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IoT Based Patient Health Monitoring using ESP8266 and Arduino

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Abstract: Internet of Things is a technological paradigm which can be incorporated in real time patient monitoring system. The review and implementation of real time monitoring of patients using biomedical sensors and microcontroller is presented where physiological parameters like heart-rate, body temperature is measured. This IoT prototype could read the pulse rate and measure the body temperature updates them to things peak an IoT platform.

Keywords: Internet of Things, ESP8266, Arduino, Biomed- Ical Sensors, Thingspeak

Introduction

The contemporary patient monitoring systems in hospitals offer continuous monitoring of patient vital signs, which require the sensors to be hooked to adjacent, bedside monitors or PCs, and basically restrict the patient to the hospital bed. Even after attaching these systems to a specific patient, a paramedical assistant must perform additional tasks among others keeping track of all of a patient's vital parameters, you can constantly monitor and record them [1, 2].Continuous monitoring of patient parameters such as heart rate and rhythm, respiration rate, blood pressure, blood oxygen saturation, and a variety of other parameters has become a standard part of critical care [3]. Electronic monitors are widely employed to collect and show physiological data when precise and timely in [4] Wireless technology based on an active network was implemented suggested and included a sensor-microcontroller module which is in charge of keeping track on the health of a large number of people. The number of patients in a critical care unit. The above-mentioned prototype was the most cost- effective.

In Jimenez, et.al, authors proposed a wellbeing observing frame- work for dealing with the emergency clinic to permit family individuals and expert specialists to remotely observing the patient's medical issue through the web with E-wellbeing sensor safeguard pack interface unit [5].

Be that as it may, it doesn't send any warning, for example, email and SMS caution to the individual relatives and specialists.

In Krishnan et.al, have thought about checking the patient's ailment and sending the vital data and warning to specialists, relatives [6]. According to the medical services division can screen movements of every kind of patients, record patient's information, and send this information from a distance with the presence of the Internet of Things [7]. Secure information transmission is essential to keep up with this association. To carry out IoT in the medical services office, this innovation is planned appropriately with high-performing and numerous correspondence principles. To keep up with data escalated wellbeing applications an asset-based information recovering strategy is presented. To control the exercises of patients this innovation is joined with a savvy box, which is treated as a clinical framework. To increment security in information transmission, Web Real-Time Communication process is carried out appropriately.

In Banerjee et.al, the authors proposed a heartbeat rate recognition framework in view of a painless method [8]. The proposed frame- work utilized plethysmography process and correspondingly showed the result carefully that made it a continuous observing gadget. The strategy has demonstrated as dependable for the patient contrasted with other obtrusive methods. This paper presents an IoT Based Patient Health Monitoring System utilizing ESP8266 and Arduino that takes in physiological parameters of patients of heart rate and temperature in real time.

Existing Literature

In Sarmah et.al the processes taken to develop and build a low- cost modular monitoring system prototype are described in this study [9]. This system was designed employing low-power specialized sensor arrays for EKG, SpO2, temperature, and movement in order to promote faster and better medical interventions in emergency situations The IoT architecture was used to design the interfaces for these sensors: a central control unit exposes a RESTful based Web interface that ensures platform agnostic behavior and provides a flexible mechanism for integrating new components[9].The unit cost for the prototype was expensive and difficult to deploy.

In Yew, et.al Patient monitoring was discussed as a critical com- ponent of today's health-care system, whether in hospitals or at home [10]. This research offers an intelligent patient monitoring system that uses multiple sensors to automatically screen the patient's health status. The information is then saved to the IoT cloud after being processed on a Raspberry Pi. The system's primary function would be to extract the bio signal, ECG, using an ECG sensor [10]. The patient's information is graphically shown and monitored on a continual basis however the system was expensive as it utilized raspberry-pi microcomputer.

The main goal of the study IoT based healthcare system was to improve the patient's quality of life by providing real-time visibility of the patient's condition by measuring physiological indicators such as systolic, diastolic, pulse rate, and body temperature [11]. The primary concept is to provide care to patients by continuously monitoring medical parameters such as blood pressure, pulse rate, and body temperature without requiring the patient to go from facility to facility for constant health monitoring[11]. The data collected from the blood pressure and temperature sensors is evaluated and saved in the cloud, where it can be monitored by the patient's caretakers from any place and correctly responded to based on the alarm received.The prototype was diffucult to deploy and also expensive to maintain.

Proposed Prototype Block Diagram

The IoT Based Patient Health Monitoring System utilizing ESP8266 and Arduino is explained in figure 1. basic block diagram.

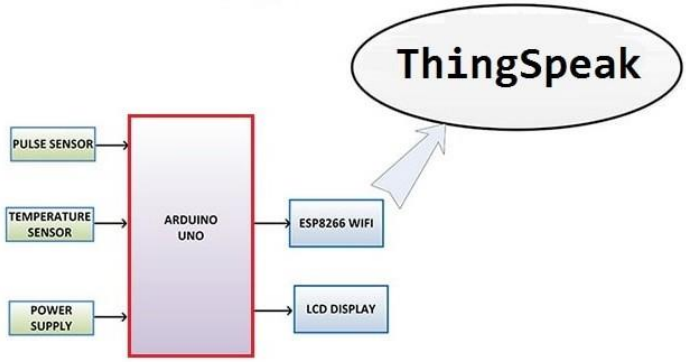

Figure 1. Proposed Prototype Block Diagram[6]

Hardware Equipment

A. 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

An integrated optical amplification circuit and a noise-reducing circuit sensor are at the heart of the system.Heart rate readings can be obtained by clipping the Pulse Sensor to your earlobe or fingertip and interfacing it to your microcontroller [11].The pulse sensor has three pins: VCC, GND and Analog Pin.

B. LM35 Temperature Sensor

The LM35 is a temperature sensor that produces a pro- portional analog response to the current temperature[11]. The output voltage can be simply translated into a Celsius temperature value. The advantage of the lm35 over the thermistor is that it does not need to be calibrated externally [11].

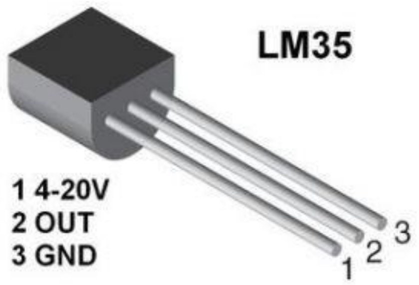

Figure 3. LM35 Temperature Sensor

C. ESP8266

The ESP8266 is a 32-bit RISC low-cost micro-controller with Wi-Fi connectivity, capable of running at 80 MHz or 160 MHz [12]. It has 64 KB of instruction RAM and 96 KB of RAM data [12].With a combination of patented method- ologies, the ESP8266 was intended for mobile, wearable electronics, and Internet of Things applications with the goal of obtaining the lowest power consumption [13]. Esp8266 is acting as a publisher of patient sensor data to Thingspeak Servers.

D. Arduino Uno

The Arduino Uno is an open-source microcontroller board designed by Arduino.cc and based on the Microchip AT- mega328P microprocessor[14]. The board has digital and ana- log input/output (I/O) pins that can be used to connect to expansion boards (shields) and other circuits [14]. The board features 14 digital I/O pins (six of which are capable of PWM output), 6 analog I/O pins, and is programmable through a type B USB cable using the Arduino IDE (Integrated Development Environment)[13]. It can be powered by a USB cable or an external 9-volt battery, with voltages ranging from 7 to 20 volts. It's similar to the Arduino Nano and Leonardo microcontrollers.

E. LCD

A liquid crystal display, or LCD, is a video display that utilizes the light modulating properties of liquid crystals to display pictures or text on a screen [10]. The utilization of an LCD is with an Arduino microcontroller. By wiring an Arduino microcontroller to the pins of an LCD display it is possible to program the microcontroller to display a desired text string or image on the screen[10].

System Software

A. Arduino IDE

Arduino IDE is an open source software used to write and upload sketches to Arduino compatible boards.It is cross- platform as it runs on mutiple operating systems [13]. The Arduino IDE is being utilized to upload sketches in the prototype and also to retrieve industrial temperature sensor data through serial monitor.

B. Thingspeak

ThingSpeak is a cloud-based IoT analytics tool that lets you gather, visualize, and analyze real-time data streams [14, 15]. ThingSpeak delivers real-time visualizations of data sent to ThingSpeak by your devices. Thingspeak is used to display the patients physiological.The ThingSpeak site to monitor and control our system prototype via the Internet by using the Channels and web pages that ThingSpeak provides[15-18].

Technological Description

A. Circuit Schematics

The Pulse Sensor output pin interfaced to A0 of Arduino and other two pins to VCC and GND. The LM35 Temperature Sensor output pin connected to A1 of Arduino and other two pins to VCC and GND.

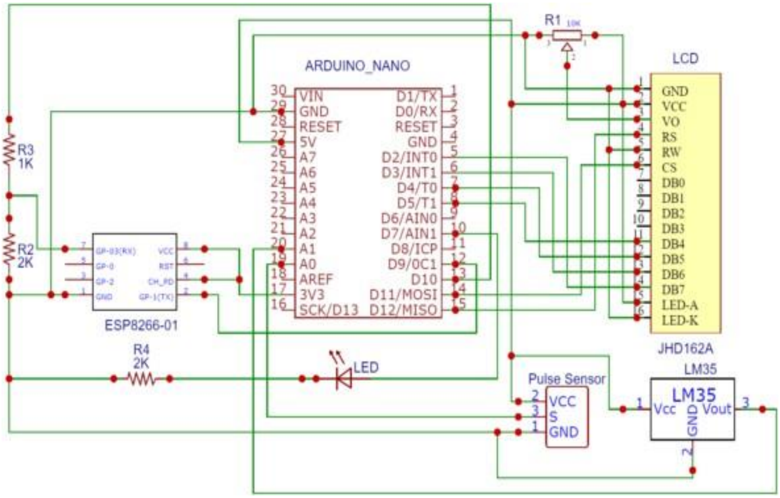

Figure 4. Circuit Schematic Diagram

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

A. Prototype Implementation

Figure 5 depicts a prototype of IoT patient monitor based on Arduino and ESP8266, in which the pulse sensor and temperature sensors are interfaced with the ESP8266 and Arduino. The sensor data is relayed to thing speak web servers for display on the dashboard.

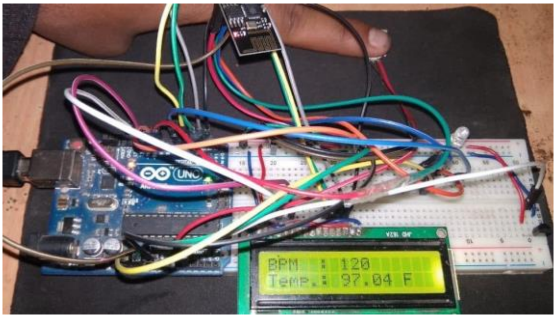

Figure 5. Implemented Prototype

B. ThingSpeak Web Dashboard

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

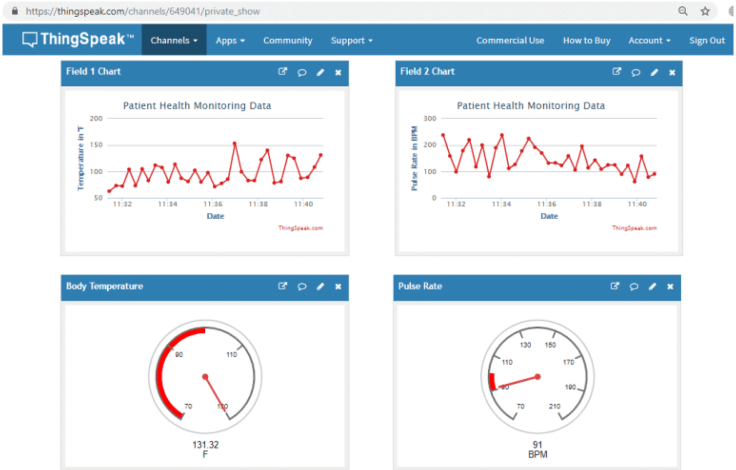

Figure 6. Thingspeak web dashboard

The time range over the the intervals was from 11:32 to 11:40 and the peak temperature was 150 degrees and the interval from 50 to 200 in both the gauges and linear curve. The pulse rate interval from 0 to 300 with the pulse rate fluctuating between 100 to 220 which clears shows that this prototype can be deployed in physical hospitals as it has minimal errors.

Conclusion and Futureworks

IoT is fast transforming the healthcare market, thanks to a slew of new healthcare technology start-ups. Because of our busy schedules and our daily lives, keeping track of your patient's health state at home or medical care units is a difficult effort. Patients, especially those with chronic illnesses, should be monitored on a regular basis. As a result, we present an innovative approach that can easily automate this task to measure physiological parameters of body temperature and heartrate in real time. The prototype utilizes a thingspeak Server to provide a smart patient health tracking system that allows for the monitoring of patient health data such as heart rate and body temperature in realtime.Future works would involve adding several sensors to measure oxygen level content and sugar content in patients blood and employing machine learning to analyse patience data and patients illnesses.

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Conflict of interest :

The Authors have no conflicts of interest to declare that they are relevant to the content of this article.