# IoT Based Health Monitoring System


## 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 are used 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. In this project, we implemented an IoT-based patient health monitoring system with ESP8266 and Arduino. Thing Speak is the IoT platform used in this project. Thing Speak is an open-source Internet of Items (IoT) application and API for storing and retrieving data from things via the Internet or a Local Area Network using the HTTP protocol.


## INTRODUCTION

In recent years, the Internet of Things (IoT) has revolutionized various industries, and healthcare is one of the most promising sectors benefiting from this technological advancement. One of the key applications of IoT in healthcare is the development of remote health monitoring systems, which enable real-time tracking of vital signs and provide continuous patient data for healthcare professionals. These systems help in early diagnosis, timely interventions, and improve the overall quality of patient care. The IoT-based health monitoring system using ESP8266 and Arduino offers a cost- effective and scalable solution for monitoring the health of patients, especially for those in remote areas or with limited access to healthcare facilities. The ESP8266 is a low-cost Wi-Fi module that facilitates wireless data transmission to a remote server or cloud platform, while Arduino serves as the core controller, interfacing with various sensors to collect health-related data such as heart rate, body temperature, and blood oxygen levels. This system can continuously monitor a patient's vital signs and send the data to a cloud- based server or mobile application, where it can be accessed by healthcare providers for analysis and diagnosis. It also allows patients to be remotely monitored, reducing the need for frequent hospital visits and enabling proactive healthcare management. With the integration of IoT technologies, this health monitoring system ensures that vital health information is available at all times, enhancing patient care and overall healthcare efficiency. The use of Arduino in conjunction with the ESP8266 module provides a flexible and easily programmable platform for prototyping such systems, while also keeping the overall cost low, making it an ideal choice for both hobbyists and professionals looking to create affordable, reliable health monitoring solutions. In this project, we will explore how the combination of these two technologies can be utilized to build a functional, real-time health monitoring system that collects vital health parameters and communicates the data wirelessly for further analysis and action.

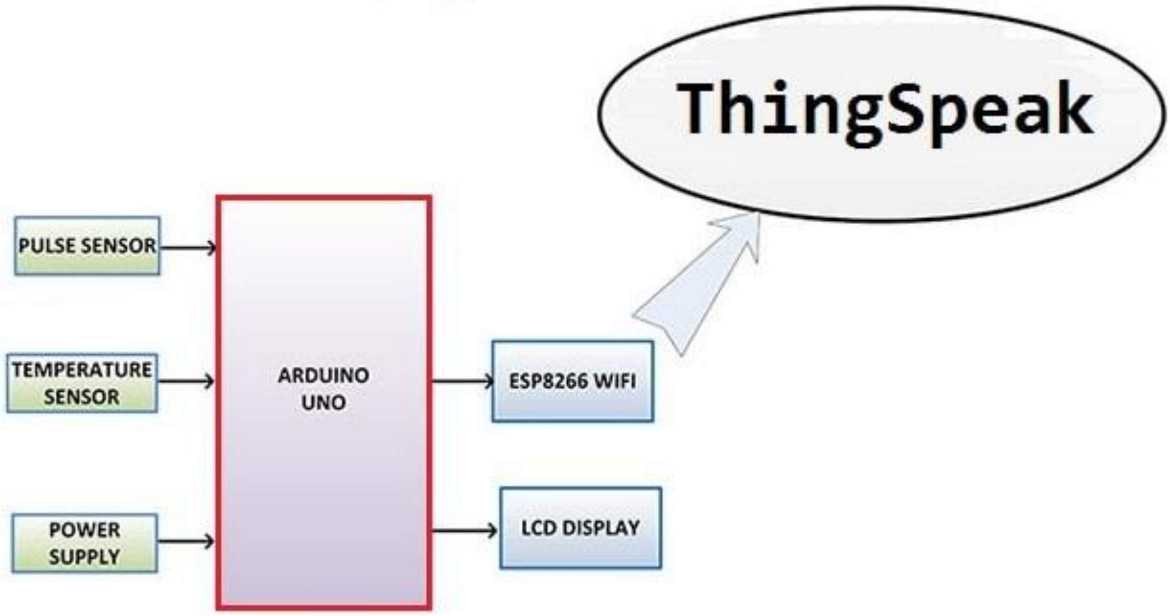
## Problem statement

In modern healthcare settings, continuous monitoring of patients' vital signs such as heart rate, body temperature, and blood pressure is crucial for effective treatment, especially in critical care units. Traditional monitoring systems are often limited by wired connections to bedside monitors or PCs, restricting the patient's mobility and requiring constant manual intervention. Moreover, the increasing number of patients and the lack of real-time monitoring pose challenges in ensuring timely medical interventions. Current solutions tend to be expensive, complex to deploy, and require frequent physical visits for monitoring.

Problem statement: To provide a cost-effective, real-time IoT-based health monitoring system using Arduino and ESP8266 to track vital signs like heart rate and body temperature.

Objectives: Design and Development of an IoT-Based Health Monitoring System, Real- Time Data Collection and Transmission.

## PROPOSED METHODOLOGY




Block Diagram of Proposed Methodology

The proposed system is depicted in Figure 3.1. The sensors for health monitoring are used to collect health related data, or data acquisition. The controller can communicate with the internet to send data wirelessly. The data was processed on the server. At the server, all data is collected and aggregated. Data management can be used to display health related information in an intelligible fashion on a web page.

Pulse Sensor:

A pulse wave is the change in the volume of a blood vessel that occurs when the heart pumps blood, and a detector that monitors this volume change is called a pulse sensor. The Pulse Sensor is an Arduino-compatible heart- rate sensor. Students, artists, athletes, makers, game and mobile developers who want to easily incorporate live heart-rate data into their projects can use it. There is also a LED in the center of this sensor module which helps in detecting the heartbeat. Below the LED, there is a noise elimination circuitry that is supposed to keep away the noise from affecting the readings.

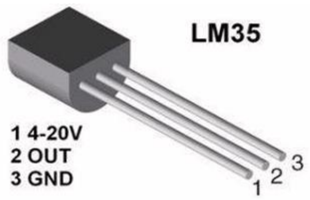
Working Principle: Pulse sensors use a photoplethysmography (PPG) technique. They emit light (usually red or infrared) into the skin, and a sensor detects the amount of light reflected back. As the heart pumps blood, the blood volume in the vessels beneath the skin increases, absorbing more light. This change in light absorption is detected by the sensor and converted into an electrical signal. By analyzing the pattern of these signals, the sensor can calculate heart rate, blood oxygen saturation, and other vital signs.

ESP8266 NodeMCU WIFI Module:

The ESP8266 NodeMCU is a popular low-cost microcontroller with built-in Wi-Fi capability. It is widely used for Internet of Things (IoT) projects due to its small size, ease of use, and powerful features.

Working Principle: The ESP8266 NodeMCU works as a low-cost WiFi-enabled microcontroller platform that can connect to the internet and interface with various sensors and actuators. It operates by running programs written in Lua or Arduino IDE-compatible C/C++ code. The board has a built-in WiFi module, making it ideal for smart home devices, wireless communication, and IoT systems.

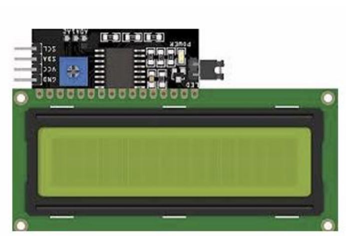
LM35 Temperature Sensor:



LM35 is a temperature sensor that outputs an analog signal which is proportional to the instantaneous temperature. The output voltage can easily be interpreted to obtain a temperature reading in Celsius. The advantage of lm35 over thermistor is it does not require any external calibration. The coating also protects it from self-heating.

Working Principle: The LM35 temperature sensor utilizes the temperature-dependent voltage characteristics of semiconductor junctions to produce an analog output voltage directly proportional to the temperature in degrees Celsius.

<u>Liquid Crystal I2C:</u>



The Liquid Crystal I2C module is a component used to simplify interfacing with standard LCD modules, such as 16x2 or 20x4 alphanumeric displays. By utilizing the I2C protocol, it reduces the number of pins required for control and data lines, making it ideal for microcontroller-based projects. The module consists of a standard LCD panel and an I2C adapter board, often equipped with a PCF8574 I2C expander chip. This adapter converts the I2C signals from the microcontroller into parallel signals required by the LCD. It communicates via the Serial Data (SDA) and Serial Clock (SCL) lines, typically at an I2C address like 0x27 or 0x3F, and includes a potentiometer for contrast adjustment and a mechanism for backlight control.

Working Principle: The working principle involves the microcontroller sending I2C commands to the module, which the adapter interprets and converts into control signals such as RS (Register Select), RW (Read/Write), and EN (Enable) for the LCD. These signals drive the LCD to display characters or execute commands, while custom characters can also be defined using its internal Character Generator RAM (CGRAM). The I2C module enables efficient pin usage by reducing the required connections from 6-10 pins to just two (SDA and SCL) while allowing multiple I2C to share the same bus.

<u>Arduino UNO:</u>

The Arduino Uno is a popular microcontroller board that makes it easy to get started with electronics and programming. It has 14 digital input/output pins, 6 analog input pins, a USB connection, a power jack, and a reset button. The Uno is programmed using the Arduino IDE, which is a user-friendly software that allows you to write code and upload it to the board. Once programmed, the Uno can be used to control various electronic components and sensors, making it a versatile tool for building a wide range of projects.

Working principle: The Arduino Uno is a microcontroller board based on the ATmega328P microcontroller. It receives input from sensors or switches through its digital and analog pins. The microcontroller processes this input according to the programmed code, and sends output signals to control devices like motors, LEDs, or displays. The USB connection allows for programming and communication with a computer.

Arduino IDE:

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

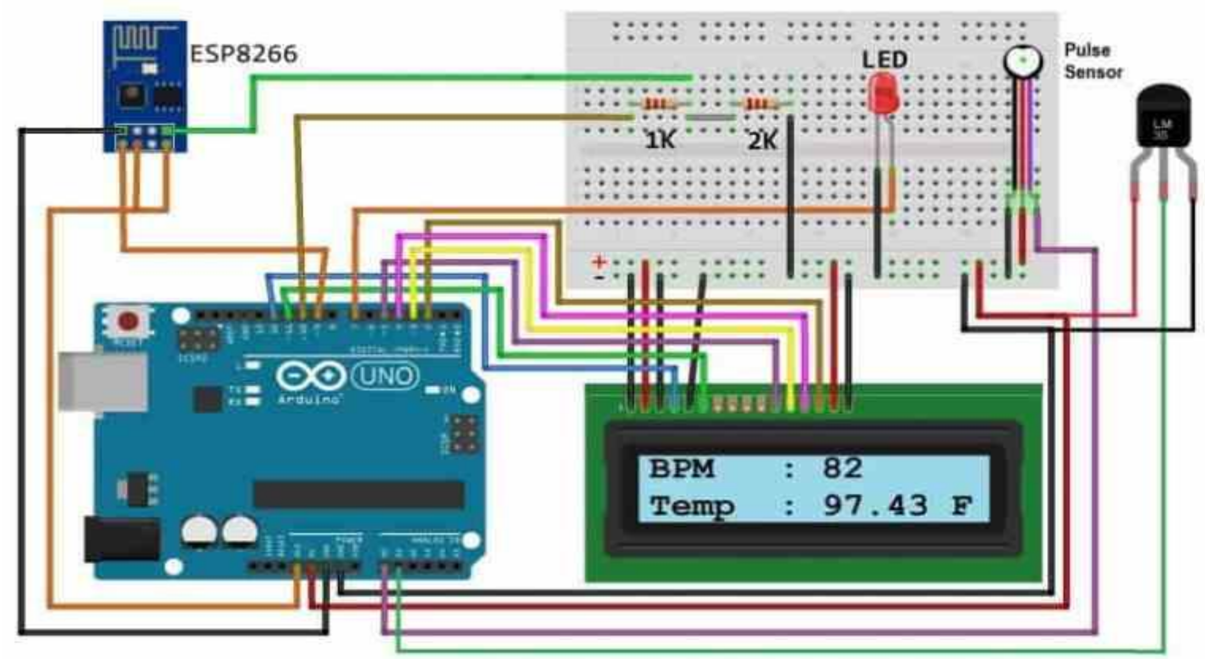
Working principle: The Arduino IDE is a user-friendly software for programming Arduino boards. You write code in a simplified version of C++ and upload it to the board. The board executes the code, controlling connected hardware components. The IDE offers features like simplified syntax, built-in functions, a serial monitor, and error checking, making it easy to learn and use for various projects.

ThingSpeak:

ThingSpeak is a cloud-based IoT analytics tool that lets you gather, visualize, and analyze real-time data streams. 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.

Working principle: ThingSpeak is an IoT platform that simplifies data collection and analysis. We create channels to store data from sensors or other devices. These devices send data to ThingSpeak using API calls or libraries. ThingSpeak stores and visualizes this data in real-time using charts and graphs. You can further analyse the data, set up alerts, and integrate with other services to create powerful IoT applications.

## CIRCUIT DIAGRAM



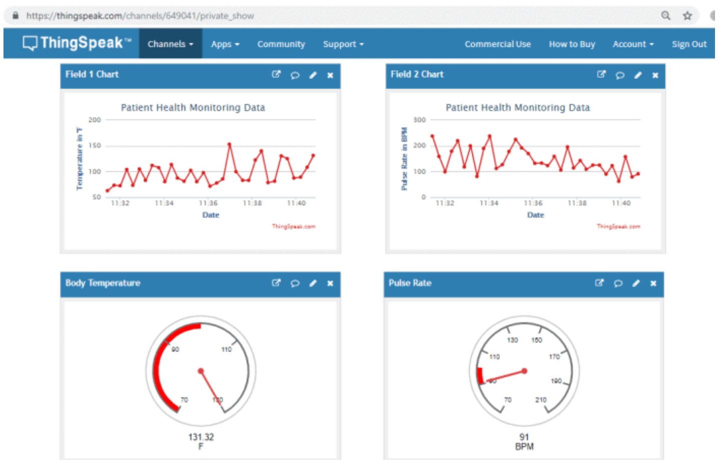

## EXPECTED OUTCOMES

• The IoT-based health monitoring system provides real-time tracking of vital signs, enabling immediate detection of any health irregularities.

• It allows remote access to patient data for healthcare providers, supporting telemedicine and remote patient care.

• The system sends automated alerts if vital signs fall outside safe ranges, ensuring timely responses in emergencies.

## RESULTS



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