Smart Patient Monitoring System

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ABSTRACT

During the current COVID-19 epidemic, IoT-based health monitoring devices could be incredibly useful for COVID-19 sufferers. This study develops an IoT-based system for real-time health monitoring that incorporates the patient's measured body temperature, pulse rate, and oxygen saturation, which are the most important critical care indicators. A liquid crystal display (LCD) shows the current temperature, heart rate, and oxygen saturation level, which can be easily linked with a mobile application for quick access. Using an Arduino Uno-based device, the recommended IoT-based technique was tested and verified on five human test subjects. The system's results were promising: the data collected by the system was saved fast. The system's results were found to be accurate when compared to other commercially available devices. IoT-based gadgets could be immensely valuable in saving people's lives during the COVID-19 epidemic.

Keywords: Internet of Things, patients, mobile application, LeenaBOT.

I. INTRODUCTION

Health monitoring is a basic issue in the present environment. Because of an absence of health monitoring observing, patients face genuine medical problems. Today, there are a plenty of IoT gadgets that can be used to remotely screen a patient's health. These brilliant gadgets are likewise being utilized by health experts to keep track on their patients. On account of a multitude of new medical care innovation new companies, the Internet of Things is quickly adjusting the medical services business. We'll build an IoT-based Health Monitoring System that screens the patient's pulse and internal temperature level and sends an email/SMS ready when those values surpass basic levels in this task. ThingSpeak and Google Sheets are utilized to record the patient's heartbeat rate and internal heat level with the goal that their wellbeing can be observed from a distance from anyplace on the planet. A signal for an emergency response will be fused with the goal that the patient can send email or instant messages to their friends and family in a crisis.

Rather than just the shortfall of disorder, health is portrayed as a total condition of physical, mental, and social prosperity. The craving for a superior presence is inseparably attached to one's actual prosperity. Tragically, because of the worldwide medical issue, certain elements, for example, chronic weakness administrations, huge imbalances among country and metropolitan regions, and doctors' and attendants' inaccessibility during insensible minutes, have made a conundrum.

The Internet of Things (IoT), which has been marked the following technological revolution, has associated everything inside during the last ten years. Smart health checking frameworks, smart parking, brilliant homes, brilliant urban communities, Smart environment, modern regions, and rural fields are largely instances of IoT applications. Medical care the board, which utilizes IoT to follow wellbeing and ecological circumstances, is the most significant utilization of IoT. The Internet of Things (IoT) is the method involved with connecting PCs to the web by means of sensors and organizations. Wellbeing checking contraptions could utilize these interrelated parts. M2M, which incorporates gear for PCs, machines for individuals, handheld gadgets, and cellphones, is then used to send the information to remote spots. It's a basic, energy-productive, essentially more intelligent, versatile, and interoperable method for following and advance consideration for any wellbeing concern. To assist with people carrying on with more intelligent lives, current innovations presently offer an adjustable connection point, partner devices, and psychological well-being the executives.

Heart rate and body temperature are the two most critical marks of human wellbeing. The quantity of heart beats each moment, frequently known as the beat rate, is the pulse. By identifying the expansion in blood stream volume, working out the beats can be used to decide the beat rate. A typical pulse for solid individuals is somewhere in the range of 60 and 100 beats each moment. Grown-up guys have resting pulses of approximately 70 beats each moment, while grown-up females have resting pulses of 75 beats each moment. Females over the age of 12 had a higher gamble of coronary illness than young men. How much hotness
discharged by the body can be estimated logically, and the temperature of the human body is basically the hotness created by the body. A great deal of variables impact an individual's internal heat level, including surrounding temperature, orientation, and dietary patterns.

II. METHODOLOGY

A. Sensor Reading Module
This module is made up of complicated sensors like the MAX30100 and MLX90614 that are capable of recording various vitals of the user such as heart rate, temperature, and SpO2 levels, which are then transmitted to the microcontroller.

B. Microcontroller Module
When you submit your final version, after your paper has been accepted, prepare it in two-column format, including figures and tables.

C. Wi-Fi Module
This is the Node MCU version 1.0, and it's in charge of retrieving data from the microcontroller and sending it to a dedicated cloud server every time a reading is taken.

D. Server Module
Contains a number of dedicated PHP scripts that interact with the Wi-Fi module, gathering data and storing it for later use.

E. Database Module
Essentially, this consists of a specially created database that is used to store the data received from the module in order to do various operations and analyses on it.

F. Website Module
This is the project's front-end component, and it not only has an API integration for displaying COVID-19 statistics, but it also displays sensor readings alongside WHO standards.

III. OBJECTIVES

- The heart rate, blood temperature, and blood pressure of a patient are all measured using sensors.
- To create a mobile application that shows the user numerous parameters.
- To allow the care taker to efficiently monitor the patient via live streaming.

IV. LITERATURE REVIEW

Reference [3] Implementation of Healthcare Monitoring System Using Raspberry Pi was published in a paper. This model is used to continuously monitor a patient's body temperature and heartbeat. Its primary goal is to collect physical parameters, which are then made available to different users. The Raspberry Pi B+ model was utilized. It interacts with a variety of parameter measurement units. Basic health parameters are examined and tracked in this system. The operational temperature range of the DS18B20 is -55 °C to +125 °C, with an accuracy of around +0.5 °C for the -10 °C to +85 °C range. A 64-bit serial code is provided with each DS18B20.

Reference [4] E-health Monitoring System for the Elderly was established. This system employs pulse and temperature sensors to simultaneously analyse a patient's heartbeat and temperature, sending readings to a centralized database at specified intervals. If the readings rise above the program's threshold settings, the device uses GSM, GPRS, or GPS shield to send the information. Temperature and heart rate are measured using Arduino microcontroller sensors. It's also meant to recognize where the patients are. This device is powered by a battery.

Reference [5] presented, Hwang designed a paradigm called A Secure IoT Based Modern Health Care System Using Body Sensor Network. This system is based on body sensor technology. EMG (Electromyography), ECG (Electrocardiogram), blood pressure, and other wearable body sensors are provided. It uses 3G/GPRS/CDMA wireless communication. They proposed an authenticated protocol to meet security needs and to gain data security standards. The encryption mechanism used was OCB, which stands for offset codebook authentication.

Reference [6] 'k-Healthcare' is the name given to a system built by. The four layers employed are the sensor layer, network layer, internet layer, and service layer. Smart phone sensors, the RTX-4100, Arduino, Raspberry Pi, and pulse oximetry were used as sensors. To communicate between layers, IEEE 802.15.4, 802.15.6, IEEE 802.11/b/g/n, Zigbee, and other protocols are utilised. To handle data storage, the system used cloud storage. The proposed system supports a variety of protocols, including HTTP, HTTPs, RESTful, and Javascript web services.

V. BLOCK DIAGRAM

As a result, the architectural module diagram simply displays how the system works as a whole by demonstrating the system's workflow from the start, when the sensors record data, to the very end, when the data can be seen on the specified website. The following modules operate as distinct modules, following the chain of events depicted in Fig. 1 to ensure the system's efficient operation.
VI. WORKING AND MODULES

The systems implementation focuses on enhancing and upgrading the predecessor's design, not only by making it more efficient and intelligent, but also by guaranteeing that the system is economically viable to serve as a solution. The system entails collecting vitals from the user via dedicated sensors and uploading them to a cloud server via Wi-Fi module, where they are then stored in a SQL database for various operations and analysis. The vitals can also be viewed on a website that not only publishes the vital records' results, but also gives some key WHO COVID-19 guidelines.

- Power supply module
- Raspberry pi
- Camera
- Microcontroller module
- Oxidation sensor
- Blood pressure sensor
- Temperature sensor
- Gateway module
- React native mobile app development

Power Supply Module: The power supply circuit is made up of a transformer that goes from 230 volts to 12 volts.

Microcontroller Module: The ATmega-328 is a difficult Virtual RISC (AVR) microcontroller. It can hold up to eight (8) bits of data. The internal memory of the ATmega-328 is 32KB.

Oxidation Sensor: The MAX30100 sensor combines a pulse oximeter and a heart rate monitor into one device. It's an optical sensor that uses two wavelengths of sunlight emitted by two LEDs - one red and one infrared - to measure the absorbance of pulsing blood through a photo detector. The colour mix of this LED is suitable for reading information with the tip of one's finger.

Temperature Sensor: The DHT11 digital temperature and humidity sensor could be a low-cost, straightforward solution. It uses a capacitive sensor and a thermistor to monitor the ambient air and outputs a digital signal on the info pin (no analogue input ports are required). It's simple to operate, but precise timing is required for data collecting.

Gateway Module: The ESP8266 is a low-cost Wi-Fi chip with a microprocessor and a full TCP/IP stack (MCU). This little gadget makes it simple for microcontrollers to connect to a Wi-Fi network and create TCP/IP connections.

Blood pressure sensor: This blood pressure monitor approximates blood strain data by measuring the implied arterial strain (MAP). A strain transducer, an Arduino UNO, and code are required to control the valve and air pump. The circuit structure consists of three simple stages: a low pass filter, a high pass filter, and a non-inverting amplifier.
Processing module: The Raspberry Pi is used to maintain and manage attendance statistics. The Raspberry Pi hardware has evolved over time to accommodate changes in memory capacity and peripheral tool support.

Camera module: The Raspberry Pi can use a USB webcam to capture photos and video. A webcam is a video camera that feeds or streams a photograph or video to or over a laptop network, which includes the Internet, in real time. The camera module, which was created specifically for Raspberry Pi boards, came with a fair number of features, making it comparable to many modern webcams on the market. The Raspberry Pi Camera Board automatically connects to the Raspberry Pi's CSI port.

React Native Application: In this task, react native is utilised to develop a mobile app. React Native is a framework that constructs JavaScript code using a hierarchy of UI embellishments.

VII. RESULTS

A. Visual Studio

This project makes use of Microsoft Visual Studio as an IDE. Visual Studio Code combines the simplicity of the mobile application module with advanced developer features like IntelliSense code completion and debugging. VS Code helps you get more done in less time with syntax highlighting, bracket matching, auto-indentation, box selection, snippets, and more. Visual Studio Code has IntelliSense code completion, deep semantic code interpretation and navigation, and code refactoring.

B. Android Studio

Android Studio is the development environment for this project's mobile app. Android Studio is the official integrated development environment (IDE) for Google's Android operating system, based on JetBrains' IntelliJ IDEA software and created exclusively for Android development.

The framework is executed utilizing a combination of equipment parts. All of the equipment parts are collected during the execution stage. The circuit schematic for the built framework is displayed in Figure 13. Every one of the sensors are associated with the ESP32 through actual pins. The ESP32 is utilized as a handling gadget since it has an implicit Wi-Fi module. All sensors' Vcc and GND pins are wired to the ESP32's Vcc and GND pins. The heart beat sensor's sign pin is associated with the ESP32's D26 pin. The information nail to the LM35 is meant the D35 nail to the microcontroller (ESP32). This is the situation with one of the patients. For room condition observing, the DHT11’s information pin is associated with the ESP32's D14 pin. In this game plan, the DHT11 is simply used to quantify room moistness. The advanced out pins of MQ-9 and MQ-135 are
associated with D27 and D34 of ESP32, individually, for estimating hurtful gases in a room environment.

We use NodeMCU in our solution, which is an open-source firmware and development kit that is ideal for IoT. The main benefit of the NodeMCU microcontroller is that it integrates WIFI and microcontroller functionality. Sensors for oximeter, temperature, and humidity are all connected to the NodMCU. The data is then uploaded to the IOT via the WIFI module ESP8266. We can monitor the patient and the environment using the blink app. Table 1 shows the real-time results, while figure 14 shows the results from the blink app.

**TABLE I: RESULTS ON BLINK APP**

| Parameters  | Value       |
|-------------|-------------|
| Temperature | 32 °C       |
| Humidity    | 70          |
| Pulse rate  | 87 pulse    |

**Fig. 13. Hardware components.**

**Fig. 14. Blink app.**

**VIII. CONCLUSION**

This project proposes the development of a patient monitoring system mobile application as a consumer electronics product with cheap processing costs and high accuracy outcomes for autonomously monitoring and recognizing the vital parameters of patients who live alone. This system can also be utilized for all patient monitoring and is particularly promising for real-time applications due to the rapid processing time. It is beneficial to those who are sick. This project's mobile application for multi-patient monitoring system can be further developed into a product that can be assessed in real time for greater accuracy. As a result, applying this in real time will assist all afflicted patients in predicting the presence of disease at an earlier stage.

**CONFLICT OF INTEREST**

Authors declare that they do not have any conflict of interest.

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