# DESIGN AND ANALYSIS OF IOT-BASED WIRELESS HEALTHCARE MONITORING SYSTEM

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

# DESIGN AND ANALYSIS OF IOT-BASED WIRELESS HEALTHCARE MONITORING SYSTEM

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**This report is submitted in partial fulfilment of the requirements for the degree of Bachelor of Electronic Engineering with Honours**

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# DEDICATION

Specially dedicated to my family, supervisor and my friends that help me to finish up my final year project report.

# ABSTRACT

Nowadays technology plays an important role in the healthcare system, not for health parameter measurement, but also in communication, monitoring and storing. The main objective of this system is to continuously track patient health condition and use internet platform to display the information through the cloud. The project uses an Arduino controller to collect patient health information. It uses temperature and pulse sensor to provide real-time monitoring for the doctor. Both sensors and RF transmitter will be attached with controller board that needs to be worn by the patient for continuous monitoring. These data will be collected by another RF receiver and Arduino controller that will send data to the server using the internet. From the IoT platform, the data can be accessible by the doctor through the web page. If the system detects any abrupt changes to the patient temperature and heartbeat, it will send push notification to the doctor smartphone about the condition. At the end of the project, an analysis was conducted to test the performance of the project that covers sensor accuracy and wireless transmission strength.

# ABSTRAK

*Teknologi memainkan peranan yang penting dalam industri kesihatan yang merangkumi sistem komunikasi, pemantauan dan penyimpanan. Tujuan utama projek ini ialah untuk memantau kesihatan pesakit secara berterusan dan menggunakan internet untuk memaparkan informasi tersebut. Projek ini menggunakan pengawal Arduino untuk mengambil status kesihatan pesakit. Ia menggunakan penderia suhu dan penderia nadi untuk memberikan pemantauan tahap kesihatan pesakit kepada doktor. Kedua-dua penderia dan penghantar RF disambungkan ke pengawal Arduino akan dipakai oleh pesakit untuk mendapatkan mengukur setiap data yang diperoleh. Kesemua data ini kemudian akan diambil oleh penerima RF dan pengawal Arduino yang akan menhantar data tersebut ke sistem pelayan menggunakan internet. Dari platform IoT, data ini dapat diakses oleh doktor melalui laman sesawang. Sekiranya sistem tersebut mengesan perubahan yang mendadak terhadap status kesihatan pesakit iaitu suhu badan dan nadi denyutan, notifikasi akan dihantar ke telefon pintar doktor untuk makluman. Di akhir projek ini, analisis terhadap data akan dibuat untuk menguji prestasi sistem yang merangkumi ketepatan penderia dan kekuatan penghantaran tanpa wayar*

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# LIST OF SYMBOLS AND ABBREVIATIONS

| | | |
|---|---|---|
| IoT | : | Internet of Things |
| ECG | : | Electrocardiogram |
| RF | : | Radio Frequency |
| ADC | : | Analog-to-Digital Converter |
| DAC | : | Digital-to- Analog Converter |
| IP | : | Internet Protocol |
| LCD | : | Liquid-crystal display |
| PDA | : | personal digital assistant |
| GSM | : | Global System for Mobile Communications |
| BPM | : | Beat Per Minute |
| IC | : | Integrated Circuit |
| WLAN | : | Wireless Local Area Network |
| HTML | : | Hypertext Markup Language |
| PHP | : | Hypertext Preprocessor |
| MYSQL | : | My Structured Query Language |
| PCB | : | Printed Circuit Board |

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# CHAPTER 1

# INTRODUCTION

## 1.1 Project Background

Nowadays, technology becomes an important role in the healthcare system which can be used to monitor health parameters. In a hospital, continuous monitoring of patient's health is required in order to get their health conditions [1]. Besides that, studies show that nearly up to 90% of all alarms system in hospital for patient in a critical situation are not actionable[2]. This is due to the beeping of medical devices that fades into the background and many alerts sound that can cause medical errors. The uses of technology can improve medical system with sensory devices where the data can be stored and processed in cloud system.

Internet of Things (IoT) can be used in the healthcare system to do monitoring and store medical information. IoT refers to the number of physical devices connected to

the internet that share data with other elements. IoT healthcare devices are able to get health parameters such as glucose level, blood pressure, heartbeat rate, body temperature, and body temperature using sensor devices[3]. 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.

Recently, internet has become a major impact in healthcare and other industries that use wireless technology. These technologies can be expanded widely to properly integrated with hospital system[4]. For example, the uses of Wi-Fi network can make data collected from each patient store in cloud system with the proper database system. Besides, RF and Bluetooth transmission also can be used in the healthcare system for short transmission that allows a wearable monitoring system to be implemented. Hence, this wireless evolution affects the healthcare industry since it can provide latest treatment plans for patients.

## 1.2 Problem Statement

Challenge in healthcare system covers data management where IBM study shows that almost 80 percent of health data collected in 2015 were not organized in a pre-defined manner[5]. The data were not arranged properly in a system due to storage issues by the medical world. It also can be concluded, most of the patient records in hospitals were not handled properly due to the system were paper-based. The lack of a healthcare system to track patient's past record can affect the treatment process[6].

Nowadays in health institution, there were many patients admitted with different type of diseases. This condition requires a lot of time since the doctor or physician need to monitor each patient carefully. Besides, the monitoring system used in a

hospital requires constant supervision by the nurse or a doctor near the patient. This is due to the monitoring device only provide alert with a beep sound when the patient condition is critical. The system is not integrated with networking which causes delay to treatment. Furthermore, monitoring equipment's used at hospital mostly are wired connection which can cause limited mobility to the patient.

Based on World Health Organization analysis, it stated that heart disease responsible for 17.9 million death in 2016[7]. World Health Organization analysis of diabetes also show that up to 1.6 million death occurs in 2015[8]. These diseases can be prevented in the early stage with continuous monitoring pulse rate, glucose level and other parameters of a patient. However, with the current medical checkup only take place once a month and depend on doctor availability which causes delay action to prevent it.

## 1.3 Project Objective

The objectives of this project are:

i. To develop and design a system that can sense patient health parameter and transmit data wirelessly integrated with Internet of Thing platform for monitoring and notification process.
ii. To analyze the performance of the system for sensor accuracy and wireless transmission strength.

## 1.4 Scope of Work

This project will focus on developing healthcare monitoring system using Arduino board as a controller, RF transceiver for short-range communication, Wi-Fi module for Internet access, smartphone for push notification and sensors to detect patient

temperature and heartbeat. The project will use two health parameter sensors, which are temperature sensor and pulse sensor. For IoT platform, the project uses a Wi-Fi module for monitoring process and android application for notification alert. Development of each hardware module connected with the controller board for input and output operation will be created.

On software development, the project will cover C language coding to be uploaded into Arduino board and AT command for Wi-Fi and RF transceiver setup. Besides that, by using PHP and MYSQL language, a web page will be created to collect health parameter data from the sensor and store through the cloud system. For the notification system, an Android application will be created using Android Studio. Next, an analysis will be made to check sensor accuracy and wireless transmission strength. A comparison will be made for both sensors to check the percentage of error with real measurement devices. Besides that, for wireless devices which is RF transceiver, an analysis will be conducted to test transmission distance with power transmit.

## 1.5 Project Outline

Chapter 1 briefly explains the background of the project and the healthcare system. This part including problem statements, objectives of the project, scope of works in completing the project.

Chapter 2 came along after chapter 1 is completed. In this chapter, it discusses the literature review where it includes all the research and technical papers related to this project. Past research included results, circuit design, type of sensor used and IoT platform. Then, enclosed of chapter 2 will be implemented in the next chapter.

Chapter 3 describe a complete methodology that is used in project implementation. Methodology part discussed the programming language to be used to communicating with Arduino controller and sensor calibration and calculation

Chapter 4 present all data and results get from doing the analysis. All the results and finding will be discussed and observed in this chapter. The results for the analyzed performance of the system using a suitable diagram will be presented in this chapter.

Chapter 5 will describe suggestions and future works based on the completed project. This will sum up all the conclusion of the process occurs throughout completing this thesis report.