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The Future of HealthCare is Connected

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ABSTRACT

An IoT based patient health monitoring system utilising ESP32 is a revolutionary method for enhancing healthcare services by enabling remote and real-time monitoring of patients health parameters.The system uses the ESP32 microcontroller and the Internet of Things (IoT) to effectively send and process data.The system uses numerous wireless sensors and when patient comes in contact with these sensors,It reads and captures critical physiological data like heart rate, blood pressure, body temperature, and oxygen saturation. Data from various sensors is received by the ESP32 microcontroller, which acts as a hub for data gathering, processing, and connection with a cloud-based platform.The cloud platform receives the health data provided by the ESP32 microcontroller.

Key words : IoT,health monitoring,cloud platform,Blynk app ESP32.

1. INTRODUCTION

A patient health monitoring system is a technology-based method used to continuously track and monitor patients' health conditions in a healthcare setting. It makes use of a range of hardware, software, and sensors to collect, analyse, and transmit real-time health data to healthcare professionals, carers, and patients themselves.

The fundamental goal of a patient health monitoring system is to raise the standard of patient care by enabling remote monitoring, early detection of health issues, and quick response. It gives medical professionals valuable knowledge about a patient's vital signs, physiological traits, and overall health regardless of where they are physically.

Wearable technology, such as smartwatches and fitness trackers, is widely used in these systems to assess several parameters, including heart rate, blood pressure, temperature, oxygen saturation, and activity levels.These systems frequently contain wearable devices, such as smartwatches, fitness trackers, or medical sensors, that may assess things like heart rate, blood pressure, temperature, oxygen saturation, and activity levels. These units are typically connected to mobile or cloud-based platforms that store and process the collected data.

Continuous monitoring allows medical practitioners to see any changes or anomalies in a patient's health status rapidly. Early identification of potential health problems allows for proactive medical intervention, reducing the risk of complications and improves patient health and also reduces health care costs. With the aid of these technologies, patients can gain a better understanding of their own health status, enabling them to take well-informed decisions about their health.

2.LITERATURE SURVEY

Patient health monitoring system tells us about the latest advancements in healthcare technologies utilizing IoT and also introduces wearable devices within the healthcare domain, and there are various international IoT and e-Health policies and regulations [1].

This paper[2] describes a smartphone with additional software,that can be used as a personal health monitoring device to track physical activity with physiological measurements.

This paper[3] provides a clear understanding of the IoT concept while also highlighting the current trends in IoT applications within the healthcare industry.

This paper[4] suggests an approach suitable for individuals friends and family, alongside healthcare professionals, to monitor their well-being. The proposed system utilizes real-time information gathered from five distinct sensors, including a HW-827, DHT11, MQ-2 sensors, MQ-135 sensor, and a room temperature sensor. These sensors feed their data

to an ESP32 processor, which subsequently presents the results on the Blynk application .

3.RELATED WORK

A patient health monitoring system for assisted living and the home environment, Alarm-Net is a heterogeneous network architecture created at the University of Virgina. The physiological, behavioural, and environmental factors are protected by networks and data security, but the system's flaw is that residents' whereabouts are subject to confidentiality assaults, and the data was leaked. UbiMon is a project created by the computing department at Imperial College London to analyse and offer answers to problems relating to the use of wearable and implementable sensors, which have gained widespread acceptance throughout the globe without taking data security into account. In order to carry out the project, Alvee Rahman presented the development of a health monitoring system that incorporates an ECG sensor and a digital thermometer for patient real-time monitoring. Based on the ideal sensor settings, this device may also notify doctors or family members. For an IoT-driven health monitoring system, Neel Kamal et al. have proposed a three-tier architecture, with the three tiers being a wired sensor network, a local processing unit, and a hardware control unit. It is effective for this system to create various reports in both accuracy mode and speed mode.

4.PROPOSED WORK

Our system is designed and implemented to continously monitor patients health in real-time and track patient health status remotely. The system can greatly enhance healthcare by enabling real-time monitoring of patient's vital signs and providing timely intervention in case of emergencies.

The system uses various sensors, and devices to monitor Specific health parameters such as BPM,SpO_2,ECG, temperature and tracks the health status of patients remotely. This type of system can be used in hospitals, nursing homes, and even in homes for patients who require continuous monitoring. The system's cloud-based architecture enables the processing and analysis of vast amounts of patient data, with real-time feedback and alerts about their health status, helping them to better manage their health conditions and prevent complications.

5.MODULE DESCRIPTION

Our proposed system uses sensors like DHT11-temperature sensor (measures body temperature), HW827-pulse sensor (measures the heart rate in beats per minute(BPM)),MAX30100-pulse oximeter sensor (measures oxygen level in blood) and AD8232-ECG sensor are given as input to ESP32.These sensors when comes in contact with human body,senses the wellbeing condition.It process data by using programming code in Arduino and transmits data to the cloud based server using in-built WiFi module.The output values of sensors like body temperature,BPM,SpO2 can be viewed in blynk app.If any sensor data preceeds predefined threshold(abnormalities from the normal range)an alert notification is pushed to the user,so that the patient can take care of his health by consulting the doctor at the earliest.

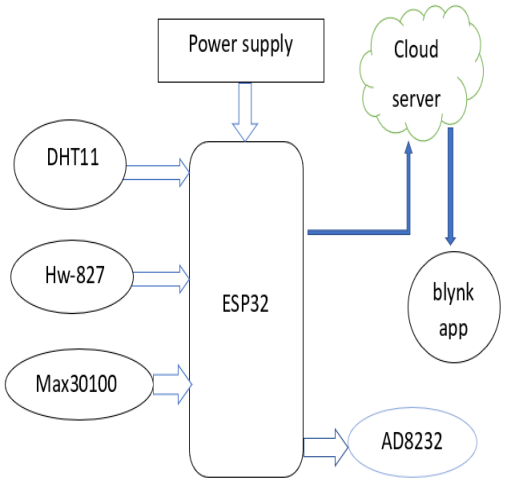

Figure 1: System Architecture

5.1 SENSOR MODULE: This module includes various sensors like DHT11,HW-827,MAX30100 and AD8232 to track the health status of patient. Connect the DHT11 sensor to measure temperature, ECG sensor to measure the patient's electrocardiogram,pulse sensor to measure the patient's heart rate,Spo2 sensor to measure the patient's blood oxygen saturation level.Ensure that the sensors are properly interfaced with arduino,so that it is capable of communicating with the Blynk app(as shown in figure 1).

1.DHT11

It Measures Temperature and Humidity.It Consists of capacitive humidity sensor and thermistor.The sensor Chip contains ADC converter and gives digital Output for Simplified Integration(as shown in figure 2).

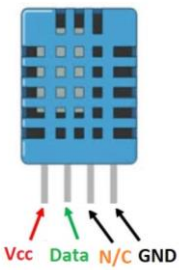

Figure 2:DHT11 Sensor

2.HW-827

It uses Light based detection and Consists of LED and photodetector(as shown in figure 3).It indentifies BPM by Blood absorption,Signal processing and gives output.

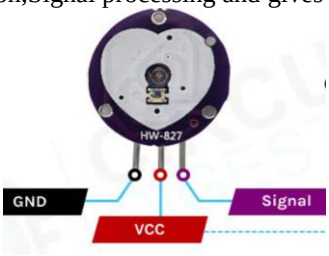

Figure 3:HW-827 Sensor

3.AD8232

It Measures electrical activity of heart.It consists of electrodes.Two electrodes are placed on left & right arm and other on the right leg(refer to figure 4).The Signal is conditioned by ADC Converter and gives output.

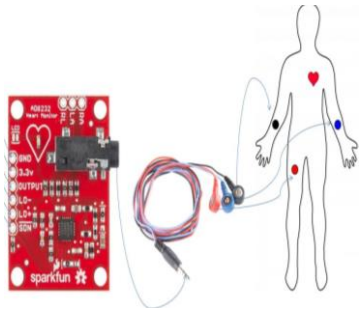

Figure 4: AD8232 Sensor

4.MAX 30100

It Measures blood oxygen saturation level(SPO2).It contains infrared LED(as shown in figure 5).The Signal is processed and gives output.

Figure 5:MAX30102 Sensor

5.2. Communication Module: To communicate data from the sensor module to the cloud server, this module incorporates a wireless communication device like Wi-Fi(ESP32 shown in figure 6). The communication module guarantees accurate and effective data transmission.

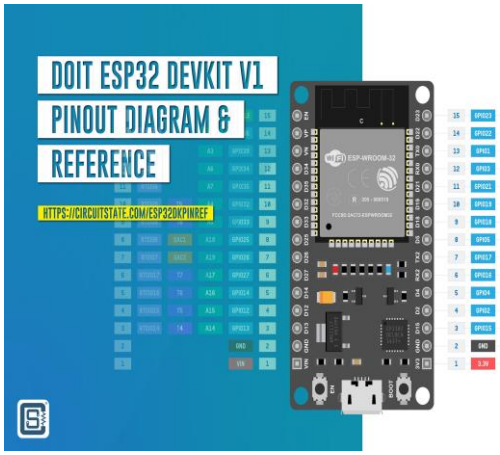

Figure 6: ESP32 Pin Diagram

5.3 Blynk app: This component pulls information from a cloud server. The processing of data and its transmission for analysis are handled by the central server module. It is possible to use threshold-based monitoring to detect unusual readings.Send an alarm or notification whenever any sensor data goes over certain limits.As shown below(Figure 7),one can customise widgets.

Figure 7: Blynk App

5.4 GSM Module: GSM modules are used to connect to servers or cloud platforms over cellular networks(shown in figure 8).Throughnotifications, the data can be accessible by authorised people like family members or medical staff.

Figure 8: GSM Module

6.SOFTWARE DESCRIPTION

This project is implemented using following software's Arduino IDE and Blynk application.

7.WORK FLOW

ESP32 collects data from each sensor, including heart rate, blood oxygen levels, ECG signals, temperature and humidity(circuit setup is shown in figure 9). The collected data is processed to ensure accuracy and reliability. ESP32 communicates with the Blynk cloud platform using Wi-Fi. Data can be logged and stored locally on the ESP32 or transmitted to a remote server or database for historical analysis. Blynk app provides a user friendly interface to visualize the collected data in real-time. Blynk displays real-time data using widgets like graphs and gauges. Thresholds can be set for each parameter (e.g., heart rate, temperature) in the app to trigger alerts if values go beyond acceptable ranges. Authorized users can monitor the patient's health using the Blynk app from anywhere with an internet connection. Ensure proper security measures, such as encryption and user authentication, to protect patient data and maintain privacy. The system could be integrated with medical services for immediate response in case of critical health events. In case of any abnormalities in patients health than an alert message is sent to patient registered mail and mobile number via SMS.

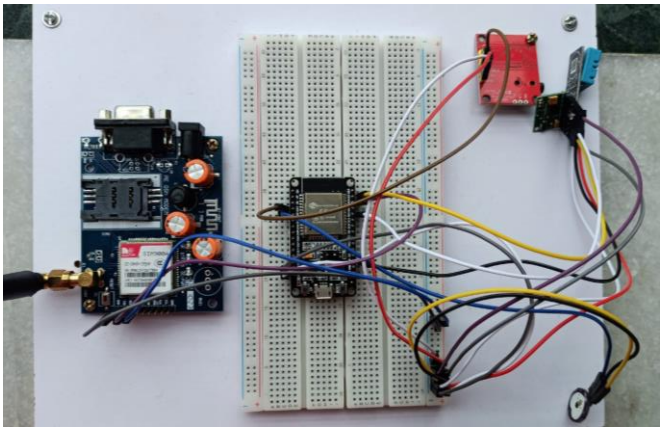

Figure 9: Circuit setup

8.RESULTS

Upon reading patients health parameters using various sensors,results are being displayed on blynk app(as shown in figure 10).If there are any abnormalities from normal range of values(as shown in Table 1) an alert notification pop ups on blynk app as "HIGH TEMP" or "LOW OXYGEN LEVELS",and also sends an email to blynk owner(as shown in figure 11).If GSM module is also connected,then an SMS is sent to given mobile number as written in code(this is shown in figure 12).

Table 1: Sensors Reading and corresponding Alert Messages for not in a normal range

Sensors	Normal Range	Alert Message
DHT11	36.1-37.2 Degree C	High Temp
HW-827	BPM(60-100)	Abnormal Pulse Detected
MAX30102	95-100%	Low Oxygen Level
AD8232	2-3 milli volts amplitude	Tachycardia or Bradycardia

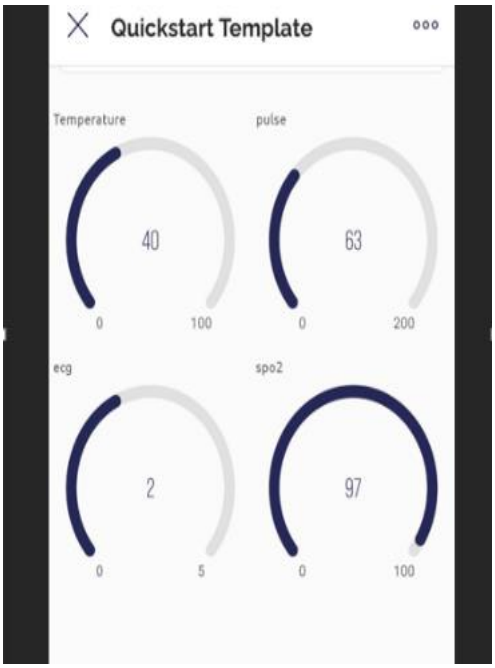

Figure 10: Output on the app when patient comes in contact with sensors

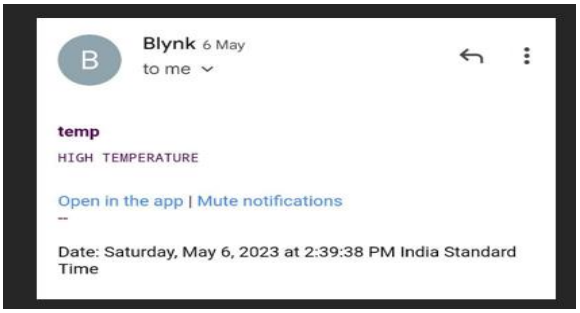

Figure 11:Email alert message sent to patient

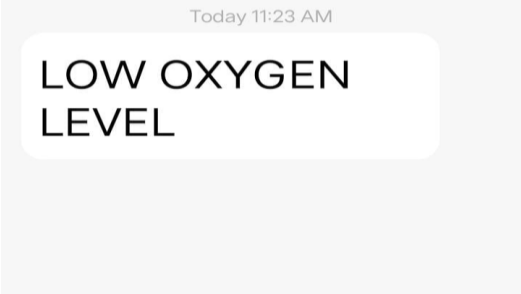

Figure 12:SMS alert message sent to registered mobile number

9. CONCLUSION

The IoT-based patient health monitor system is an innovative healthcare solution that leverages the power of the internet of things (IoT) technology to track and monitor patient's vital signs in real-time. The system collects and analyzes data from various sensors and medical devices, such as heart rate monitors, oxygen level sensors, and temperature sensors, to provide an accurate and up-to-date picture of a patient's health status. This information is then transmitted to healthcare providers and family members, enabling them to respond quickly in case of emergencies or changes in the patient's condition. The system can also be used to provide personalized treatment plans and preventive care based on the patient's health data, ultimately improving the quality of care and reducing healthcare costs.

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