CHAPTER 1

INTRODUCTION

1.1 Background

In 2020, COVID-19 has changed the way our civilization lives. In this pandemic situation, people have been introduced to social-distancing protocol, which restricted any direct contact activities. Meanwhile, digital technology has grown and proved to be useful to provide necessary public services during COVID-19 pandemic situation [1]. Digital technology helps people to stay connected remotely and gain access to multiple platforms such as digital telecommunication and the Internet of Things.

With the rise of digital technology and internet of things, some of the problems that people face during COVID-19 can be solved. One of the problems is the difficulty to access the healthcare facility. The role of the healthcare facility is very important especially during the COVID-19 crisis [2]. Unfortunately, people are being forced to stay at home, unless for necessary purposes. At the same time, some healthcare facilities are used as COVID-19's care center, which means those areas are red zones for healthy people. Therefore, telemedicine technology will become very useful to help people gain access to healthcare facilities remotely.

The current telemedicine technology that can be found in our society is the technology which provides people with access to video conference with their doctor. There is another telemedicine technology such as remote healthcare devices, which are used for remote healthcare data transmission, but this technology is quite expensive and

only can be found in hospitals. Therefore, a cheaper and more accessible remote healthcare device is required to provide healthcare services through all circles of society.

During pandemic, data such as oxygen saturation (SpO_2) is the data used to determine a person have a possibility of being exposed to COVID-19. There is plenty of SpO_2 sensor on the market known as a pulse oximeter and it comes with heartbeat sensor as well. Our society is now facing a problem on how to send the healthcare data that has been obtained from their device to their doctor. Usually, people write the data down on a piece of paper and verbally informed their doctor through the video conference, but with the help of telemedicine, this problem now can be solved.

With those ideas and considerations, this research aims to develop a prototype of a telemedicine system using MAX30100 and a non-invasive blood glucose sensor integrated into IoT and Android apps which helps users to have access to healthcare services remotely during COVID-19 crisis.

1.2. Aims and Objectives

The ultimate goal of this research is to develop a simple telemedicine system based on IoT and Android app that can be used as a remote health monitoring system, where the data from the monitoring system can be sent directly to a specific doctor via e-mail. The main component of this device includes the pulse oximeter sensor (MAX30100) and a non-invasive blood sugar sensor using NIR LED. Those sensors are connected to WEMOS D1 MINI as the microcontroller and act as both data transmitter and receiver as well. The Firebase is used as a real-time and cloud database to store the sensors' data.

The Android application is built with the Flutter framework, which is also connected to the firebase so it can be used to obtain and present the data to the user.

1.3. Scope of The Research

This research is limited to designing the devices, sensor calibration, collecting data, developing the Android app with a feature that enables user to receive and send sensor's data to their doctor via e-mail. The expected result of this research is the sensors will have accuracy of 96% or more and the Android app can collect and present the data from the real-time database to the user and to send the data to the registered doctor email address.

1.4. Research Method

The research method is separated into three sections, the first section includes literature studies, designing the prototype circuit of the hardware system where data can be collected, calibrating and comparing the sensors with commercial devices, and developing the Android application. The next section includes troubleshooting and collecting data to find the best result on the sensor. The final section involves troubleshooting the Android app and add features including the user login system, the app's UI, and troubleshooting the IoT system to make sure the sensors have high stability on reading data as well as having less delay in transmitting data from hardware to the app.

1.5. Thesis Structure

This thesis is divided and organized into six chapters which are as follows:

a) **Chapter 1**

This chapter contains the introduction which includes the background, aims and objectives, scope of the research, research method, and thesis structures. This chapter involves the focus of the research.

b) **Chapter 2**

This chapter discusses the theory which underlies the research such as Beer-Lambert Law as the working principle of MAX30100 and non-invasive blood sugar sensor, Flutter framework, and the usage of firebase cloud database as IoT data storage.

c) **Chapter 3**

This chapter presents the overall research method and detail of the system framework on telemedicine prototype.

d) **Chapter 4**

This chapter presents the process of designing the Telemedicine system based on IoT and Android app. It starts with designing and calibrating the pulse oximeter sensor and the non-invasive blood sugar sensor circuit, designing the communication system between the sensors, Firebase, and Android app, developing the Android app, and creating the app's IoT system and feature that allows users to have access to send the data to the doctor via email.

e) **Chapter 5**

This chapter present the data and analysis related to the sensor and Android app as well as the troubleshooting that occurred while doing the research.

f) Chapter 6

This chapter concludes the thesis and advice on future related research.