DEVELOPMENT OF SLEEP MONITORING SYSTEM USING IoT

AIMAN HAKEEM BIN SHOKSI
B071710957

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
2020

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF SLEEP MONITORING SYSTEM USING IOT

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical and Electronic Engineering Technology with Honours.

by

AIMAN HAKEEM BIN SHOKSI

B071710957

961215-03-6055

FACULTY OF ELECTRICAL AND ELECTRONIC ENGINEERING TECHNOLOGY

2020

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: DEVELOPMENT OF SLEEP MONITORING SYSTEM USING IoT

Sesi Pengajian: 2020

Saya **AIMAN HAKEEM BIN SHOKSI** mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (X)

☐ SULIT*	Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972.

☐ TERHAD*

Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan.

☒ TIDAK TERHAD

Yang benar,

.....*AIMAN*.....

AIMAN HAKEEM BIN SHOKSI

Alamat Tetap:

PT 1554, KG. TERUSAN,

PASIR TUMBOH, 16150

KOTA BHARU, KELANTAN

Tarikh: 18/1/2021

Disahkan oleh penyelia:

.....

SIR AHMAD SAYUTHI

Cop Rasmi Penyelia

Tarikh: 18/1/2021

*Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini

DECLARATION

I hereby, declared this report entitled DEVELOPMENT OF SLEEP MONITORING SYSTEM USING IoT is the results of my own research except as cited in references.

Signature: ……*AIMAN*……

Author: AIMAN HAKEEM BIN SHOKSI

Date: 18/1/2020

APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Automotive) with Honours. The member of the supervisory is as follow:

Signature: .....

Supervisor: SIR AHMAD SAYUTHI

ABSTRACT

Sleep deprivation is one of the major issues across the globe. This is due to lack of exercise and healthy food other than environment and body weight. Severe sleep issues such as sleep apnea may cause fatal. This study is to develop an IoT integrated system to monitor the sleep disturbance at night and the result can be used by medical expertise or the patient itself to summaries their performance of sleep. The project aim is to develop the end user prototyping for sleep monitoring system which measures the room ambient and body condition by using Wi-Fi Connection. The main monitoring parameters to be used is body movement, body temperature, and heartrate for body monitoring and for room ambient, temperature, light intensity, and humidity were monitored by using Blynk application. The captured data are log into database. Time stamp is also been recorded to make data collection.

ABSTRAK

Kekurangan tidur atau tidur tidak mencukupi merupakan salah satu masalah utama yang dihadapi oleh setiap sesesorang di seluruh dunia. Perkara ini disebabkan oleh kurangnya senaman dan pemakanan yang sihat selain keadaan persekitaran dan berat badan ideal yang menjadi masalah. Masalah tidur ini secara tidak langsung boleh menyebabkan maut. Tujuan projek ini adalah untuk menghasilkan system pemantauan tidur untuk mengkaji keadaan badan dan persekitaran bilik dan hasilnya dapat digunakan oleh pakar perubatan dan pengguna itu sendiri untuk meningkatkan lagi prestasi tidur mereka. Projek ini menggunakan rangkaian Wi-Fi untuk menghubungkan bacaan sensor ke paparan. Antara parameter yang digunakan untuk memantau keadaan badan adalah pergerakan badan, suhu badan dan denyutan jantung. Untuk memantau persekitaran bilik pula, antara parameter yang digunakan adalah suhu bilik, kelembapan bilik dan keamatan cahaya. Kesemua parameter ini akan dipaparkan menggunakan aplikasi Blynk. Data yang diambil akan disimpan dan masa setiap bacaan juga akan diambil untuk membuat kajian.

DEDICATION

Specially dedicated to

My beloved family and friends for the help and encouragement. Thanks for my supervisor, Mr. Ahmad Sayuthi bin Mohamad Shokri and all the lecturers who gave me guidance and advice throughout the process of finish my final year project.

ACKNOWLEDGEMENTS

I would like to thank all parties who took part in helping me in this project.

I would like to thank my supervisor, Mr. Ahmad Sayuthi bin Mohamad Shokri who gave advice and guided me during the time when the project was carried out.

I would like to thank my project co-supervisor, Dr. Wira Hidayat Mohd Saad for all the advices and guidance during the project was carried out.

Nevertheless, I am also grateful to my family members that supporting me spiritually throughout carrying this project and my life in general.

Lastly, I would like to thank my friends for accepting nothing less than excellence from me.

Thank you.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

EMG	Electromyography
EEG	Electrogram
REM	Rapid Eye Movement
NREM	Non- Rapid Eye Movement
EDR	ECG-Derived Respiration
MT	Movement Time
ME	Movement Events
SWS	Slow-Wave Sleep
BLE	Bluetooth Low Energy
LDR	Light Dependent Resistor
DHT 22	Digital Humidity and Temperature Sensor
IDE	Integrated Development Environment
Window App	Window Application
DOF	Degree of Freedom
IMU	Inertial-Measure Unit

US	United State
EU	European Union
SDB	Sleep Disorders Breathing
NF	Neurofeedback
API	Application Programming Interface
RH	Relative Humidity
GND	Ground
SCL	Serial Clock
SDA	Serial Data
LiPo	Lithium Polymer
IOT	Internet of Things

CHAPTER 1

INTRODUCTION

This chapter will discuss the background of this project. Problem statement, objective and scope will be explained in this section. Structure of report will explain deeply in this chapter as well.

1.1 Project Background

Sleep monitoring is important for people with undiagnosed sleep apnea, which cause respiration and heart failures. The terms health monitoring can be interpreted by monitoring balanced diet or exercise time. In this case, health monitoring is interpreted in monitoring the vital signs of the body. Vital signs are used to measure the basic function of our body which may varies with age, weight, gender, and overall health. The main vital signs that are usually monitored body temperature, blood pressure, pulse or heart rate and respiratory rate. According to that, in a modern world nowadays where technologies are advanced, health monitoring have been revolutionized to the stage that health monitoring can be done anywhere contradicts to the traditional way where it can only be done in the hospitals or clinics. In these years, many people living through a busy and stressful life. Most of citizen living with inconsistent work shift, stress and lack of sleep and their tendency to go to hospitals for health check-up is mostly small, where citizen will not go to the hospitals unless when they feel unbearable pain. For some diseases, when going for check-up at this stage (unbearable pain), it is already in the worse condition stage of the disease.

Therefore, with the help of today's technology, high end health monitoring device that takes very accurate measurement was invented and was marketed for hospitals and clinics. However, these devices usually cost thousands of Malaysian ringgits. Thus, an idea to design a health monitoring system based on IoT to be used at home comes up and this project is carried out to serve that purposes. The Internet of Things is a network of physical objects that use sensors and APIs (Application Program Interface) to connect and exchange data over the internet to enhance the quality of life.

A lot of sleep disorders can be caused by poor sleep. The familiar examples of sleep disorders are insomnia, restless leg syndrome, and narcolepsy. Among that, insomnia is common and always occurs in women and the elderly and in people with psychosocial disadvantages. [M. Thorpy 2015]. One of the reasons why someone has insomnia is a busy and stressful lifestyle. In addition, other types of disorders, such as sleep walking, nightmares, and enuresis, also exist.

It can be classified into two states when a person sleeps, which are called rapid eye movement (REM) and non-REM (NREM) [Ackerman et al. 2014]. For each stage, non-REM sleep consists of three phases that can last from 5 to 15 minutes. Stage 1 is known as the stage of transition, where sleep begins. [S.J. Casey et al. 2016]. When someone is at this stage, his or her eyes will move slowly, the activity of the muscles will slow down, and it will be easy for people to awaken. The eyes will stop movement during stage 2, and the physical parameters such as heart rate and body temperature will decrease. It will be more difficult for him or her to wake up during stage 3. This phase is called the deep stage. The state of REM is dream sleep. People fall asleep during this phase, and dreams take place. In this stage, the heart rate and body temperature are increased to supply a lot of energy to the brain and body. [M.A. Carskadon et al. 2011].

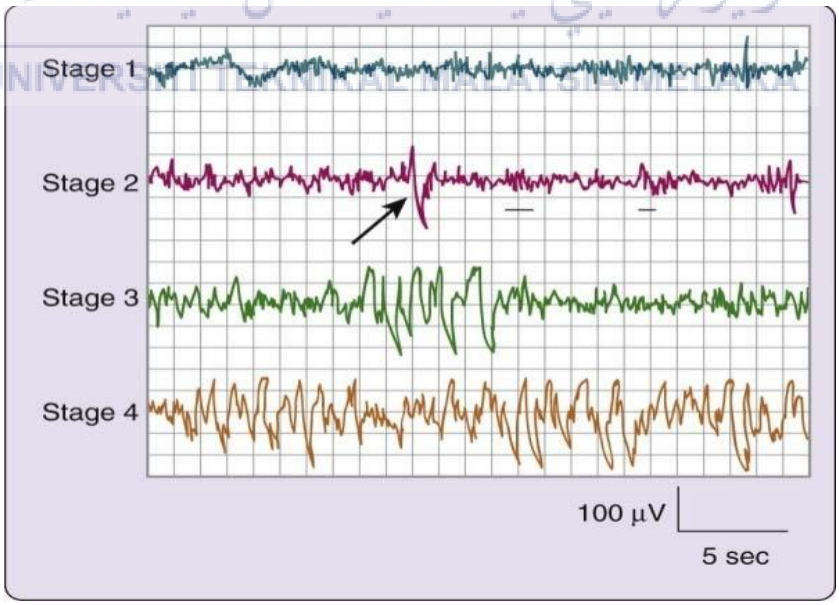

Figure 1.1: The arrow showed that there is largest event in healthy human EEG (K-complex) during stage 2.

In the room, physical conditions such as room temperature and humidity will affect people's sleep-in various ways. Some studies have analysed the effect of both cold and warm temperatures on the phases of sleep. [M.A. Carskadon et al. 2011]. The research shows that the warm temperature environment helps users to sleep well at night. [Mizuno et al. 2011]. In addition, humidity in the room is also an important issue.

In the research done by Okamoto-Mizuno [Mizuno et al. 2011], It demonstrates that both the skin temperature and wakefulness caused by hot-humid conditions have been increased. The REM phase and slow-wave sleep have been reduced. In addition to room temperature and humidity, noise environment also causes individuals not to have a good night's sleep. [B. Israel et al. 2012]. This is proved in the 2012 study conducted by Pedersen [B. Israel et al. 2012]. It states that some individuals have not had a good sleep due to traffic noise during their night sleep.

The quality of sleep can be defined or perhaps estimated by determining the body condition such as heart rate, body temperature as well as body movement [Z.H. Jia et al. 2016]. This is because the body parameter is changed based on the sleep stage.

1.2 Problem Statement

In these years, many people living through a busy and stressful life. Most of citizen living with inconsistent work shift, stress and lack of sleep and their tendency to go to hospitals for health check-up is mostly small, where citizen will not go to the hospitals unless when they feel unbearable pain. For some diseases, when going for check-up at this stage (unbearable pain), it is already in the worse condition stage of the disease.

Therefore, with the help of today's technology, high end health monitoring device that takes very accurate measurement was invented and was marketed for hospitals and clinics. However, these devices usually cost thousands of Malaysian ringgits. Thus, an idea to design a health monitoring system based on IoT to be used at home comes up and this project is carried out to serve that purposes. The Internet of Things is a network of physical objects that use sensors and APIs (Application Program Interface) to connect and exchange data over the internet to enhance the quality of life.

1.3 Aim and Objective of the Research

The aim of this project is to develop the end user prototyping for sleep monitoring system which measuring the room ambient and body condition by using Wi-Fi Connection.

The objectives of this study had been determined as following:

i. To develop a health monitoring system based on the IoT (Internet of Thing) concept

ii. To design health monitoring system that can take data reading for body condition such as heart rate, body temperature and body movement.

iii. To investigate the effect of ambient surrounding such as temperature, humidity, and light intensity toward the sleep quality.

1.4 Scope Project

There are two part which is hardware part and software part. For the hardware part, it is included of two microcontrollers that work together with several sensors to analysis the quality of sleep. One of the microcontrollers is NodeMCU ESP8266 with DHT 22 and Light Dependent Resistor (LDR) to measure the room environment which included room humidity, room temperature, and light intensity. While the heart rate, body temperature and body movement are measured by using pulse sensor, thermistor and accelerometer which work together with BLUNO NANO.

For software part, Arduino IDE is used to program the NodeMCU ESP8266 and BLUNO NANO so that the sensor reading can be transferred to Blynk Application via Wi-Fi connection.

From the Blynk app, the token was given and need to attach in Arduino IDE to make the Blynk App function well. Sketch up is used to design the prototype for the circuit of ambient monitoring system. The body monitoring system is placed on a wearable stripe so that user can be wearing it on the chest to measure the rate of heart, body temperature and movement of sleep when in sleep.

1.5 Project Significance

In this modern world, most of the people are always busy with their own work and hectic lifestyles that cause people to neglect their own physical and mind health. Sleep is very important in maintaining health, but people nowadays keep on avoiding having a quality sleep as they did not have enough time to manage all their work. Sleep monitoring system will monitor the surrounding environment where the user sleep and their body condition while sleeping. With the data collected, user can know whether they get enough quality sleep or the surrounding environment of their room affecting their sleep. As a result, this device can help people in self-health transform as they can change their sleeping habit or the surrounding environment that prevent from getting a quality sleep every night.