Using the Internet of Things with the ESP8266 and Arduino to Monitor the Health

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Abstract:

An emerging paradigm in information technology, the Internet of Things (IoT) could find a home in CPM. This article discusses the creation of a technology that uses biomedical sensors and a microcontroller to monitor physiological variables such as heart rate and body temperature in real time. This gadget has the potential to monitor vital indicators and provide updates in real-time using a prototype Internet of Things platform.

Keywords:

The terms "Internet of Things," "ESP8266," "Arduino," "Biomedical Sensors," and "Thing speak" are all in this context.

Introduction

While modern hospital patient monitoring systems provide constant vitals tracking, patients are limited in their movement due to the sensors' necessity to be linked to adjacent monitors or personal computers. After attaching these gadgets to a patient, the paramedical assistant's job is far from done. Keeping tabs on all the pertinent data allows for constant monitoring and recording of a patient's vitals [1, 2]. Critical care patients are now regularly monitored 24 hours a day for vital indicators such as heart rate, blood pressure, oxygen saturation, and respiratory rate [3]. Physiological data is often shown and analyzed using electronic displays when time is of the essence. [4] A sensor-microcontroller module would be responsible for monitoring the health of several people at once using wireless technology based on an active network. The sum of all intensive care unit patients. The prototype discussed before was perfect from a financial standpoint. In order for family members and doctors to be able to check on a patient's status even while they're not in the hospital, Jimenez et al. [5] recommended using an E-health sensor safeguard pack interface unit with a web-based monitoring framework.Nevertheless, it fails to notify specific individuals, such as family members or medical professionals, by any means, including email or SMS alerts. Keeping tabs on a patient's vitals and notifying healthcare providers and loved ones of any changes was something Krishnan et al. [6] thought about. With the help of the Internet of Things, the medical services division can reportedly track the whereabouts of all patients, gather information about them, and send it all over the world ([7]). In order for this connection to persist, it is essential that all information transmissions be kept confidential. When it comes to using the Internet of Things (IoT) in a medical services office, this technology is built with effective and diverse communication principles. To stay up with data-intensive health applications, an asset-based data recovery method is provided. An integrated smart box serves as a clinical foundation for this technology, allowing for the monitoring and management of patients' activities. To ensure the security of data transfers, web real-time communication is carried out correctly. A heart rate recognition framework was proposed by Banerjee et al. [8] as a non-invasive approach. The proposed framework became a continuous monitoring device when it used a plethysmography approach and prominently showed the data. This method has shown to be dependable for the patient in comparison to more invasive therapies. By combining ESP8266 with Arduino, we demonstrate how to construct an IoT-based patient health monitoring system that can take temperature and heart rate readings in real time.

There is already a body of literature

Sarmah et al. [9] lays out the processes needed to build a low-cost modular monitoring system prototype. Using low-power sensor arrays for electrocardiogram (ECG), temperature, oxygen saturation (SpO2), and mobility, this system was created to provide more effective and fast medical interventions during times of crisis [9]. Designed with the Internet of Things (IoT) in mind, these sensors' interfaces expose a RESTful web interface from a centralised control unit, which ensures platform-independent behavior and provides a flexible way to add more components [9]. The prototype proved difficult to deploy and had high per-unit costs. Modern healthcare institutions and home health care systems both rely on patient monitoring, as highlighted by Yew et al. [10]. This smart patient monitoring system can keep an eye on a patient's vitals without anyone having to lift a finger by integrating data from many sensors. The data is uploaded to the IoT cloud after processing on a Raspberry Pi. In order to get the bio signal, the system's central component would be an electrocardiogram (ECG) sensor [10]. This technology is expensive, but it employs a raspberry-pi microcontroller to show graphical representations of the patient's data and monitor it continually. Patient satisfaction was the key focus of the study's Internet of Things (IoT) healthcare system, which aimed to provide round-the-clock monitoring of vital indicators including systolic and diastolic blood pressure, pulse rate, and core body temperature [11]. Without the patient having to constantly visit different facilities for health monitoring, the major aim is to provide care by continually monitoring medical parameters including blood pressure, heart rate, and body temperature [11]. Caretakers may access the patient's data from any location by collecting it from sensors that measure their temperature and blood pressure. The data is then reviewed and recorded in the cloud. Based on the alarm receivers, the data can be properly replied to. The prototype was expensive to maintain and had a complicated installation process.

Plan for a Prototype Block Diagram

Figure 1 shows a simple block diagram of the Internet of Things based Patient Health Monitoring System built using ESP8266 and Arduino.

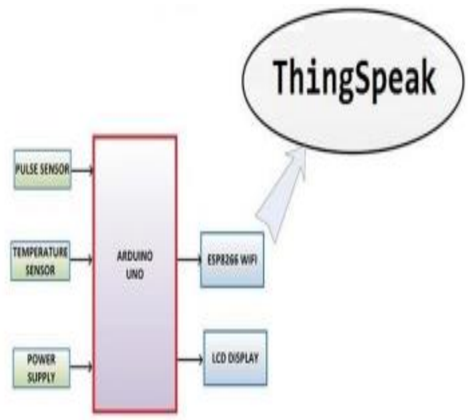

Figure 1. Proposed Prototype Block Diagram[6]

Hardware Equipment

Pulse Sensor

The Pulse Sensor is an Arduino-compatible heart-rate sen- sor. Students, artists, athletes, and game and smartphone de- velopers who wish to incorporate live heart-rate data into their work can make an application of it [11].

Figure 2. Pulse Sensor

The system's brains are an integrated optical amplification circuit and a noise-reducing circuit sensor. The Pulse Sensor may be clipped to an earlobe or a fingertip and interfaced with a microcontroller to provide heart rate measurements [11]. There are three pins on the pulse sensor, for power (VCC), ground (GND), and analogue readings (Analog Pin).

Digital Temperature Sensor LM35

An analogue proportional response to the current temperature is generated by the LM35 temperature sensor[11]. Getting the temperature in degrees Celsius from the voltage output is easy. The lm35 is superior than the thermistor since it does not need an external calibration [11].

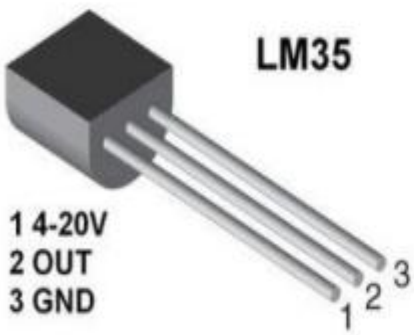

Figure 3. LM35 Temperature Sensor

ESP8266

An inexpensive 32-bit RISC microcontroller with two available clock speeds (80 MHz and 160 MHz) with Wi-Fi capabilities is the ESP8266 [12]. With 64 KB set aside for processing instructions and 96 KB for data storage, the total amount of RAM available is 192 KB [12]. With its very low power consumption—achieved via a variety of patent-protected technologies—the ESP8266 is perfect for use in mobile, wearable, and IoT applications [13]. As a publisher, the Esp8266 is communicating with the ThingSpeak servers to transmit data collected by the patient's sensors.

Uno Arduino

The Arduino Uno is a free and open-source microcontroller board that uses the Microchip AT-mega328P[14]. Connectivity to external circuits, including extension boards (shields), is made possible via the digital and analogue I/O pins on the board [14]. The board may be programmed using the Arduino IDE (Integrated Development Environment) with a type B USB cable[13]. It contains 14 digital I/O pins, 6 of which can be used for PWM output, and 6 analogue I/O pins. A 9-volt battery or a USB connection can power it, and it can handle voltages ranging from 7 to 20 volts. This microcontroller is comparable in operation to the Leonardo and Nano Arduino boards.

LCD

Lcds are video displays that make use of the light-modulating capabilities of liquid crystals.

screen technology that displays text and pictures using liquid crystal displays [10]. The Arduino microcontroller works in tandem with an LCD screen. Any text or image written into an Arduino microcontroller may be shown on an LCD display by connecting its pins to the microcontroller [10].

Programming for the System

Arduino Software Development Environment

The Arduino Software Development Kit (IDE) is free software for creating and uploading sketches to Arduino boards.

For this reason, it is considered cross-platform [13], meaning that it may be used with a variety of computer systems. Uploading sketches to the prototype and reading data from industrial temperature sensors are both being done via the Arduino IDE.

Thing speaks

Thing Speak is an Internet of Things (IoT) analytics application that operates in the cloud and facilitates the collection, presentation, and evaluation of streaming data [14, 15]. When your devices provide data to Thing Speak, you'll see real-time visualisations of that data. The patient's vitals are shown using Thing speak. Using the Channels and web pages that Thing Speak offers, we are able to remotely monitor and operate our system prototype. [15-18] Descriptive Technology

Electrical Diagrams

The Pulse Sensor's output pin was connected to Arduino's A0, while the other two were connected to VCC and GND. Pin A1 of Arduino is wired to the LM35 temperature sensor's output, while VCC and GND are linked to the other two pins.

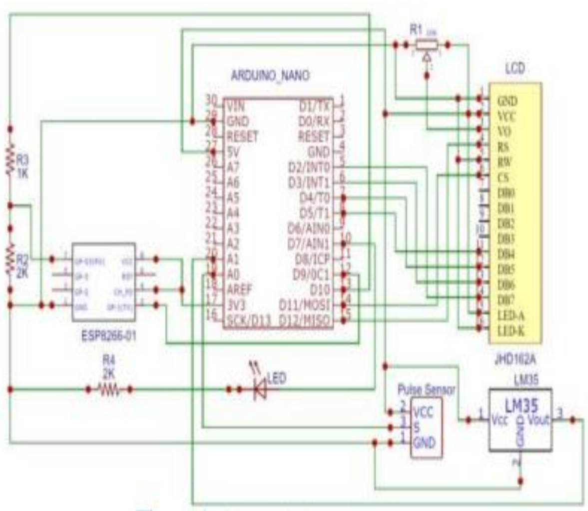

Figure 4.Circuit Schematic Diagram.

The interfacing of Pins 1,3,5,16 of LCD to GND.Hardware connection of Pin 2,15 of LCD to VCC was also done. The Pins 4,6,11,12,13,14 of LCD to Digital Pin 12,11,5,4,3,2 of Arduino. The RX pin of ESP8266 works on 3.3V and the TX pin of the ESP8266 to pin 9 of the Arduino.

Results and Discussion

Implementation of a Prototype

The pulse sensor and temperature sensors are shown interfaced with the ESP8266 and Arduino in Figure 5, depicting a prototype of an Internet of Things patient monitor built on these two boards. The dashboard displays sensor data that has been sent to thing talk web servers.

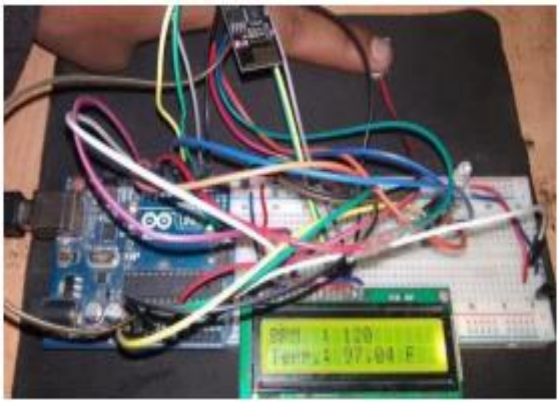

Figure 5. Implemented Prototype

Thing Speak Web Dashboard

The ESP8266 publishes temperature and pulse rate sensor data readings tothings peak servers. The things peak dashboard displays gauges for pulse rate and temperature and well as line graphs which are vital in measurement of physiological parameters for patient monitoring.

Figure 6.Thing speak web dashboard

Temperatures peaked at 150 degrees Fahrenheit, with a range of 50 to 200 degrees Fahrenheit, while the interval time ranged from 11:32 to 11:40. Clear evidence that this prototype has low enough error rates to be used in real hospitals is provided by the range of 100 to 220 in which the pulse rate typically falls.

Conclusion

The fast development of the Internet of Things (IoT) in healthcare is being aided by a plethora of new healthcare technology startups. The fast-paced nature of our daily lives makes it very difficult to keep tabs on a patient's vitals whether they're in a hospital or at home. Patients with chronic illnesses need close observation on a regular basis. Therefore, we provide a new way to automatically monitor vital indicators like heart rate and core temperature in real time. Smart patient health tracking, including real-time monitoring of vitals like temperature and heart rate, is created by the prototype using a things peak server. Some possible future developments include the use of machine learning to analyze patient data and make diagnoses, the addition of many sensors to measure blood oxygen and glucose levels, and the integration of other similar technologies.

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