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# An IoT based Automated and Intelligent System for Patient Health

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## Abstract

The Internet of Things (IoT) has remained extensively to connect accessible medical resources and provide smooth, dependable, and in effect of healthcare services to patients, and it has the potential to disrupt healthcare innovation. Health monitoring system using IoT application is the recent trend in medical field, by discovering the potential of the technology. Humans are incrassating the several issues and precocious death due to numerous illness, and by deficiency in providing medical treatment to the patients. To obtain the solution to this issue, a real time health monitoring system is proposed based on the recent technology such as IoT. Enhanced and intelligent healthcare system is the representation of developed and prosperous nation. The proposed method improves the monitoring system by shrinking the use of sensors, which have been attempted to exploit the new technology to obtain the solution for the healthcare problem currently society is facing, and a remote healthcare system is designed. The proposed automated and intelligent system involved with the different phases such as revealing the vitality of patient's using sensors, sends patients data to cloud storage and thus providing it to the doctors to utilize it, which will help to access and observe the patient's well-being improvement away from hospital locations. The proposed automated and intelligent system is used to interconnect the accessible medical resources and offer smart, reliable, and effective healthcare system to the people. An IoT architecture with customized healthcare applications have been developed to support remote health monitoring system.

**Keywords:** Internet of Things, ThingSpeak, Arduino Board, Sensor

## 1. Introduction

The signals obtain through Biomedical equipment performs a dynamic role in IoT based automated and intelligent healthcare systems. Incorporating the different types of


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signals consents us to develop an enriched healthcare specialist care system in terms of detecting the issues of the patient's health. Healthcare monitoring system using IoT is mainly a booming concept in medical field to have association between the peoples, device etc. Healthcare monitoring system has transmuted healthcare in the course of the earlier few decades in line for the technological revolution [1, 2]. IoT's major involvement today's life is towards fighting the current endemic situation by means of active mechanism of data, better treatment, and enhanced analysis of health [3, 4, 5].

The IoT based monitoring system, uses sensors to monitor, control through automation and give feedback values to assist healthcare application with cities smarter. The sensors' feedback principles benefit the healthcare providers bring out monitoring and control through a sequence of automation procedure and can be accompanied with the latest technology such as IoT, wireless sensor networks, deep learning etc [6]. The inevitability development of a intellectual healthcare monitoring system in both rural and urban areas. The survey has been taken in 2020 by global system for mobile communication (GSMA) 2.0 billion IoT devices are shipped to the market annually. Among that 10% devices have been used for smarter health care applications. So there is need to develop an IoT based patient monitoring system to provide flexibility in monitoring the health issues of the peoples in different area.

## 2. Proposed IoT based Automated and Intelligent System

The application of IoT technology in the healthcare sector has enabled remote surveillance, which has the ability to provide patients with a safe and healthy environment. It also increased patient participation and satisfaction by making interaction with clinicians more convenient and efficient. Furthermore, remote health monitoring helps to cut down on hospital stays and re-admissions. In healthcare, IoT has a substantial impact on cost reduction and increased therapeutic benefits. This IoT-based automated and intelligent system detects the health status of patients, stores and presents the data over the internet, and alerts doctors to critical conditions.

## 3. Architecture

IoT is a new paradigm in which a large number of smart objects and smart gadgets are connected to the internet and communicate with one another. These smart gadgets are used to collect data such as heart rate, temperature, and other factors that are utilized to assess a

patient's health. The difficult task in the IoT is communicating the acquired data to the doctor, making precise decisions based on the data collected, and notifying the patient. In the event of a severe scenario, this system advises the patient on medical care and the next steps to take. The suggested system is evaluated for a number of parameters, and judgments are made based on the data collected from the source for monitoring the patients' health. The simulation results test the correctness and effectiveness of the proposed solution.

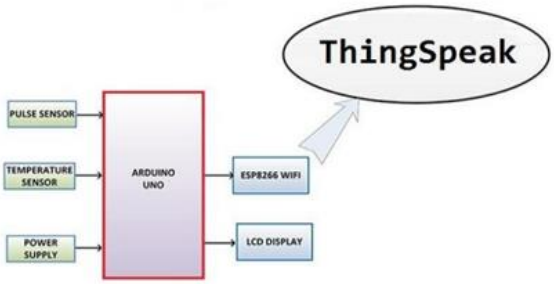


**Figure 1.** Architecture of the patient monitoring system

## 4. Hardware Specifications

The hardware used for the automated and intelligent system are ESP 8266 Wi-Fi module, Pulse rate sensor, Temperature sensor, Arduino Board and GSM Modem 4.1.1 ESP 8266.

### 4.1 ESP 8266 Wi-Fi module

Wi-Fi module used is the ESP8266 which is the budget component where the manufacturers are using wisely for wireless network application is shown in Figure 2. ESP8266 Wi-Fi module works with the frequency range of 2.4GHz. It works with 32bit CPU running at 80MHZ and TCP/IP (Transfer control protocol) where the IoT operation are held [3]. It has 64kb boot ROM, 64kb RAM. Wi-Fi module performs IoT operation by directing files to webpage and it can be accessed through IP address. The TX, RX pins in the component are connected to the 7and 8 pins of the Arduino microcontroller.

**Figure 2.** ESP 8266 Wi-Fi module

### 4.2 Pulse Rate Sensor

Pulse rate is captured using the heart rate sensor and is well-designed for Arduino is shown in Figure 3. The sensor chips onto a fingertip and plugs right into Arduino. It also comprises with an open-source monitoring application which used to record your heart rate in real time. The front side of the sensor is the concealed with the heart shape logo and it is made for using to contact with the skin of the body. There is a small round hole in which LED is present under which a little square box is present which act as an ambient light sensor used to adjust the brightness of the screen. The LED shines light senses and reads the amount of light that bounces back which calculates the heart rate.

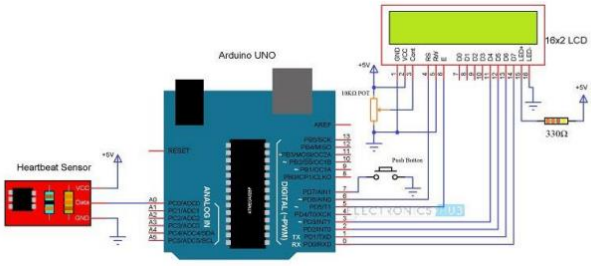


**Figure 3.** Pulse rate generator

### 4.3 Temperature sensor

A temperature sensor, as shown in Figure 4, is a device that is meant to measure how hot or cold an object is. The LM35 is a exactness IC temperature sensor with related output to temperature (in degrees Celsius). The temperature can be measured more precisely with the LM35 compared to the thermistor. It also has a poor self-heating capability, causing a temperature rise of less than 0.1 °C in still air. The temperature range for operation is -55°C to 150°C.

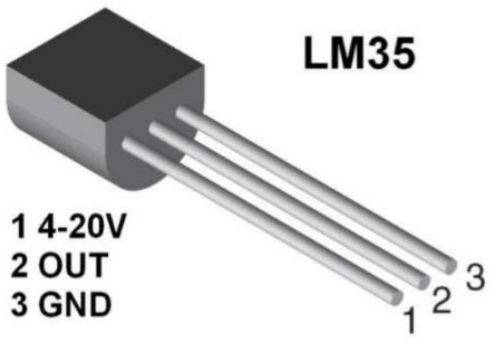


**Figure 4.** Temperature Sensor

### 4.4 Arduino Board

Arduino board is a microcontroller device and is shown in Figure 5. The configuration of the Arduino is with 14 Input/ Output pins, 6 analog inputs with 16 MHz ceramic, USB connection and reset button. It is connected as usual with the supply for working on it. After the connection is established, it will intercept the first few bytes of data transferred to the board.

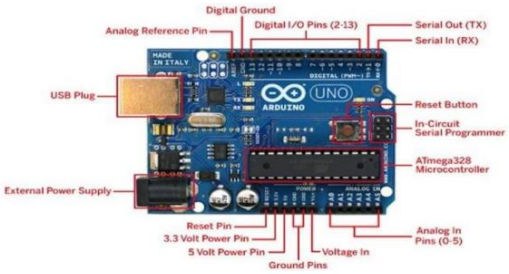


**Figure 5.** Arduino Board

## 5. Implementations

An automated and intelligent system based on IoT for patient monitoring is implemented and is explained below.

### 5.1 Pulse Rate Detection

The pulse rate is detected by sensing the flow of blood in the finger with respect to time. LM358 sensor senses the signal, and the amplified signal gets inverted and filtered. A heart rate sensor is accumulated with the benefit of the sensor in order to compute the heart rate based on the blood flow in the fingertip.

### 5.2 Temperature Detection

Temperature sensors is used to sense the temperature of the human body by use of the direct and reliable communication with microprocessors with cost effective and without the converters. LM35 is a analog linear temperature sensor. The operating temperature range is from -55°C to 150°C.

### 5.3 Collection of Data

The ESP8266 Wi-Fi module is a complete Wi-Fi internet of network, is used to transfer the data from sensor and store it in Thingspeak, an open data platform for things. The

records is stored on a regular basis, along with their time intervals and can then be accessed by medical professionals, in turn, can assess their patients as required.

### 5.4 Alert Module

Temperature threshold is around 36.5–37.5 °C. Pulse threshold is around 60-100 BPM. If the values read fundamental vital signs, such as heart rate and body temperature, as well as some indicators of the hospital room's state, such as humidity. The intelligent system will improve the recent healthcare montioring system, potentially saving many lives. It will be created in the future, using new technologies, to accurately find the patterns of particular diseases from historical data, and ideally forecast the sickness.

### 5.5 Configuring Cloud Data Online

The data from the ESP8266 sensor is uploaded to the internet. It's a three-step procedure. Connect to your internet-connected WiFi hotspot. Figure 5 shows how to read sensor data and upload it to ThingSpeak. ThingSpeak can handle up to 8 data fields, in case you need to submit more than one value to it. Use ThingSpeak to communicate numerous values to ThingSpeak from an Arduino. For each value to send, use set Field and then ThingSpeak. To submit everything to ThingSpeak, use WriteFields (myChannelNumber, myWriteAPIKey). To send multiple pin voltages to ThingSpeak, use the WriteMultipleFields Arduino programme example. Every 15 seconds, the WriteSingleField Arduino programme reads an analogue signal from pin 0 and sends it to a channel on ThingSpeak. Open the Arduino IDE and load the example. Ensure that the WiFi module and COM port are the correct ones. The code should then be uploaded to Arduino.

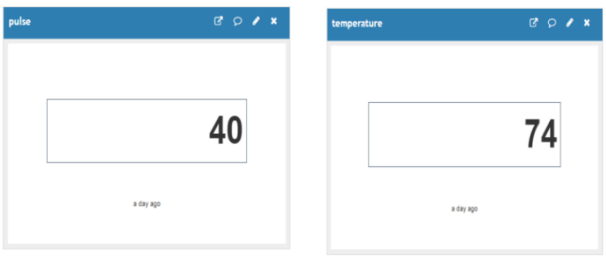


**Figure 5.** Configuring ThinkSpeak

## 6. Conclusion

The suggested work's principal goal has been accomplished satisfactorily. All the component modules, such as the heartbeat detection, fall detection, and remote watching

modules, have produced expected results. The developed system modules can be refined and manufactured as a single circuit. The fact that all the circuit components used in the remote health detection system are readily available was also discovered during the project design. The system offered smart healthcare to monitor patients' fundamental vital signs, such as heart rate and body temperature, as well as some indicators of the hospital room's state, such as humidity. The intelligent system will improve the recent healthcare monitoring system, potentially saving many lives. It will be created in the future, using new technologies, to accurately find the patterns of particular diseases from historical data, and ideally forecast the sickness.

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