Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF SMART HEALTH MONITORING SYSTEM UTILIZING INTERNET OF THINGS (IoT) AND ARDUINO

AMEYSHAFIDA BINTI MIHAT

Bachelor of Electronics Engineering Technology with Honours

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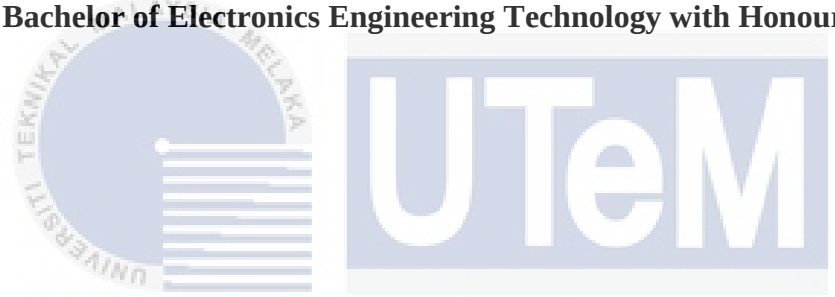
A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electronics Engineering Technology with Honours



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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI TEKNOLOGI KEJUTERAAN ELEKTRIK DAN ELEKTRONIK

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I declare that this project report entitled “Development of Smart Health Monitoring System Utilizing Internet of Things (IoT) and Arduino” is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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DEDICATION

My heartfelt gratitude goes out to my adoring parents, siblings, and friends who have always been by my side and encouraged me to successfully finish my final year project. Meanwhile, I dedicate my thesis to my dear supervisor, TS. DR. NORHASHIMAH BINTI MOHD SAAD, who has imparted invaluable knowledge to me through the process of successfully finishing my final year project. Many thanks. I'm grateful. I am humble and grateful for their willingness to make this endeavour possible via their sacrifice, tolerance, and thoughtfulness. I was at a loss for words to convey my appreciation for their commitment, support, and faith in my abilities to accomplish my goals.

ABSTRACT

The use of healthcare monitoring systems in hospitals and other health facilities has grown exponentially, and portable healthcare monitoring systems based on new technologies haveemerged as a severe concern in a number of countries throughout the globe. The emergenceof Internet of Things (IoT) technology has contributed in the progress of healthcare from face-to-face counselling to telemedicine. Nowadays, many Internet of Things (IoT) application are also being developed. So now the doctor or family members can monitor or track the patient's health through the Android application. When need to monitor, record and monitor changes in patient health parameters over time, Internet of Things (IoT) monitoring comes in handy. The construction of this database of health parameter changes uses Internet of Things (IoT) health tracking. This paper suggests a system of smart health monitoring system in an Internet of Things (IoT) ecosystem capable of monitoring patients'basic health information. The project aims to design a reliable health monitoring system using Internet of things (IoT) that can be used to measure and track various parameters for instance body temperature, heart rate and level of oxygen in the blood in both hospitals and homes. What makes the project unique than the other innovation, the system is capable to verify that the transmission of the sensor's data to the host computer is done in real time. Overall, this system demonstrated a high level of accuracy, with 99.9 percent accuracy for measuring body temperature, 99.4 percent accuracy for measuring heart rate, and 99.9 percent accuracy for measuring blood oxygen levels. This developed system provides many facilities for medical staff and families to perform the process of health measurement or monitoring, whether at home or in the hospital.

ABSTRAK

Penggunaan sistem pemantauan penjagaan kesihatan di hospital dan kemudahan kesihatan lain telah meningkat dengan ketara, dan sistem pemantauan penjagaan kesihatan mudah alih berdasarkan teknologi baru kini menjadi perhatian utama bagi banyak negara di seluruh dunia. Kemajuan penjagaan kesihatan dari terus bersemuka ke aplikasi secara talian atau maya telah dibantu oleh pengenalan teknologi "Internet of Things (IoT)". Pada masa kini, aplikasi "Internet of Things (IoT)" juga sedang berkembang pesat. Dengan kemajuan teknologi ini, doktor dan ahli keluarga dapat memantau dan mengesan tahap kesihatan dengan mudah melalui aplikasi di telefon pintar. Untuk membuat pemantauan, penyimpanan data, dan pemantauan perubahan dalam parameter kesihatan pesakit dari masa ke masa, "Internet of Things (IoT)" dilihat sangat berguna bagi menjalankannya. Pembinaan pangkalan data perubahan parameter kesihatan ini terbukti berjaya dibina dengan menggunakan teknologi kesihatan "Internet of Things (IoT)". Oleh itu, kertas ini mencadangkan pembinaan pemantauan kesihatan pintar dalam persekitaran "Internet of Things (IoT)" yang dapat memantau dan mengukur gejala kesihatan asas pesakit. Projek ini bertujuan untuk merancang sistem pemantauan kesihatan yang boleh dipercayai menggunakan "Internet of things (Iot)" yang dapat digunakan untuk mengukur dan mengesan pelbagai parameter seperti suhu badan, degupan jantung dan paras oksigen dalam darah tidak kira sama ada digunakan di hospital atau di rumah. Apa yang menjadikan projek ini unik daripada inovasi lain, sistem ini dapat mengesahkan bahawa penghantaran data sensor ke komputer host dilakukan dalam masa nyata. Secara keseluruhannya, sistem ini menunjukkan tahap ketepatan yang tinggi, dengan ketepatan 99.9 peratus untuk mengukur suhu badan, ketepatan 99.4 peratus untuk mengukur kadar denyutan jantung, dan ketepatan 99.9 peratus untuk mengukur tahap oksigen darah. Sistem yang dibangunkan ini menyediakan banyak kemudahan untuk kakitangan perubatan dan keluarga melakukan proses pengukuran atau pemantauan kesihatan sama ada di rumah mahupun di hospital.

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All praise is due to Allah, the Most Generous and Merciful, who has bestowed upon me the strength and intelligence necessary to achieve this endeavour. Without his blessings, my whole effort to generate ideas for this endeavour would have failed miserably.

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Finally, I want to say thank you to everyone in my class, as well as everyone else who helped and worked with me.

Many thanks to everyone. It is greatly appreciated.

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LIST OF SYMBOLS

nm	-	Nanometer
V	-	Volt
mV	-	MiliVolt
A	-	Ampere
C	-	Celcius

LIST OF ABBREVIATIONS

JSON File	-	JavaScrips Object Notation
TCP/IP	-	The Internet Protocol Suite
HTML	-	Hypertext Markup Language
IoT	-	Internet of Things
WPAN	-	Wireless Personal Area Network
MQTT	-	Massage Queuing Telemetry Transport
HTTP	-	Hyper Text Transfer Protocol
TLS	-	Transport Layer Security
LCD	-	Liquid Crystal Display
AC	-	Analog Current
DC	-	Direct Current
V	-	Voltage
A	-	Current

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter will set the stage for the remainder of the project, which will include the development of a Smart Health Monitoring System utilising the Internet of Things (IoT) andArduino. This project is a wireless healthcare monitoring gadget that can detect andwirelessly transmit the pulse rate, temperature, and oxygen saturation level of the blood to the host computer. This chapter discusses the project's context, problem description, aim, and scope.

1.2 Background

Rather than merely the absence of sickness, health is defined as a full condition of physical, emotional, and social well-being. Individuals' aspirations for a better life are inextricably tied to their health. Regrettably, global health crisis has produced a paradox as a result of a variety of causes, including insufficient health care, enormous divides between rural and urban regions, and physician and nurse shortages at important periods. The Internet of Things (IoT) has connected every thing inside during the previous decade, and it has been labelled the next technological revolution. The Internet of Things is most widely used in healthcare management, where it is used to monitor health and environmental factors. The Internet of Things (IoT) is the process of establishing a connection between computers and the internet using sensors and networks. These interlinked components might be utilised in health surveillance systems. Modern technologies now include a customizable interface,

personal assistant gadgets, and mental health care to aid individuals in living more intelligent lives.

Approximately 6.4 million Malaysian individuals today have high blood pressure or hypertension, and some are unaware they have the ailment. According to the 2019 National Health and Morbidity Survey (NHMS), there are 6.4 million persons with high blood pressure, with an estimated 3.4 million already aware, and the remainder unaware. According to him, this statistic is quite concerning for the Malaysian Ministry of Health (MOH). When the proportion of hypertension is compared to the previous year, there is a minor decrease of 30% in 2019 compared to 32.7 percent in 2011. Malaysia, on the other hand, has a greater prevalence of hypertension than the world norm and is among the highest in the Asean region. Additionally, the prevalence of hypertension rises with age. As a result, it is necessary to build new high-tech methods to overcome this limit.

Additionally, given the country's present predicament with the Covid-19 virus, monitoring the quantity of oxygen in the blood is critical today. Typical SpO2 readings vary according to an individual's age, ethnic origin, and health, but a value of 95-99 percent is considered normal for a healthy person. There are instances of oxygen intoxication with 100% SpO2, however this occurs primarily in hospitals when the patient is on a continual supply of oxygen due to a specific treatment. When a patient receives an excessive quantity of oxygen, pulmonary toxicity ensues, which may have a detrimental effect on the central nervous system (Graves, 2011). Reduced oxygen levels may potentially be fatal, since organs may become oxygen-depleted when oxygen levels fall below 90%. Hypoxemia occurs often when the human body's tissues and cells are deprived of oxygen.

As a result, the usage of in hospitals and other health institutions, healthcare monitoring systems has significantly enlarged, and new technology-enabled portable healthcare monitoring devices have become a serious issue in a number of nations worldwide. The emergence of Internet of Things (IoT) technology has contributed in the progress of healthcare from face-to-face counselling to telemedicine. Numerous Internet of Things (IoT) applications are also being developed at the moment. Thus, doctors and family members may now monitor or follow a patient's health using the Android application. When monitoring, recording, and tracking changes in patient health metrics over time becomes necessary, Internet of Things (IoT) Monitoring comes in helpful. This database of health parameter changes was created using Internet of Things (IoT) health monitoring. This article presents a smart health monitoring system that can monitor patients' fundamental health symptoms in an Internet of Things (IoT) environment. This device may be used in both hospitals and households to monitor and record numerous factors such as body temperature, heart rate and blood's oxygen level. This is a large sensor-based project using cutting-edge technologies.

1.3 Problem Statement

Health monitoring is a significant concern in today's climate. Patients have serious health difficulties as a consequence of an insufficient health monitoring system. The new health monitoring system is unable to deliver real-time patient health warnings and is constrained by the distance between the patient and the hospital. Additionally, the new technique requires time to collect data from patients. Besides, it is inefficient in terms of cost. A low-cost contemporary gadget capable of providing real-time data. As a result, various Internet of Things (IoT) gadgets are now available that may be used to remotely monitor and regulate a patient's health. Health care workers are increasingly using these intelligent gadgets to monitor their patients. The primary reason for developing this

system is to address the absence of effective health monitoring in community life, the disparity between rural and urban health care centres, and the inability of the present health monitoring system to give real-time patient health alerts.

1.4 Project Objective

i. To design a reliable health monitoring system using Internet of things (IoT).

ii. To analyze the measurement of the health monitoring system based on body temperature, heart rate and level of oxygen in the blood.

iii. To verify that the transmission of the sensor's data to the host computer is done in real time.

1.5 Scope of Project

The following are the specifics of this project's scope:

a) The ultimate aim of this project is to create a prototype that can meet the above-mentioned goals.

b) The project's aim is to create a prototype of a healthcare monitoring device that can detect and wirelessly transmit a human body's temperature, pulse rate and the level of oxygen in the blood to a host PC.

c) The health-monitoring equipment created here is an Internet-of-Things (IoT) system. It's based on the Arduino UNO.

d) The Arduino UNO is a common prototyping board that is often used in Internet of Things projects.

e) To develop this medical IoT system, the Arduino is utilised to link the pulse LM-35 temperature sensor, MAX30100 pulse oximeter, character LCD, and ESP8266 Wi-Fi modem.

f) The computed pulse rate, temperature, and oxygen saturation level in the blood are shown on the character LCD attached to an Arduino and sent to the cloud platform through a Wi-Fi access point.

g) On a regular basic, health-related data such as pulse rate, body temperature, and blood oxygen saturation level are updated and recorded to the ThingSpeak platform. The data may be utilised to maintain a patient's medical history.

1.6 Outline of the Project

Chapter 1: Introduction

This chapter summarises the project that will be detailed in the remainder of the report. Thatis the background of the project. This section will describe the project's introduction, whichincludes an overview, a report of issues, the study's objectives, and the scope of work.

Chapter 2: Literature Review

This chapter summarises ideas, experimental studies, and some key findings from prior research that are pertinent to the present endeavour. Additionally, the study will be summarised.

Chapter 3: Methodology

Chapter 3 goes into further depth on the strategy and plan for accomplishing the goals. Thischapter will discuss control theory and demonstrate how to use it. Each step has its own technique, as does the overall project's flow chart.

Chapter 4: Result, Analysis, and Discussion

This chapter discusses the illustrations and graphs accompanying the experiments shown inthe images, as well as the study's findings.

Chapter 5: Conclusion and Recommendation

Chapter 5 summarises the trial's findings as well as the project's critical milestones. Additionally, this chapter makes some suggestions for future growth and improvement. Suggestions for further research are also being prepared for potential innovators.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The objective of this chapter is to conduct a literature evaluation of prior projects and research conducted by other specialists that are relevant to the development of a smart health monitoring system using the Internet of Things (IoT) and Arduino. This project presents a smart health monitoring system that can monitor patients' fundamental health symptoms in an Internet of Things (IoT) environment. This device may be used in both hospitals and households to monitor and record numerous characteristics such as body temperature, heart rate, and blood oxygen saturation level. This is a significant sensor-basedproject that incorporates cutting-edge technologies. By using this method, it is possible to contribute to the community's disease prevention efforts. Users will be able to check their health in order to avoid contracting or being afflicted by any unanticipated ailments.

2.2 Previous Research Paper

From the previous study, [1] proposed paper IoT based Patient Health Monitoring using ESP8266. The study objective was to construct a health monitoring system, which detects body temperature and heart rate, to construct a system for storing patient data in the cloud over time, and to conduct analysis on the sensor data acquired. The suggested solution incorporates health care security and the cloud of things. The system is divided into two key stages which are storage and data retrieval. Data is kept and modified at the