IOT BASED DEVICE FOR SELF-MONITORING OF COVID-19 PATIENT

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DEDICATION

I dedicate this thesis to my parents, who have always believed in me and my abilities. Their unwavering love and support throughout my education has been a constant source of motivation for me. Without their sacrifices and encouragement, this accomplishment would not have been possible. I will always be grateful for their guidance and for the sacrifices they have made for me. I also dedicate this thesis to my supervisor, DR Anis Suhaila Binti Mohd Zain, who has been an invaluable mentorand friend throughout my final year project journey. Her expertise and knowledge in the field has been essential to the success of this project. I would like to thank her forher patience, guidance and for always being available to answer my questions. Withouther support and encouragement, this thesis would not have been possible. Finally, I would like to express my gratitude to my friends who have supported me throughout this final year project journey. Their encouragement, feedback and friendship have been invaluable. I will always be grateful for the role they have played in helping me reach this goal.

ABSTRACT

The current COVID-19 pandemic has made many impacts to the world. The rate of infection of the COVID-19 virus increased, leading to an increase in the number of positive cases of COVID-19 reaching thousands of patients. Due to the suddenincrease in positive cases in the short term, the hospital has to limit the use of medicalfacilities to the “red zone”. Patients are required to do their own home examination, where they need to spend a dollar to buy two different devices to take health readings.In addition, the hospital has a shortage of doctors and nurses to conduct patient-centred examinations. Tracing the modern state of technology 4.0, medical technology was created to help address the number of patients in the hospital. This technology is called self-monitoring that can be done alone at home. The project's first objective was to introduce a device that included pulse rate sensors, oxygen levels and temperature sensors. The second objective of the project is to make it easier for the medical team to serve patients easily by using BOT Telegram as a medium of communication between the medical team and the patient.

ABSTRAK

Pandemik COVID-19 saat ini telah memberikan pelbagai impak kepada dunia. Kadar keberjangkitan virus COVID-19 meningkat menyebabkan penambahan bilangan kes positif COVID-19 mencecah ribuan pesakit. Disebabkan kenaikan kes positif secara mendadak dalam jangka masa pendek,Pihak hospital terpaksa menghadkan kegunaan fasiliti perubatan kepada pesaki yang berada dalam ruanga yang dikenali "red zone". Para pesakit dikehendaki membuat pemeriksaan sendiri di rumah, dimana perlu mengeluarkan wang ringgit untuk membeli dua device yang berbeza untuk mengambil bacaan kesihatan. Selain itu, pihak hospital mengalami kekurangan doktor dan jururawat untuk melakukan pemeriksaaan keatas pesakit. Menyelusuri arus kemodenan teknologi 4.0, teknologi perubatan dicipta bagi membantu menangani jumlah pesakit di hospital. Teknologi ini dipanggil self-monitoring yang boleh dilakukan secara sendirian di rumah. Objektif pertama projek ini memperkenalkan sebuah device yang merangkumi sensor kadar nadi, kadar oksigen serta sensor suhu. Obejktif kedua projek ini adalah memudahkan pihak pasukan perubatan melayani para pesakit secara mudah dengan menggunakan BOT Telegram sebagai medium komunikasi antara pihak pasukan perubatan dan pesakit.

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CHAPTER 1

INTRODUCTION

1.1 Project Background

The COVID-19 pandemic is currently one of the largest in the world problems faced by medical institutions. From November 19, 2020, it said that the total number of people in the world has been confirmed. More than 56.4 million people are infected with SARS-COV-2, and the total number of deaths from coronavirus is 1.35 million people proving that the number of COVID-19 cases is increasing rapidly worldwide [1]. Independent and convenient, healthy living is the aim of any human being irrespective of age, gender, location, or health status. However, there are limitations due to age, illness, medication, hospitalization, epidemic, pandemic, and alternative circumstances. Health-watching systems have evolved to help the convenient healthy living, additional accessible communication between healthcare givers and patients for close monitoring, the measure of important health parameters, routine consultation, and overall healthy living. Moreover, with the recent advances in info and communication technologies (ICT) through the adoption of the net of Things (IoT) technology, smart health monitoring, and support systems currently have the next fringe of development and acceptableness for increased healthy living [2].

COVID-19 patients experience a variety of symptoms, including fever, shortness of breath, a drop in oxygen saturation, a dry cough and diarrhea, vomiting, sore throat, headache, loss of taste and smell, and body pain as well as abnormal pulse rate. High fever, low oxygen saturation level, and abnormal pulse rate are all considered serious symptoms. Hypoxemia and hypoxia are caused by low oxygen saturation levels and shortness of breath, respectively. Patients with hypoxemia and pulse rate issues have a lower chance of survival. Sometimes patients fail to recognize hypoxemia and an increasing rate of pulse and they die as a result of not receiving proper treatment. As a result, COVID-19 patients must be kept up to date on their health status, particularly their body temperature, heart rate, and oxygen saturation (SpO2) [1].

The health department advises that every citizen should undergo a health screening when they reach the age of 18. This is because an early examination can detect early signs of a health condition before experiencing any physical symptoms. During the COVID-19 pandemic, the health department advises that every citizen is required to carry out self-exams as often as possible. This is because it can help in reducing contagion among humans when patients can detect early signs of COVID-19.

The parameters taken during the COVID-19 examination are heart rate, oxygen level, and body temperature. Heart rate is the number of heart beats per minute, also known as pulse rate. Calculating the pulses can be used to measure the pulse rate by increasing the blood flow volume. Healthy people have a heart rate that ranges between 60 and 100 beats per minute. Adult males typically have a restful heart rate of 70 bpm, while adult females have a restful heart rate of 75 bpm [3]. Particular care should be taken when self-monitoring vital parameters such as blood oxygen saturation (SpO2), the abnormal values of which are warning signs of a possible COVID-19 infection [4]. When assessing a person for COVID-19, body temperature the most typical COVID-19 symptoms is a fever or a raised body temperature, whichcan be a sign that the body is battling an infection. Table 1 shows the symptoms that need to take care of by the patient during COVID-19. While table 2 shows the symptoms of COVID-19 with category with analysis that has been found in these fewyears.

Table 1: Patient diagnoses with COVID-19

Mild Disease	Moderate Disease	Severe Disease
• Fever/ Symptoms of upper respiratory tract infection • SpO2 ≥ 97% on room air	• Symptoms of pneumonia with RR ≥ 24 minute • SpO2 ≤ 94% on room air	• Respiratory disease requiring mechanical ventilation. • SpO2 ≤ 90% on room air.

Table 2:Symptoms of COVID-19 with category

Category	Symptoms
1	Asymptomatic
2A	• Sore throat/ cold • Cough • Loss of sense of taste • Loss of sense of smell

	• No fever • No difficulty breathing • Diarrhea twice in 24 hours • Nausea and vomiting • Fatigue • Muscle aches and pains
2B	• Fever/ onset of fever for more than two days • Shortness of breath when exerting yourself • Chest pain • Loss of appetite • Fatigue while doing daily activities or after waking up • Requires walking assistance • Increasing severity of symptoms (e.g., persistent cough, nausea, diarrhea) • Decreased level of consciousness • The gradual decrease in urine output over 24 hours
3	• Some breathing issues
4	• Requires oxygen support
5	• Needs intubation/ ventilator

The Internet of Things (IoT) offers new opportunities for applications such as smart cities and smart healthcare. Currently, the main uses of IoT in healthcare are remote monitoring and real-time health systems. In a time of crisis, such as the COVID-19 pandemic in 2020, IoT systems can help manage and control situations without imposing drastic restrictions on individuals and industries [5].

The proposed device integrates a temperature sensor and a heart rate sensor. It is designed to monitor body temperature, pulse rate, and oxygen saturation. It utilizes Telegram as a communication platform between COVID-19 patients and medical staff or healthcare personnel that can access and update a database containing information on registered patients. Through this platform, medical staff can provide instructions and guidance to both COVID-19 and post-COVID-19 patients.

1.2 Problem Statement

The problem statement is a crucial element of any project or research study, as it helps to define the scope of the work and serves as a clear and focused guide for solving the problems at hand. By accurately identifying and describing the problem orissue, the context in which it occurs, and its impact on stakeholders, a well-written problem statement can provide a clear and concise foundation for the project or study.

The rapid increase in daily active cases of COVID-19 is causing widespread concern globally and Malaysia is no exception. With over 30,000 daily active cases, the country is facing significant challenges in managing the pandemic. Two issues have been identified that contribute to this situation which are the lack of affordable and multi-functional health devices and the shortage of medical personnel to assist all patients. These issues highlight the urgent need for solutions to effectively manage the COVID-19 pandemic in Malaysia.

One of the driving factors behind this project is the lack of affordable and multi-functional health devices on the market. Currently, individuals must purchase separate devices to measure body temperature, pulse rate, and oxygen saturation, which can be expensive. As a result, patients must spend money to purchase multiple devices to track their daily health status. This inspired the proposal for a single device that can measure all these vital signs.

Another issue that this project aims to address is the shortage of medical personnel available to assist all patients. Hospitals and clinics frequently receive a large number of patients in a single day and the lack of staff to conduct health checks can lead to medical personnel working overtime, especially during the COVID-19 pandemic. This can increase the risk of infection during hospital or clinic visits, contributing to the rise in daily cases of COVID-19. This issue is particularly relevant in Malaysia as highlighted by several articles discussing the country's shortage of medical personnel.

1.3 Objective

Achieving the objectives of this project is crucial to its success and serves as a guide throughout the project to ensure the desired goals are met. The first objective is to design a prototype of an embedded device that can simultaneously measure body temperature, oxygen saturation, and pulse rate. The second objective is to create an IoT communication platform using a Telegram BOT for patient data stored in a database. Through this platform, doctors can also send messages to patients about their health status.

1.4 Scope of Work

For this project, we need to use some hardware and software. The hardware includes an ESP 32 microcontroller, an Infrared Temperature Sensor to measure body temperature, a Pulse Oximeter Sensor to check pulse rate and oxygen levels, and a mobile phone for the Telegram app. The software we will use is the Arduino IDE to code the ESP 32 microcontroller.

1.5 Thesis Outline

This report is organized into five parts, each of which discusses a specific aspect of the project.

Chapter 1 provides an overview of the project, including the project background, problem statement, objectives, and scopes of work. Chapter 2 reviews similar projects that have been undertaken including their objectives and outcomes. Chapter 3 outlines the methodology used in this project, including the hardware and software used in this project. Chapter 4 presents the results of the project, including data analysis of measurements such as body temperature, heart rate, and oxygen saturation. Chapter 5, summarizes the entire project and future work that can upgrade this project easier to use and give an advantage to the people.

CHAPTER 2

BACKGROUND STUDY

Revolution 4.0 is a technological revolution incorporating automation that presents new challenges to the national economy. Automation, the Internet of Things (IoT), analytics and big data, simulation, systems integration, robots, and the cloud are some of the technologies that will help the country progress further. This new technology has the potential to solve issues in every sector of the country, as well as to develop the country and transform the country's future in the world of work. This technology has several advantages, particularly in the health industry. The technology intended for the health industry is where this technologymay assist and relieve doctors' burdens in managing patient examinations. Duringthe COVID-19 isolation phase, this equipment may remotely monitor and examinepatients. It can help physicians work quicker and avoid face-to-face interactions.