done using a variety of protocols, such as Wi-Fi, Bluetooth, or cellular.

4.5 Arduino IDE

The Arduino IDE (Integrated Development Environment) is used to write the computer code and upload this code to the physical board. The Arduino IDE is very simple and this simplicity is probably one of the main reasons Arduino became so popular. The Arduino Software (IDE) makes it easy to write code and upload it to the board offline. We recommend it for users with poor or no internet connection. This software can be used with any Arduino board.

4.6 Blynk IoT

Blynk is a popular Internet of Things (IoT) platform that allows users to easily build and control IoT devices through a user-friendly mobile app. It provides a simple and intuitive way to create customizable interfaces for various IoT projects without the need for extensive coding or hardware knowledge. Blynk offers a drag-and-drop interface that lets users design custom dashboards for their IoT projects. Users can add buttons, sliders, graphs, and other widgets to control and monitor their connected devices.

Blynk provides libraries and code examples for different hardware platforms and programming languages. This simplifies the process of connecting devices to the Blynk platform, making it accessible for both beginners and experienced developers. Blynk optimizes the communication between the hardware and the cloud, making it energy-efficient, which is crucial for battery-powered IoT devices. Blynk emphasizes security, offering features like encrypted communication between devices and the Blynk server. This ensures the privacy and integrity of the data exchanged between the IoT devices and the platform.

4.7 Flow of Data and Communication between Components

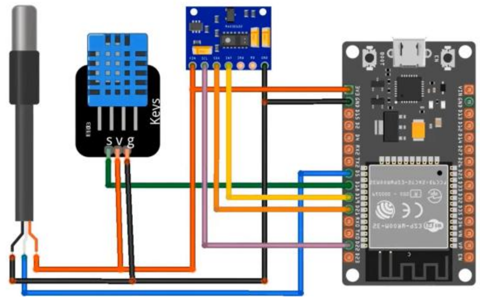


Fig 5: Process Circuit of Components

Data Collection from Patient Monitoring Device

The monitoring device collects real-time health data (heart rate, blood oxygen level, body temperature) from the patient using built-in sensors.

Data Transmission to IoT Platform

The monitoring device transmits the collected data to the IoT platform using wireless communication protocols (e.g., Wi-Fi).

IoT Platform

Receives the health data from the monitoring device. Prepares the data for further processing and analysis.

5. IMPLEMENTATION

Connecting an IoT device to the Blynk platform involves several steps. After the code execution, open the serial monitor. The ESP32 gets connected with the network and shows the IP Address.

Step 1: Create a Blynk Account

Download Blynk App: Install the Blynk app from the App Store or Google Play Store on your smartphone or tablet.

Create an Account: Launch the app and create a Blynk account. Provide the email address and set a password.

Step 2: Create a New Project

Create a New Project: After logging in, create a new project

Choose Hardware: Select the hardware required for implementation (e.g., Arduino, ESP8266, etc.,).

Get AuthenticationToken: Once the project is created, Blynk will send an authentication token via email. This token is essential for connecting the hardware to the Blynk project.

Step 3: Set Up Your Hardware

Install Blynk Library: Install the Blynk library in the development environment (Arduino IDE, PlatformIO, etc.).

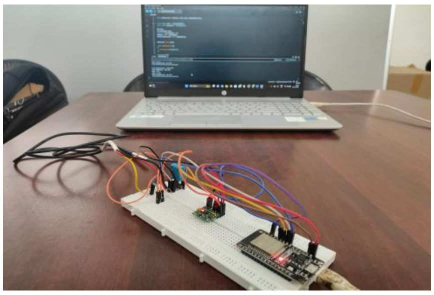


Fig 6:IoT device connected with the system

Add Code: Write code for the IoTdevice.Include the Blynk library and connect to the Wi-Finetwork. Use the authentication token that received to establish a connection with the Blynk server.

Step 4: Configure Blynk Widgets

Add Widgets: In the Blynk project, add widgets like buttons, sliders, or displays to control or monitor the IoT device.

Step 5: Test the Code

Upload Code: Upload the code to the IoT device.

Open Serial Monitor: Using Arduino, open the Serial Monitor to check the device's connection status and debug any issues.

Interact with Widgets: Use the Blynk app to interact with the widgets and see it controls the IoT device in real-time.

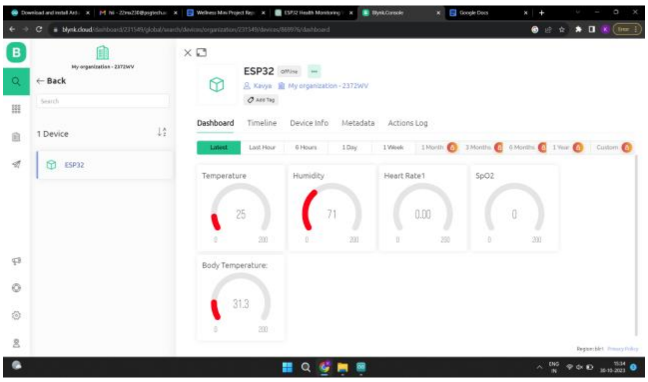


Fig 7: Patient Health Status

Similarly you can also view the Patient health status on the screen.

6. CONCLUSION

This system helps the patients to alert them to take medicines during their busy times. Patients will not be able to remain healthy when they are in busy times. This system sends alerts to patients and also it sends the message to patients once the health condition is abnormal.

7. FUTURE ENHANCEMENT

Future enhancements for this patient health monitoring project could include integrating advanced sensors for monitoring additional vital signs, such as ECG for heart rhythm analysis and respiration rate. Incorporating machine learning algorithms can enable early anomaly detection and personalized healthcare recommendations.

Ensuring robust data security with technologies like blockchain is essential for protecting sensitive medical data. Expanding the Blynk application with telemedicine features for remote consultations with healthcare professionals would further enhance the project's utility and revolutionize remote patient care.

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