Smart Health Monitoring System of Patients Through IoT

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Batch: 2024

Abstract:

Present-day IoT brings gadgets together and assumes a fundamental part in different methodologies like smart home mechanization, savvy urban areas, vehicle parking, traffic control, brilliant industries, smart environment, agribusiness fields patient health monitoring systems, and so on. One of the approaches is to monitor the health state of the patient and screen it to doctors or paramedical staff through the IoT, as it is hard to screen the patient for 24 hours. So here the patient's health condition or status i.e. Pulse rate, Respiratory rate, Body Temperature, Position of the body, Blood glucose, ECG and so on can be measured by utilizing Non-invasive sensors. These sensors are associated with the Arduino Uno board, it gathers the information i.e. biomedical data from the sensors, and the detected biomedical information can be transmitted to the server. The "Thingspeak" new cloud is utilized here to place the detected information into the server. From this server, the information can be envisioned to the specialists and other paramedical staff by the Thingspeak android app. In this way, this Smart health monitoring system diminishes the exertion of specialists and paramedical staff to screen the patient for 24 hours and lessens the time and cost of support.

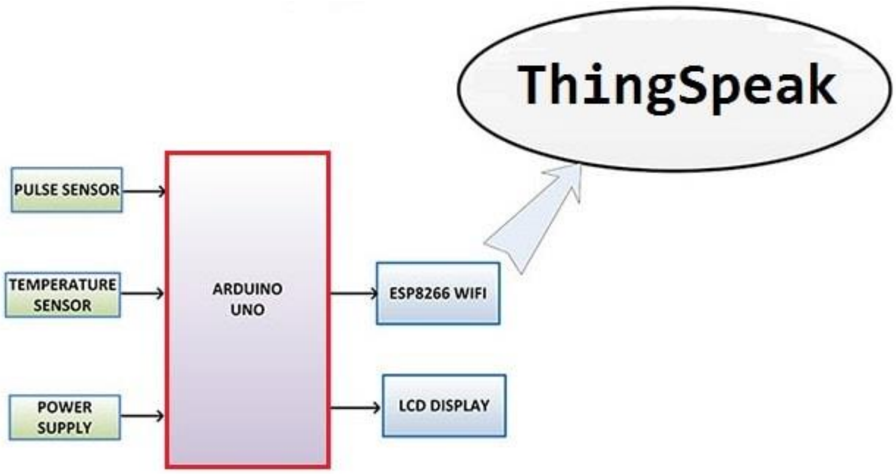
INTRODUCTION:

India confronting an issue of the absence of Doctors, from the most recent report of the Medical Council of India (MCI) we have 10.4 lakh specialists enlisted in the Register of India Medical. In that 10.4 lakh, 80% of specialists presently serve the patient at the same time. It is 8.32 lakh specialists may be truly available for dynamic support to patients. In India specialists and patient, proportion is around 1:1568 at odds with the World Health Organization standard of 1:1000. The 60,000 doctors and 28,000 post-graduation doctors are moved on from different colleges once a year. There are around 11.65 lakh medical caretakers enlisted in the Nursing Council of India. Of that, just 42% are in dynamic service. As per the suggests an attendant patient proportion of 1:1 in the intensive care unit, 1:3 in the general care unit, and 1:6 in the emergency ward. On the off chance, 45 nurses are required for every 15 patients, as 15 will work in every shift. You additionally require 30% leave save. This is the reason there is an immense deficiency of medical attendants. We require double the current number of nursing experts to adjust the diminishing patient-nurture proportion. In this way, it is clear there is just a single doctor for 2000 patients and requires twofold sum paramedical staff for present existing staff. It is impractical to rise to the patient and specialist proportion and multiply the paramedical staff. Smart Health Monitoring System through an IoT approach is utilized to decrease the endeavors of the doctors and paramedical staff. This strategy is likewise comfort for the patient since it lessens the enormous hardware, which presently utilized as a part of ICUs.

Component used:

Sl.no	Component name:
1.	Arduino Nano Board
2	ESP8266-01 Wi-Fi Module
3	16x2 LCD Display
4	Pulse Sensor
5	LM35 Temperature Sensor
6	2K Resistor
7	1K Resistor
8	LED 5mm Any Color
9	Connecting Wires
10	Breadboard

Block Diagram:



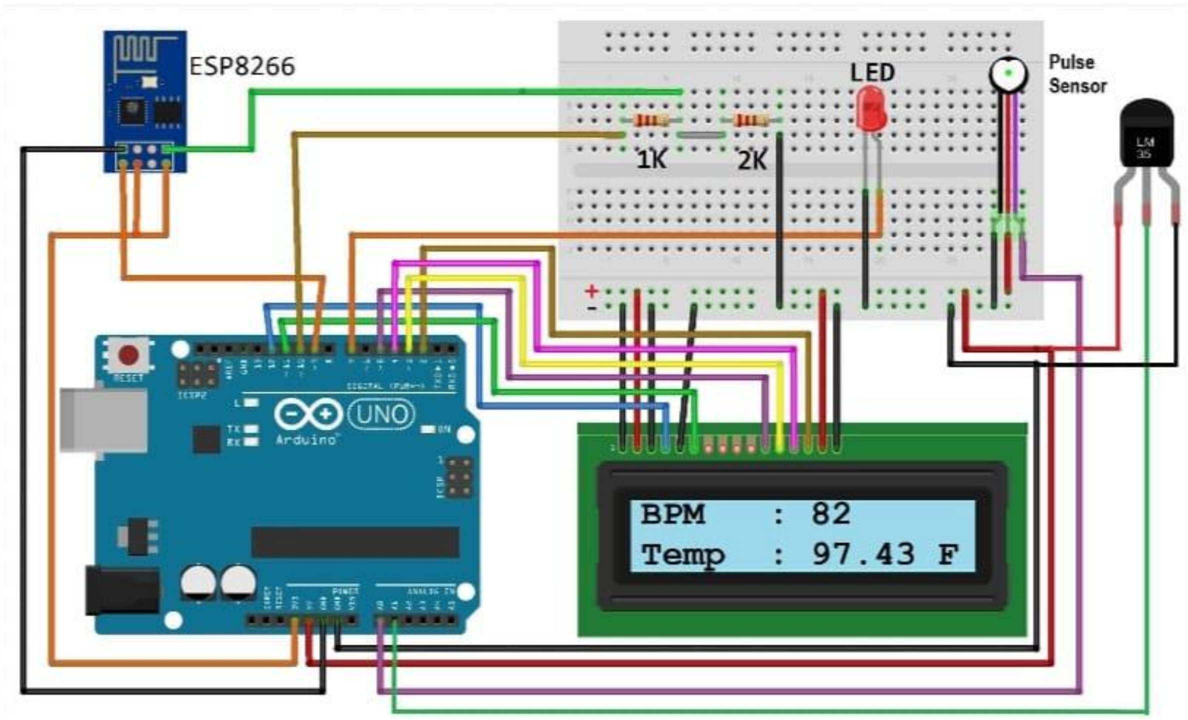
The diagram illustrates a smart health monitoring system designed to measure and transmit vital health parameters such as heart rate and body temperature. The core of the system is the Arduino UNO, which processes data from two key sensors: a pulse sensor for heart rate detection and a temperature sensor (e.g., LM35) for measuring body temperature. These sensors are powered by an external power supply and send analog signals to the Arduino, which converts them into readable values. The results are displayed on an LCD screen in real time, providing the user with instant feedback.

Additionally, the system features an ESP8266 WiFi module to enable wireless data transmission. Using the ESP8266, the processed data is sent to the **ThingSpeak** IoT platform, where it can be monitored remotely. ThingSpeak allows users or healthcare providers to visualize and analyze the data in real time, making the system suitable for telemedicine or fitness tracking applications. The integration of sensors, Arduino, and IoT connectivity creates a compact and efficient solution for continuous health monitoring.

Working:

The smart health monitoring system shown in the uploaded diagram integrates an Arduino UNO microcontroller with a pulse sensor, an LM35 temperature sensor, an LCD, and an ESP8266 WiFi module to measure and display vital health parameters such as heart rate (BPM) and body temperature. The pulse sensor uses photoplethysmography (PPG) to detect changes in blood volume with each heartbeat, generating an analog signal that is processed by the Arduino to calculate the beats per minute. Simultaneously, the LM35 sensor measures body temperature by converting temperature into a proportional voltage, which the Arduino reads and converts into degrees Fahrenheit or Celsius using mathematical formulas. These calculated values are displayed in real time on the 16x2 LCD screen.

In addition to displaying the health metrics locally, the system uses the ESP8266 WiFi module to transmit the data to a cloud platform or remote monitoring app, allowing users or healthcare professionals to access the information from anywhere. The onboard LED blinks in synchronization with the heartbeats, providing a visual confirmation of the system's operation. This system serves as an efficient, compact, and portable solution for real-time health monitoring, making it suitable for applications in home-based patient care or fitness tracking.



Code:

```
// Smart Health Monitoring and Alert System
#include <Servo.h>
#include <LiquidCrystal_I2C.h>
// Initialize components
Servo servoMotor;
LiquidCrystal_I2C lcd(0x27, 16, 2);
// Pins for sensors and actuators
int heartRateSensorPin = A4;
int tempSensorPin = A5;
int waterButtonPin = 2;
int ledPin = 3;
// Variables for simulation
int simulatedHeartRate = 75;
int waitTime = 1000; // Time to wait in milliseconds
void setup() {
  servoMotor.attach(9); // Servo motor for medicine dispenser
  pinMode(heartRateSensorPin, INPUT);
  pinMode(tempSensorPin, INPUT);
  pinMode(waterButtonPin, INPUT_PULLUP);
  pinMode(ledPin, OUTPUT);
  lcd.init(); // Initialize the LCD
  lcd.backlight(); // Turn on the backlight
}
void loop() {
  simulateHeartRate();
  simulateTemperature();
  checkWaterIntake();
```

```
  delay(waitTime);
}
void simulateHeartRate() {
  simulatedHeartRate = random(70, 91);
  lcd.setCursor(0, 0);
  lcd.print("HR: ");
  lcd.print(simulatedHeartRate);
  lcd.print(" bpm    ");
}
void simulateTemperature() {
  // temperature variability
  int temperature = random(0, 15);
  lcd.setCursor(0, 1);
  lcd.print("Temp: ");
  lcd.print(temperature);
  lcd.print(" C    ");
}
void checkWaterIntake() {
  static unsigned long lastDebounceTime = 0;
  static bool isServoOpen = false;
  int reading = digitalRead(waterButtonPin);
  if (reading == LOW && (millis() - lastDebounceTime > 200)) {
    lastDebounceTime = millis(); // Update the last debounce time
    if (!isServoOpen) {
      simulatedHeartRate += 5; // Increase heart rate due to activity
      servoMotor.write(0);
      digitalWrite(ledPin, HIGH); // Turn on the LED
      isServoOpen = true;
      delay(waitTime);  }}
```

```
  if (isServoOpen && (millis() - lastDebounceTime > waitTime)) {
    servoMotor.write(90); // Close the servo
    digitalWrite(ledPin, LOW); // Turn off the LED
    isServoOpen = false;
    simulatedHeartRate = 75; // Reset to default heart rate
  }
}
```

Application:

1.Remote Patient Monitoring:

- Enables doctors to monitor patients' vital signs (heart rate, body temperature, blood pressure, etc.) in real time from remote locations.
- Ideal for elderly care and chronic disease management, such as for patients with diabetes, hypertension, or cardiovascular diseases.

2. Fitness and Wellness Tracking:

- Used in fitness devices or wearable technology to track heart rate and body temperature during workouts or daily activities.
- Helps individuals monitor their health metrics for better lifestyle management.

3. Telemedicine:

- Provides healthcare professionals with real-time data through IoT platforms like ThingSpeak or mobile apps, facilitating virtual consultations.
- Reduces the need for frequent hospital visits and enhances access to healthcare in rural areas.

4. Early Health Issue Detection:

- Alerts users or healthcare providers to abnormalities in vital signs, enabling timely medical intervention.
- Useful in detecting signs of fever, arrhythmia, or other conditions.

5. Hospital and Home Healthcare:

- Utilized in hospitals for continuous bedside monitoring of patients.
- At home, it allows family members to track health parameters and receive alerts in case of emergencies.

6. Personalized Healthcare Solutions:

- Data collected can be analyzed to provide personalized insights into an individual's health trends.

Future Scope:

1. Integration with Advanced IoT and AI:

- Future systems will leverage **AI and machine learning** to analyze collected health data, predict potential health risks, and provide personalized healthcare recommendations.

2. Expansion into Wearable Technology:

- Miniaturization of components and enhanced sensor technology will lead to more compact and comfortable wearable devices.

3. Remote Surgery and Real-Time Diagnostics:

- Smart health monitoring systems will assist in real-time diagnostics and facilitate tele-surgery, especially in remote or underserved areas.

4. Advanced Disease Prediction and Management:

- Predictive algorithms will improve the early detection of chronic diseases like diabetes, heart conditions, and neurodegenerative diseases.

5. Improved Accessibility and Affordability:

- Low-cost solutions will make smart health monitoring systems accessible to rural and low-income populations, bridging the healthcare gap.

6. Smart Homes and Hospitals:

- Integration with smart home systems will allow automated health monitoring for families, with alerts sent to caregivers or emergency services.

7. Integration with Blockchain Technology:

- To ensure secure and private handling of sensitive health data, future systems may integrate blockchain for tamper-proof and transparent record-keeping.

Conclusion:

Previously, the sensors that are utilized for observing the patient's status are not such an exact, but rather here the sensors we utilized are essentially precise and appropriate for ongoing checking intelligently. So as we are utilizing Thingspeak named new android application and new open source cloud, the Doctor can screen the patient's condition 24*7 and any abrupt changes in patient's status is notified to the Doctor or Paramedical staff through a toast notification. What's more, as the information is accessible in the Thingspeak server, the patient's condition can be checked remotely from anyplace on the planet. Aside from simply seeing the pervious information of a patient, we can utilize this information for snappy comprehension and curing the patient's health by respective experts.

References:

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- https://www.ijert.org/research/an-iot-based-health-monitoring-system-using-arduino-uno-IJERTV10IS030268.pdf(Arduino collects real-time health data)
- https://bpbonline.com/collections/iot-hardware-books-online (**Internet Of Things** (**IoT**) Development & Hardware **Books** online at best prices from one of the biggest **book**-selling Publishers - BPB Publication.)
- https://www.skkatariaandsons.com/view_book.aspx?productid=18616 (learn about how the **Internet of Things** works.)