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# Sleep Quality Monitoring and Notification System for Homecare Patient

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**Abstract**: Human physical and mental health, as well as daytime performance and safety, are all influenced by sleep quality. Good sleep can lower the risk of chronic disease. An improved sleep quality monitoring system is required to assist patients in getting better sleep. By leveraging the rapid improvement of sensor and mobile technologies, the emergence of internet-of-things technology has created a potential chance to build a reliable sleep quality monitoring system. Health monitoring and condition evaluation should be carried out as soon as possible so that better clinical choices may be made about a patient's state in terms of heartbeat and temperature at home. Healthcare interaction via the Internet of Things (IoT) is implemented in order to access home care patient medical criteria at home. This health monitoring station, created using Blynk Applications, focuses on giving reliable data as well as information and early warnings regarding health issues for homecare patients. The evaluation and monitoring activities are aimed to monitor the patient's current condition so that the health system can be controlled and effective steps may be taken based on these observations. Normal and abnormal situations can determine the patient's heart rate in most cases. It is considered normal if the pulse rate is between 35 and 89 beats per minute. If the value is below 35 or above 90, the effect is the opposite. The system uses an alarm to inform the caregiver. When the microcontroller receives data from sensors and detects abnormal activities, the buzzer will turn on. The goal of the buzzer alert is to notify and alert the caregiver that immediate action is required. As a result, this approach can be extremely helpful in preventing patients from becoming critically ill while they are sleeping or awake, as well as raising caregiver awareness.

**Keywords**: Sleep Quality Monitoring, Notification System, Homecare Patient

## 1. Introduction

Based on the general definition, sleep is a type of "brain activity" and the purpose of this activity is to recover from brain fatigue. Nowadays, the results of a study of sleep habit problems involving 500 respondents from all over the country since the beginning of this year, it is seen that nine out of 10

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people have one or more sleep problems in a time [1]. It is important to always be alert for changes in breathing difficulty, such as struggling for each breath, being unable to speak or cry because of difficulty breath. Besides, indoor air can dry out airways and make mucus stickier. Therefore, it is important to ensure the temperature and the humidity of the room is within a safe range for homecare patient [2],[3].

Sleep Quality Monitoring and Notification System for Homecare Patient is developed with the thought of taking precaution and as early warning from having the worst condition of health. Homecare patient usually needs extra care and extra precaution in terms of their health condition. The patient is those who are within 20-40 years of age.

Hence, the Sleep Quality Monitoring and Notification System (SQMNS) an ambient sleep monitoring that will be introduced using sensors and installed inside living apartments. The type of sensors that will be use BH1750 light sensor as light sensors that had been attached to the wall of room, temperature sensors to detect room temperature and sensors that can detect heat application usage and electricity.

The aim of the prototype system is to be able to monitor sleep quality system for homecare patient by using Arduino Mega 2560.

## 2. Materials and Methods

### 2.1 Materials

The proposed system is a sleep quality monitoring and notification system using the Arduino Mega 2560. There are two type of environment sensor used which is ambient and human condition. From ESP8266 Wi-Fi module, all the data transfer and stored to the cloud server. Blynk App will display the interface of two part of sleep quality monitoring system homecare patient condition. Lastly, the buzzer is also set as an alarm and will produce a loud noise in the event of unusually patient condition.

### 2.2 Methods

In this section contains the elaboration of the sleep quality monitoring and notification system. The system consists of set biomedical sensor attached with the body of a patient. The block diagram for this project shown in Figure 1 which is consist of sensor, Arduino Mega 2560, ESP8266 Wi-Fi module, Blynk app, and buzzer.

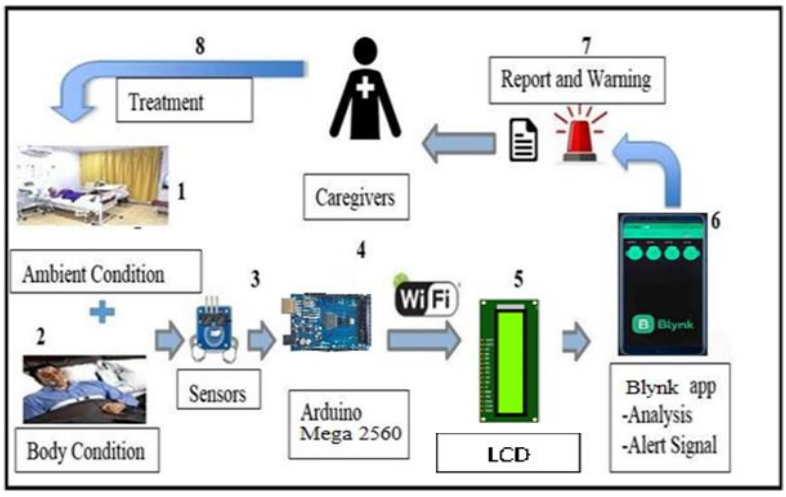


**Figure 1: Block diagram of sleep quality monitoring and notification system**

Begin by detecting the sensor, collecting data, and processing the system on a Blynk application until the user is notified. The system's operation is depicted in Figure 2.

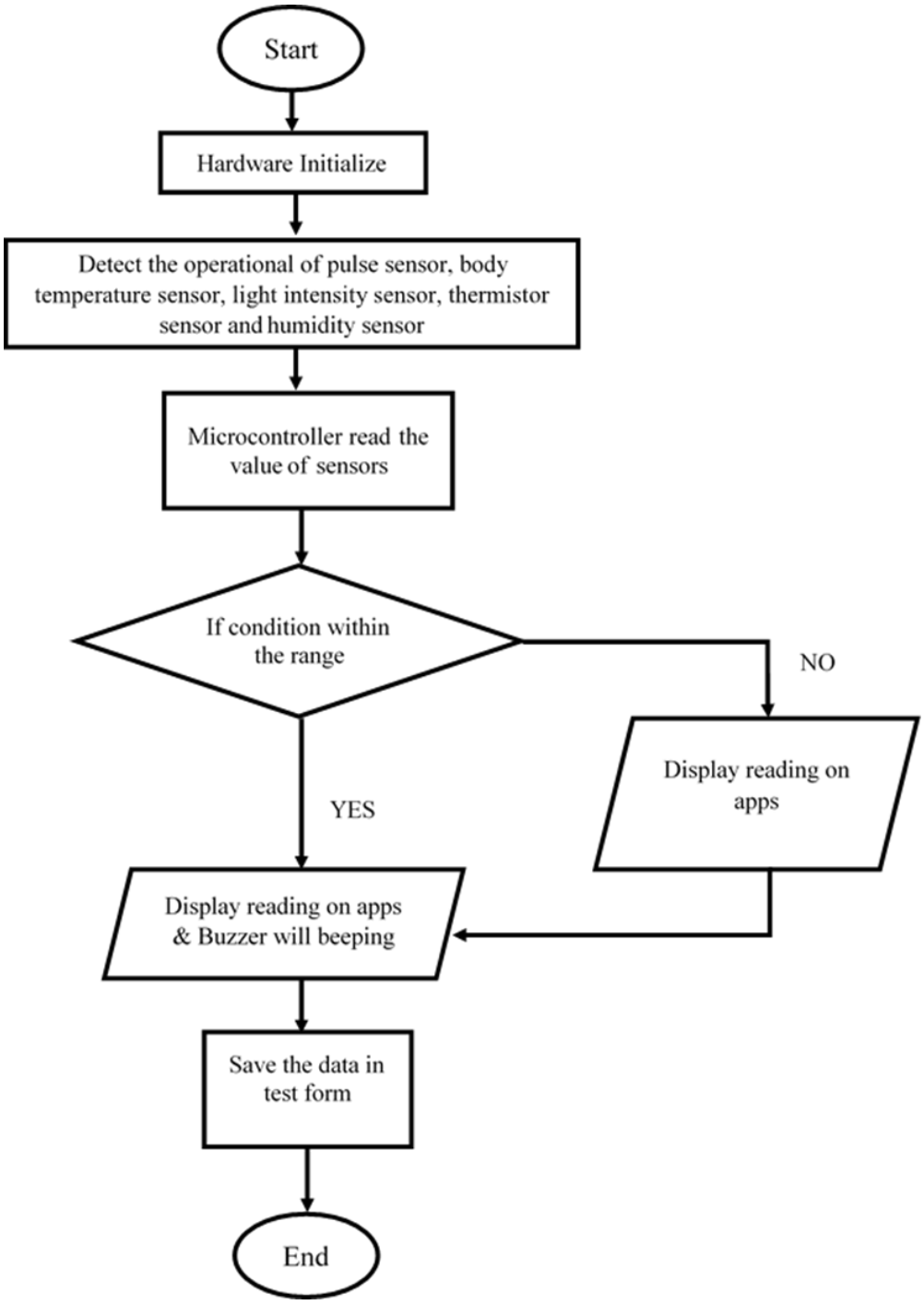


**Figure 2: Flow chart of operation system**

To execute an application on a mobile phone, there are various steps required. The program is divided into three phases: login or registration, connecting the ESP8266 Wi-Fi module, and the main page, which displays the data and saves it in text format. The flow chart of Blynk Apps is shown in Figure 3.

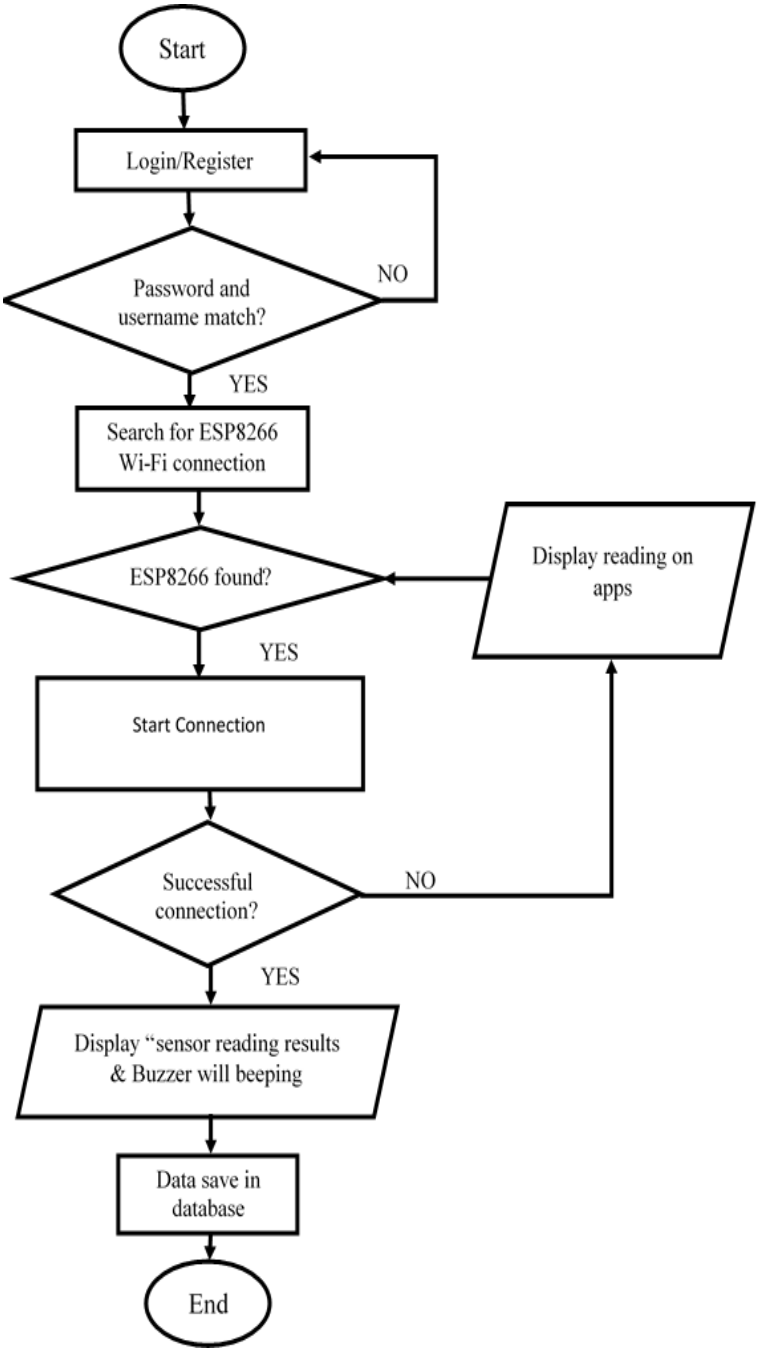


**Figure 3: Flowchart of Blynk Apps**

## 3. Results and Discussion

In this chapter the result of the study is presented and discussed with reference to the aim of the study. Several experiment and testing conducted to evaluate each hardware used in developing this sleep quality monitoring system. These experiments were conducted to test the function and efficiency of each hardware such as pulse sensor and humidity sensor. The hardware will be evaluated against each other with the Arduino.

### 3.1 Device Design

The hardware design is developed utilizing an electronic medium-sized box that serves as a base for the microcontroller and circuit board. This device uses an application medium to interface the

hardware and software designs. The hardware will provide data to the applications, which will be displayed and saved in a database. The Blynk apps is a platform that been used to create an interface on the mobile phone. Figure 4, Figure 5 and Figure 6 show the hardware design of the device, patient and device setup, and schematic circuit of the device.


**Figure 4: Hardware design of the device**


**Figure 5: Patient and device setup**

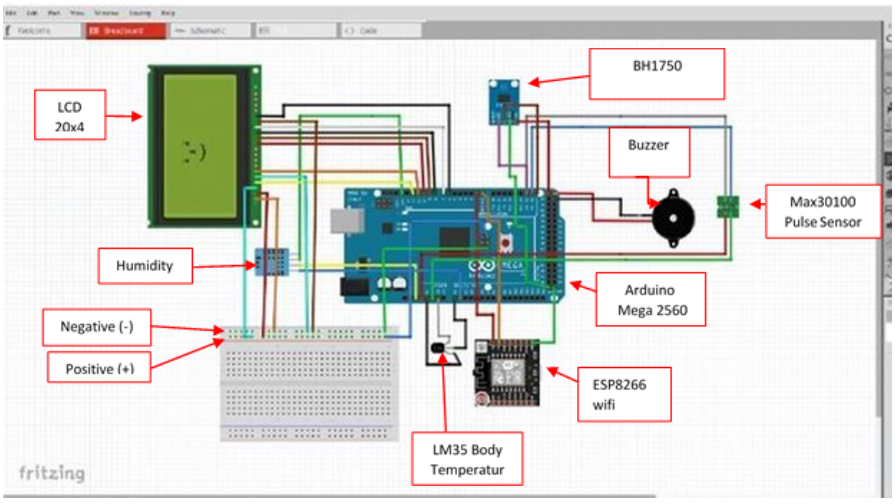


**Figure 6: Schematic circuit design of the device**

## 3.2 Testing

The Humidity sensor, Max30100, LM35, BH1750 has a high sensitivity. The sensor must be appropriately attached to the patient's finger and to the body in order to accurately monitor the patient's heart rate (Bpm) and temperature (°C). The light intensity and humidity sensor will be mounted on the room's wall. Figures 7 and 8 show the LCD display during startup and real-time data display.


**Figure 7: LCD display for starting**


**Figure 8: LCD display real time data**

This project responds to two situations: the first is when the detected range is in a normal state, and the second is when the detected range is in an abnormal state. Both conditions have a similar approach, and the condition range values will appear on the LCD and in the application. The buzzer, on the other hand, will beep anytime the sensor detects the second condition, which is an abnormal condition, to alert the caregiver to the patient's status. The buzzer will not beep if the sensor detects a normal situation. The reading values will still be displayed on the LCD and in the application. Figure 9 depicts an example of real-time data obtained from the Arduino and sensor via the ESP Wi-Fi module.

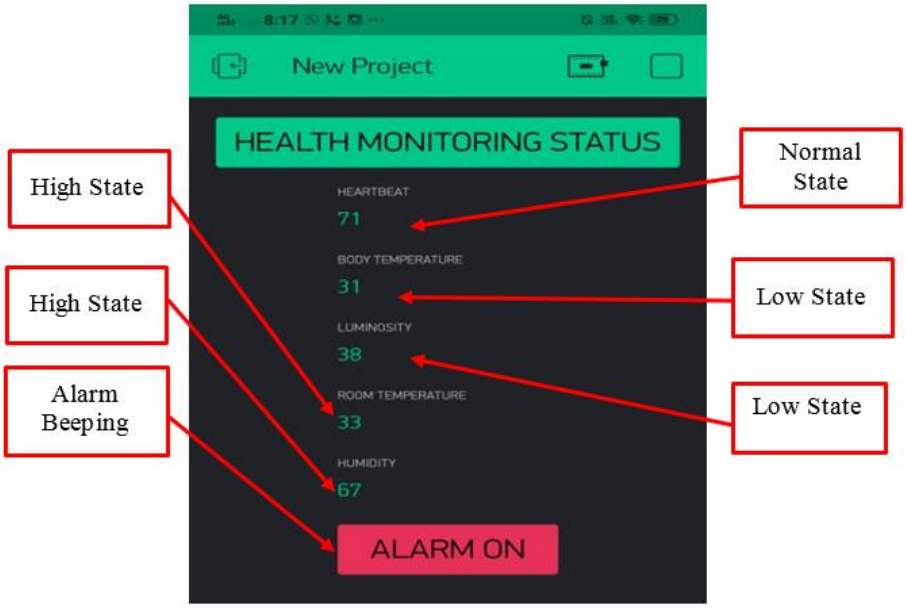


**Figure 9: Result of real time data that appear on the application**

### 3.3 Analysis of condition state

A few participants (subjects) were identified to run the test with a range age of less than 27 years old, as shown in Table 1 and Table 2, to see if this gadget is compatible and suitable for adults. Each subject undergoes the testing multiple times to guarantee that the results are correct. To conduct the test, each selected participant must be at rest and in a passive state, and the output of the buzzer, LCD, and sensor response are assessed.

**Table 1: List of tested subjects by sleep quality monitoring and notification system**

| Subjects | Age (Year Old) | Heart Rate Reading (Bpm) | Body Temperature (°C) | Humidity (RH) | Room Temperature (°C) | Light Intensity (lx) | Buzzer | Condition |
|---|---|---|---|---|---|---|---|---|
| 1 | 26 | 69 | 36 | 67 | 33 | 38 | On | Normal |
| 2 | 26 | 64 | 38 | 67 | 33 | 38 | On | Normal |
| 3 | 27 | 80 | 37 | 67 | 33 | 38 | On | Normal |

**Table 2: List of tested subjects by existing devices**

| Subjects | Age (Years Old) | Heart Rate Reading (Bpm) | Body Temperature (°C) | Condition |
|---|---|---|---|---|
| 1 | 26 | 66 | 36.4 | Normal |
| 2 | 26 | 61 | 36.5 | Normal |
| 3 | 27 | 77 | 36.6 | Normal |

The readings of all subjects are also evaluated in terms of a graph for all of the sensors, in addition to using a Table. The graphs of Heartrate, Body Temperature, Humidity, Body Temperature, and Light Intensity are shown in Figure 10, 11, and 12.

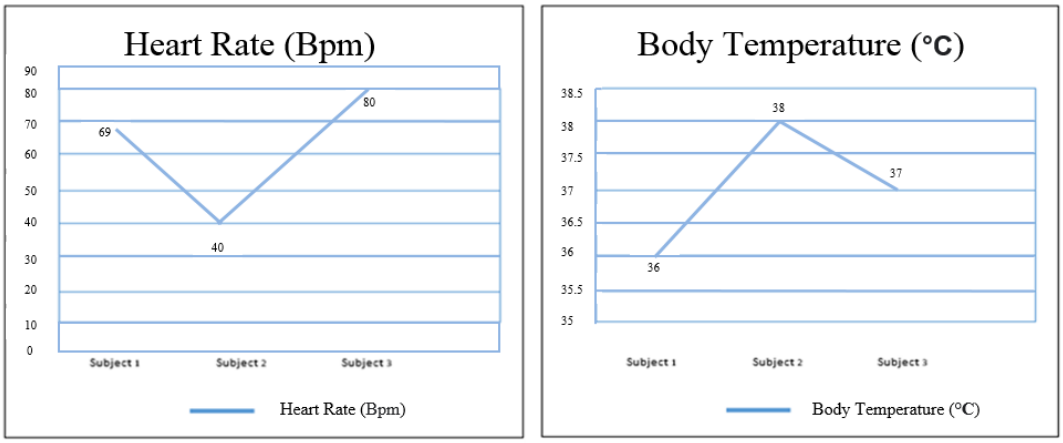


**Figure 10: Heart rate and Body temperature result from 3 subjects**

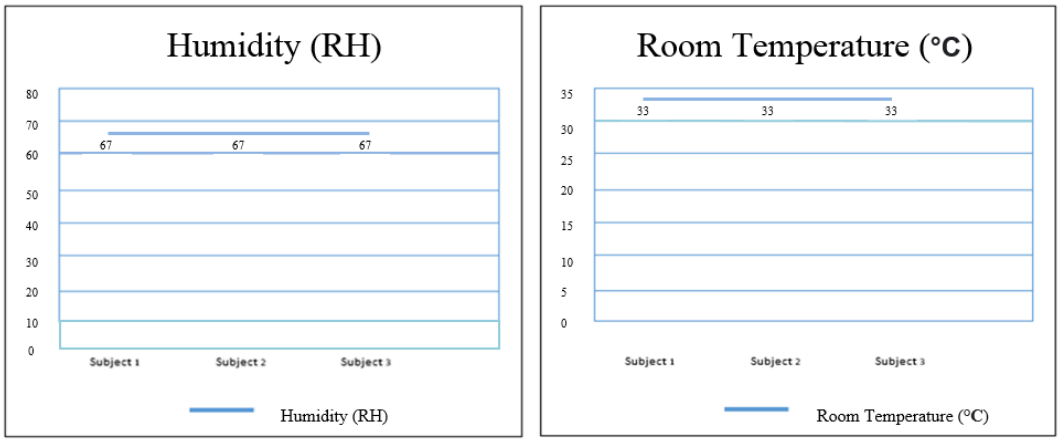


**Figure 11: Humidity and Room temperature result from 3 subjects**

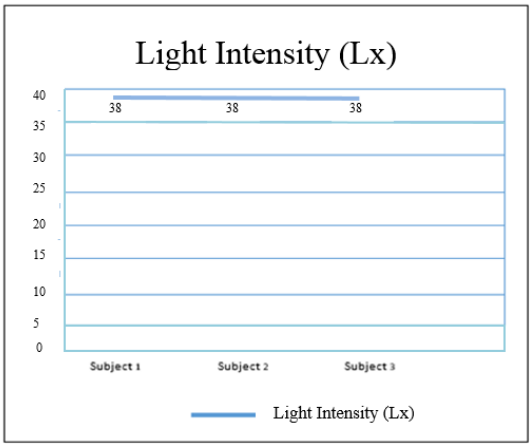


**Figure 12: Light Intensity result from 3 subjects**

### 3.4 Project Comparison

The purpose of the comparison analysis is to compare the results of this project with existing devices in the market. The results illustrate the difference between this project and existing devices on the market, to ensuring that the project measurement reading are accurate. Figure 13 shows that comparison result between sleep quality monitoring and notification system project and existing devices.

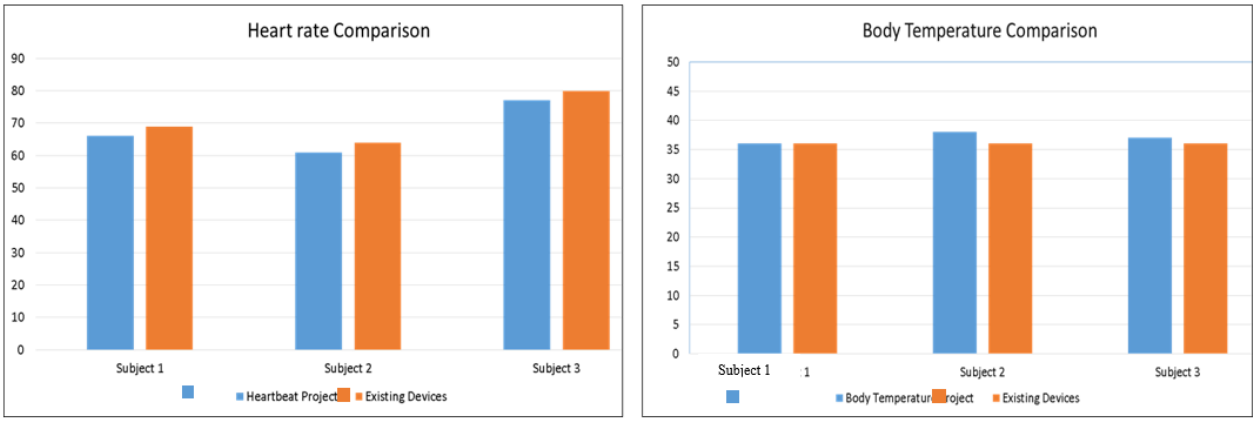


**Figure 13: comparison result between sleep quality monitoring and notification system project and existing devices**

## 4. Conclusion

As a conclusion, this project was able to achieve preliminary target that could work on the basic of its general workflow. This project is about developing a monitoring system for homecare patient. It is use to develop health- monitoring device based on IOT that can provide real time information of body conditions and to identify the health condition status of patient based on related output data MAX30100 pulse, LM35 Body temperature, Humidity and BH1750 Light Intensity sensor by using Blynk Application to design interface of health monitoring system that can save and retrieve data of users.

Besides, this project is developed to inform and alert caregiver to always monitor their patient and to prevent their patient condition become worse. Previous research showed that many homecare patients did not really well monitored and ended up the patient need to go to the hospital for further action. One

of the advantages of this device is that it has the ability to alert the caregiver or the guardians if the patient condition is worse and need further action.

Besides, the data taken at home can be stored in the application to make it easier for hospitalization purpose. One of the disadvantages of the device is that it is quite sensitive. Patient finger should be put properly on the sensor. This device requires many improvements to ensure it can be sold broadly and become a must have product in every homecare patient for home monitoring purpose.

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**References**

[1] Saad, N. H. M. "Innovation of a sleep monitoring system to observe the effect of the room environment on sleep quality," says the paper. Materials Science and Engineering 210, No. 012050, 2017, IOP Conf. Series: Materials Science and Engineering

[2] Agency for Healthcare Research and Quality (US), Kristine Alster, "Patient Safety and Quality in Home Health Care," April 2008

[3] "Supporting Family Caregivers in Providing Care," Nirvana Huhtala Petlick, Agency for Healthcare Research and Quality (US) Ronda G Hughes, editor, January 2008