# Design and Analysis of IoT-Based Wireless Healthcare Monitoring System

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**ABSTRACT:** This work develops a system that can continuously track the patient's health condition and display it using cloud computing platform. This system shows a reliable and consistent sense values with accuracy of 99.4% and 86% for temperature and pulse sensors, respectively. The project uses an Arduino controller to collect patient health information such as temperature and pulse sensor and provide real-time monitoring system for medical practitioners. Both the sensors and RF transmitter will be attached with a controller board worn by the patient for continuous monitoring. These data will be collected by other RF receiver and Arduino controller and then transmit the data to the server using internet. From the IoT platform, the data can be accessible by the medical practitioners through the web page. If the system detects any abrupt changes to the patient temperature and heartbeat, it will send push notification to the medical practitioner's smartphone regarding the condition. At the end, an analysis will be conducted to test the performance of the project that covers sensor accuracy and wireless transmission strength.

**Keywords:** *ESP8266; Healthcare; Internet of Things.*

## 1. INTRODUCTION

Nowadays technology plays an important role in the healthcare system. In hospitals, continuous monitoring of patient's health is required in order to observe their health conditions [1]. Studies show that nearly up to 90% of the alarms system for critical patients are not actionable [2]. The uses of technology can improve the medical system with sensory devices where the data can be stored and processed in cloud system.

Internet of Things (IoT) refers to the number of physical devices connected to the internet that share data with other elements. Recently, there are a lot of sensors that connected and embedded to the internet such as temperature, liquid [3], light [4], frequency signal [5] and etc. for monitoring purposes. In IoT healthcare sector, the health parameters such as glucose level, blood pressure, heartbeat rate, body temperature, and body temperature can also be monitored using sensor devices. Then, these data can be stored through cloud system and shared with doctors, family members or physician to allow them to monitor the health parameter collected regardless of place and time with the help of the IoT platform.

The main idea of the system proposed is to real time monitoring of the patients over internet. The system design utilizes temperature sensor and pulse sensor placed on tip of the finger of patient hand to detect health parameters which are heartbeat rate and body temperature. Figure 1 shows the block diagram of the system design.

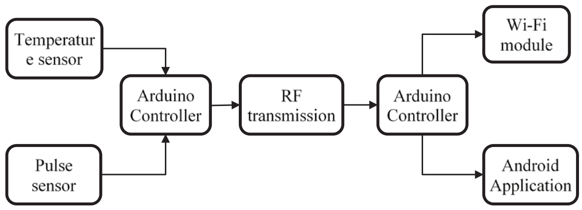



Figure 1 Block diagram of proposed system

## 2. METHODOLOGY

The system is constructed on breadboard to test each component and get a result. In this experiment jumper wire and temporary power source are used to test the system functionality. Once each of the test completed with zero error, the circuit is designed on printed circuit board (PCB) using Proteus software. The circuit is shown in Figure 2. A complete board for transmitter board that uses Arduino Beetle and receiver board that use UNO Arduino were created and proven to work.

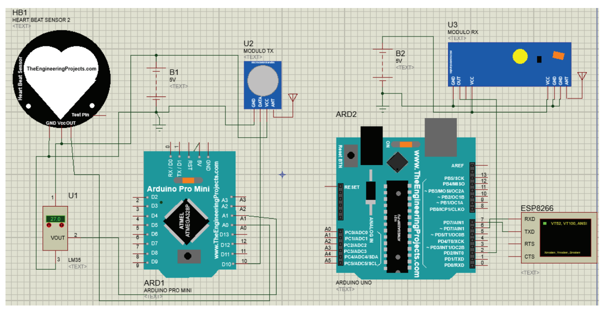


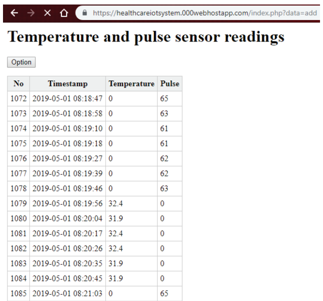
Figure 2 Circuit built using Proteus software

By using hardware and software created, the sensor reading can be display through the webpage with notification system implemented. In order to wear the transmitter board mounted with sensors in hand, a casing is created using 3D printing to keep the board intact as shown in Figure 3. For the receiver board, it uses power bank as power source to turn ON the Arduino board.

Figure 3 Transmitter and receiver board with casing

## 3. RESULTS AND DISCUSSION

The website display data from the IoT device every 10 seconds delay and update in the database connected to the server. Figure 4 shows result obtained from the webpage for pulse rate and temperature value. The parameter values are within an acceptable range.



https://healthcareiotsystem.000webhostapp.com/index.php?data=add

**Temperature and pulse sensor readings**

Option

| No | Timestamp | Temperature | Pulse |
|---|---|---|---|
| 1072 | 2019-05-01 08:18:47 | 0 | 65 |
| 1073 | 2019-05-01 08:18:58 | 0 | 63 |
| 1074 | 2019-05-01 08:19:10 | 0 | 61 |
| 1075 | 2019-05-01 08:19:18 | 0 | 61 |
| 1076 | 2019-05-01 08:19:27 | 0 | 62 |
| 1077 | 2019-05-01 08:19:39 | 0 | 62 |
| 1078 | 2019-05-01 08:19:46 | 0 | 63 |
| 1079 | 2019-05-01 08:19:56 | 32.4 | 0 |
| 1080 | 2019-05-01 08:20:04 | 31.9 | 0 |
| 1081 | 2019-05-01 08:20:17 | 32.4 | 0 |
| 1082 | 2019-05-01 08:20:26 | 32.4 | 0 |
| 1083 | 2019-05-01 08:20:35 | 31.9 | 0 |
| 1084 | 2019-05-01 08:20:45 | 31.9 | 0 |
| 1085 | 2019-05-01 08:21:03 | 0 | 65 |

Figure 4 Result obtained for temperature and pulse rate.

The temperature sensor LM35 used in this project is a low-cost sensor that can provide 0.5 °C sensitivity. The sensor had undergone several tests and compared with real value obtained. From Figure 5, the measured temperature using LM35 varied due to its accuracy. The average temperature is around 33.8 °C, compared to actual temperature which is 33.6 °C., with percentage of error 0.6%. Hence the accuracy of the sensor is around 99.6%.

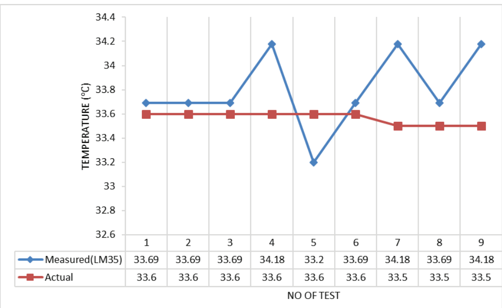



Figure 5 Measured and actual temperature

The pulse sensor also being tested for its accuracy and reliability. From Figure 6, the BPM is check using pulse sensor for 10 consecutive times and compared with real value. The project used real measurement unit from Samsung heart rate optical sensor. The BPM obtained using pulse sensor have slightly difference between actual measurement. From this analysis, the average BPM obtained using pulse sensor is 60.2 and actual sensor is 69.9. So, from the measure and actual data obtained, the error of reading is around 14% and give accuracy of 86% for the pulse sensor.

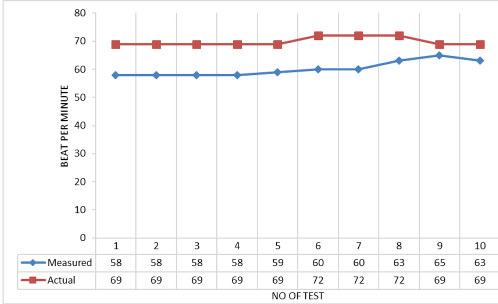



Figure 6 Measured and actual BPM

## 4. CONCLUSIONS

This work has developed a low-cost health monitoring system. The results obtained are almost accurate by comparing between the measured and actual values. The LM35 temperature sensor has produced a consistent and accurate of 99.4%, while the pulse sensor shows a slightly missed values but still above 85%. This may occur due to the pulse sensor circuitry fault and also response delay from Arduino controller setup.

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