ISOEVA-2022

6th INTERNATIONAL SYMPOSIUM OF EDUCATION AND VALUES

(6. ULUSLARARASI EĞİTİM VE DEĞERLER SEMPOZYUMU)

27-30 Ekim/October 2022

Kemer/ANTALYA

TAM METİN KİTABI

(FULL TEXT BOOK)

ISBN: 978-605-73901-6-5

KORİNT YAYINCILIK

IoT-BASED LONG COVID DEVICE & MONITORING SYSTEM

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ABSTRACT

IoT-based health monitoring solutions have the potential to be extremely valuable for COVID-19 patients throughout the epidemic. This research provides an IoT-based system for real-time health monitoring that employs measured values of a patient's body temperature, pulse rate, and oxygen saturation, which are the most significant critical care indicators. The device has a liquid crystal display (LCD) that shows the current temperature, heart rate, and oxygen saturation level, and it can be readily synced with a mobile app for quick access. Among the commercially available Arduino boards are the Uno, Due, Mega, and Leonardo. The Arduino Uno features 20 I/O pins, 14 digital and 6 Analogue. The Arduino Due is equipped with 54 digital I/O pins, 12 analogue I/O pins, and two analogue output pins. The Arduino Mega has 54 digital I/O pins, 16 analogue inputs, and no output pins. The Arduino Leonardo has 20 digital I/O pins, 12 analogue input pins, and no output pins. Because of its pin configuration, I chose the Arduino Uno as the system's main controller. It is a well-known open-source microcontroller board based on the ATmega328p. The proposed Internet of Things technique is based on an Arduino Uno system and has been tested and validated on five human testers. To diagnose patients remotely, the user must pair the device with their phone and use the apps. The data will be saved in the Apps. The system's results are promising: the data it collects is stored at lightning speed. The system's results are determined to be accurate when compared to other commercially available equipment. During the COVID-19 epidemic, IoT-based solutions might be extremely useful in saving lives. IoT-based collected real-time GPS assists in automatically alerting the patient to reduce risk factors. Wearable IoT devices are attached to the human body and networked with edge nodes to analyse data and make health-related decisions. This system leverages the wearable IoT sensor, cloud, and web layers to examine the patient’s health condition remotely. The first layer gathers patient health information, which is then transferred to the second layer, which stores it in the cloud. The network analyses health data and notifies patients, allowing users to act quickly.

Keywords: pulse rate, temperature, thingspeak, LCD

INTRODUCTION

Remotely monitoring a patient's state is a key issue that must be solved. Remote health management systems are methods, procedures, techniques, and facilities that enable doctors or other medical professionals to consult with, diagnose, and treat patients from a distance. The major purpose of continuous health monitoring is to deliver timely medical care through the use of telecommunications technology. The mysterious ways in which Covid-19 influences the body appear to encourage strangers. Several individuals' symptoms completely disappear until they suddenly relapse within a few hours, which happens regularly. Other people recovered and tested "negative," but then tested "positive." IoT-based health monitoring technologies have the potential to be extremely beneficial for COVID-19 patients throughout the outbreak. This research provides an IoT-based system for real-time health monitoring that uses measured values of a patient's body temperature, pulse rate, and oxygen saturation, which are the most significant critical care metrics.

When we look in the official website of the Malaysian government for data and views on COVID-19, individuals the quarantine at home is still high where if we do not get a device and system that can control the condition of patients at risk of not getting immediate treatment when an emergency especially the elderly and low immunity. In addition, a person who has not taken the vaccine and has taken the vaccine is still at risk of getting covid-19 infection unknowingly due to different levels of immunity and some individuals have not taken the vaccine fully according to the recommendations recommended by the Ministry of Health Malaysia to the people either get early signs through mild to more serious symptoms. At the same time, there are still people who do not care about health despite experiencing symptoms such as a fasting person experiencing extreme fatigue but unknowingly infected for not doing RTK Antigen (RTK-Ag) and Reverse Transcription- Polymerase Chain Reaction (RT-PCR) while those closest to him also experience other symptoms such as fever, sore throat, cough and cold while at home or dormitory.

Plus, as a person becomes older, it becomes increasingly important to get regular medical health checks. Because getting frequent health check-up visits may be time-consuming and difficult for most people, IoT-based arrangements might be advantageous to individuals for routine health check-ups. IoT technology has evolved into a critical invention with countless applications. It refers to any system of physical devices that acquire and share data through wireless networks without the need for human intervention.

Various sorts of instruments have recently been employed to measure these variables. In most countries, for example, a fingertip pulse oximeter, which measures SpO2 and pulse rate, is commercially accessible. The deluxe portable pulse oximeter, which can monitor SpO2 and heart rate, is also commercially available; however, it costs around RM90.00. A wrist-worn pulse oximeter that measures SpO2 and heart rate is available over the counter. This gadget, like the others described, lacks body temperature measuring capabilities. The wrist-worn pulse oximeter is pricey, costing RM189.00. There are both analogue and digital thermometers on the market right now, but the most of them are rather pricey. The gadgets described previously are not IoT-based. Some of them display values, but getting measurements from various devices is cumbersome. As a result, obtaining updates from all patients at once is challenging for a doctor in Malaysia. Rapid monitoring of COVID-19 patients with significant symptoms is in high demand.

LITERATURE REVIEW

IoT-Based Smart Health Monitoring System for COVID-19 Patients

This approach can help those who have a fever, low oxygen saturation, or a pulse rate that is rising or falling. A person's pulse rate is influenced by their age, body size, heart health, and mental stability. The oxygen saturation and pulse rate are connected because as a patient's oxygen level lowers, their pulse rate drops as well. A smart healthcare system based on the Internet of Things (IoT) is a real-time patient monitoring technology that has considerably aided the healthcare industry. Smart healthcare gadgets based on IoT have recently piqued the curiosity of researchers. The literature reviewed examines the development of smart healthcare monitoring systems in an IoT context. In this study, we used an Android-based pulse-monitoring system comprising a temperature sensor, a SpO2 sensor, and a heart rate sensor. The SpO2 measuring sensor was not used, and the data collected was uploaded to the internet. Temperature, SpO2, and pulse rate were not included in a suggested IoT-based long function monitoring system for asthma patients. The current trend in health monitoring systems is toward portable personal devices rather than hospitals, with Arduino, Android, and microcontroller-based heart rate monitoring systems being suggested. This work demonstrates how consumer technology, like as heart rate monitors, can be used for medical research and diagnostics in addition to sporting applications. Our group's goal was to create a simple, accurate, and low-cost system that would use a few pieces of data from a heart rate monitor and process them on a smartphone to I provide detailed test reports about the user's health state; (ii) store report records; (iii) generate emergency calls or SMSs; and (iv) connect to a remote telemedicine portal to relay the data to an online database. However, there is no real-world testing data available. In this system, the patient's pulse rate was measured using a pulse rate sensor, and the data was processed using Arduino. The patient's pulse rate was measured using a pulse rate sensor in this system, and the data were analysed using Arduino. The measured data was sent to the Android application. The experiment used a limited number of sensors.

IOT COVID-19 Portable Health Monitoring System using Raspberry Pi, Node-Red and ThingSpeak

Patient health monitoring can be viewed as clinical supervision because the major goal of this system is to observe the patients' health state. It may also display the information on the screen, making it easier for doctors to detect any irregularities in the patient's condition. However, during this unanticipated COVID-19 pandemic, a considerable adjustment in monitoring system is required, particularly for remote monitoring capability system. The COVID-19 virus can spread through a droplet of saliva or when an infected person sneezes or coughs. To prevent transmission, keep your distance from somebody who may already be afflicted. The majority of hospitals in the worst-affected countries have been overloaded by the amount of patients, and some have even hit their capacity limits as a result of the pandemic. As a result, those in stages 2 and 3 are isolated at home. Furthermore, individuals who regularly get their routine check-ups may be delayed. These people require a health monitoring gadget that can transmit data to healthcare providers. The Internet of Things (IoT) is a network of physical objects that may be linked to other devices such as sensors and other technology, as well as software. This is required to connect, transfer, and exchange data with other systems through the Internet without the need for human interaction. The term 'thing' refers to a device that may be connected to any sensors in order to alert for any difficulties that occur by gathering and sharing data. The Internet of Things is changing our way of life, from how we react to how we behave. The Internet of Things (IoT) is a massive network capable of linking things. Physical devices with network connectivity that are embedded with sensors and network connectivity are used to collect and exchange data. In the most basic terms, it converts everyday objects into smart devices capable of transferring data and executing processes without the need for manual intervention from a user. The levels of IOT Internet of things can be divided into five categories. They each have their own set of tasks and functions. First, there is the Perception Layer, which is responsible for data collection and transmission to higher layers. Second, the Network Layer: This is a communication layer that secures data. Its primary role is data transport between the lowest and top layers. Following that is the Middleware Layer, which is where data is stored. It is also capable of handling service management. Another layer is the Application Layer, which is responsible for providing all types of services related to the respective field. Furthermore, the Business Layer: Analysis can be performed on this layer. This is where additional data actions can be planned and guided.

Using Metaheuristics Convolute Networks from IoT-Based Wearable Device Health Data

An IoT-based system presented in this work can employ critical-care parameters such as body temperature, heart rate, and oxygen saturation in real time. A liquid crystal display (LCD) coupled to a mobile application allows for real-time monitoring of temperature, heart rate, and oxygen saturation levels. The healthcare system employs several IoT components, such as a microcontroller, actuators, sensors, and cloud-enabled systems, to collect patients' health data from home rather than having them visit the hospital. The IoT-health monitoring mechanism examines physiological data and COVID-19 symptoms transmitted to the health centre via the Application Peripheral Interface (API). The API is the database that is used to assess disease infection levels. In addition, the IoT sensor computes geographical information, which aids in informing relatives when self-quarantined individuals exhibit COVID-19 symptoms. The system is constructed in three layers: IoT, cloud, and mobile. Each layer serves a specific role in monitoring COVID-19 patients using recordings. The major purpose of the health monitoring system is to alert people and healthcare providers about infected individuals in a variety of locations and environments. To process the received signal information, the Mel-frequency Cepstral Coefficients (MFCC) feature extraction technique is applied. The MFCC-derived properties are fed into a neural network that detects the patient's health status. The features are extracted using 24 cepstral coefficients and 0.02 frame length. In this scenario, the database is employed to retain the gathered healthcare information and obtain specifics for further medical analysis.

IOT Based Handheld Smart Health Monitoring System for Covid 19

The circuit diagram provides a fundamental understanding of the system's circuit arrangement. Encoding for the system is done with an Arduino-Uno microcontroller software that records data from sensors and is also used to programme Node MCU modules to connect to Wi-Fi and deliver data. The PHP server side script is also used in the project to handle data sent by the Node MCU. Finally, HTML, CSS, and JavaScript are used for website front end development. Because the project appears to be complex in nature, architectural defective components, both software and hardware, have been developed to gain a deeper knowledge of the system architecture. It has thus been divided into six modules, ranging from the hardware component [Sensors-Arduino-Wifi Module (Node MCU)] to the software component [Server side PHP scripting-Database-Website]. As a result, the architectural module diagram simply displays how the system performs as a whole by depicting the system's workflow from the beginning, when sensors record data, to the very end, when the system ends. The data can be viewed on the designated webpage. The following modules perform the following functions: separate modules following the event cycle for optimal system operation Sensor reading module: It mostly consists of complicated sensors such as the MAX30100 and MLX90614 that are capable of capturing various vitals of the user levels such as heart rate, temperature, and SpO2, which are then relayed to the microcontroller. The Arduino UNO microcontroller acts as the system's brain, collecting all data and delivering it to the Wi-Fi module. The Node MCU version 1.0 is in charge of retrieving data from the microcontroller and transferring it to a dedicated cloud server with each reading. A server module is a group of dedicated PHP scripts that communicate with the Wi-Fi module, capturing data and storing it for later use. Database module: This module essentially comprises of a specially designed database that is used to store the data received from the module so that various operations and analyses may be performed on it. Website module: Serves as the project's front-end component, boasting not just an API integration for displaying COVID-19 information, but also displaying sensor readings as well as WHO standards.

Wearable Sensors for COVID-19: A Call to Action to Harness Our Digital Infrastructure for Remote Patient Monitoring and Virtual Assessments

Most recovery and return of "normal" daily life tactics depend around testing, namely identifying who is currently sick and who has produced antibodies against the virus, indicating a likely recovery. Any test has the potential to provide false positive or false negative results. Furthermore, SARS-CoV-2 exhibits considerable cross-reactivity with four other coronaviruses, including those associated with the common cold. In the laboratory, polymerase chain reaction (PCR)-based assays are exceedingly sensitive and specific; nevertheless, high prices and limited availability make these tests difficult to satisfy public health demands. Time is of the essence during a pandemic, and researchers must create novel approaches to improve disease diagnosis and disease progression tracking. We believe that examining systemic infection precursors with innovative assays in clinical trials has the potential to leverage advances in remote patient monitoring technology to aid in early sickness detection and monitoring. Wearable sensor data could warn doctors and patients about a possible SARS-CoV-2 infection before symptoms escalate. COVID-19, like other viral infections, causes a multitude of physiological changes that can be monitored with wearable sensors. Many heart-rhythm parameters, such as heart rate (HR), heart rate variability (HRV), resting heart rate (RHR), and respiration rate (RR), are already captured by wearable devices such as the Apple Watch, WHOOP Strap, and Fitbit, and could serve as potential indications of COVID-19 infection. Changes in electrocardiogram (ECG) waveforms may also reveal information about a disease. Because these metrics combine several variables, they should have a larger aggregate signal to noise ratio (SNR) than individual raw signals alone, and thus a higher predictive value. Because these metrics combine several variables, they should have a larger aggregate signal to noise ratio (SNR) than individual raw signals alone, and thus a higher predictive value. Furthermore, we hypothesise that wearable devices, once validated through rigorous longitudinal randomised controlled trials, can reduce invasive metrics generated from arterial blood gas procedures (designed to assess how well the lungs transfer oxygen into the blood) or cardiac troponins (indicative of myocardial injury). As a result of the advancement of integrated sensor technology, precise remote assessment of multiple physiologic indicators, many of which are therapeutically beneficial in monitoring disease progression in a viral infection, is now possible. This approach has a wide range of uses; it might be used to help identify a person under home quarantine who requires additional care, or it could be used to detect a community where an emergent outbreak is imminent and requires immediate intervention. As a result, clinical workers such as critical care nurses use early warning system signs to identify whether patients are at risk for additional complications related to their care.

IoT Technologies for Tackling COVID-19 in Malaysia and Worldwide using Smart Thermal Detection

This Internet of Things technology is based on thermal cameras, which are sensitive to radiations in the Infra-Red (IR) part of the electromagnetic spectrum but not visible light. This feature renders it insensitive to visible light in ambient lighting circumstances such as intensity, saturation, or light direction. There are various digital cameras on the market today, some of which feature detection capabilities that go beyond the visible RGB colour spectrum. Thermal cameras, for example, operate in the infrared thermal wavelength region (8–14 m). The band detected by these cameras is known as thermal infrared emission. This device detects fever in passing human bodies by relating the strength of an object's thermal IR radiation emissions to its temperature, which can be displayed on a monitoring screen or linked to an automatic warning system when temperatures surpass the threshold. A thermal camera has a germanium lens that records the infrared radiation created by the scene's objects or features to a thermal sensor known as an infrared focal plane array. Thermal imaging sensors are developed in such a way that pixels are miniature thermal infrared emissions detecting devices constructed of thermal infrared radiation sensitive materials. Thermal cameras can use this technology to detect how thermal radiations are distributed in the scenes they shoot as thermal images. Countries that have established major protective measures, such as tracking and contact tracing using IoT technologies, have shown that COVID-19 spread can be reduced. With the WHO recommending workplace temperature screening, one strategy implemented in Malaysia is the use of non-contact infrared thermometers in all workplaces to detect cases of high body temperature as an overlapping symptom with COVID-19. This statistic is regarded as crucial in the operation of critical business locations such as factories, some residential structures, and critical companies and infrastructure. Telekom Malaysia Berhad (TM), based in Kuala Lumpur, has introduced an Internet of Things (IoT)-based smart solution to aid in the early detection of thermal abnormalities through its Research & Development division (TM R&D). Early Warning, Alert, and Response, or "EWAR," is a novel system created by TM's research and development division that can measure people's body temperatures in public locations. Body temperature testing is considered a key physiological sign; it is also considered an important symptom in the diagnosis of many previous influenza-like outbreaks, offering useful medical diagnostic information. As a result, IoT technology permitted the use of remote monitoring stations to monitor exceedingly dangerous and remote environments. Flying IoT-based Unmanned Aerial Vehicles (UAVs) are an example of video surveillance acquired by drones that can be used to detect any suspicious activity among crowds. Flying above the affected areas while streaming recorded data to a cloud-based server via an onboard integrated transmission device via high-speed networks access.

METHODOLOGY

ATMEGA BASED MICROCONTROLLER (ARDUINO UNO)

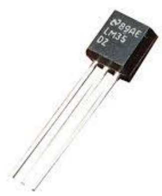
The Arduino Uno, Due, Mega, and Leonardo are among the commercially available Arduino boards. The Arduino Uno has 20 I/O pins, 14 of which are digital and 6 of which are analogue. The Arduino Due has 54 digital I/O pins, 12 analogue I/O pins, and two analogue output pins. There are 54 digital I/O pins, 16 analogue inputs, and no output pins on the Arduino Mega. The Arduino Leonardo has 20 digital I/O pins, 12 analogue input pins, and no output pins. I chose the Arduino Uno to build the system since its pin configuration matches our needs and serves as the system's main controller. It is a popular open-source microcontroller board that is based on the ATmega328p. The Arduino IDE can be used to program this microcontroller. It is crucial in this system because it acts as a bridge between the sensors and the other IoT devices.

PULSE SENSOR HEART RATE

The pulse sensor beams light through the skin and uses a photodetector to measure the reflection. Photoplethysmogram is a way of detecting pulses using light. The sensor's operation is divided into two parts: heart rate measurement and blood oxygen level measurement. The oxygen in hemoglobin has a unique property in that it can absorb a certain quantity of green light. The more oxygen in the blood, the redder the blood, which improves light absorption and decreases reflection. The amount of reflected light fluctuates as blood flows through the veins in the finger, resulting in an oscillating waveform. And by measuring this wave, the heartbeat may be calculated. The amplitude of the signal coming out of the sensor is very small and noisy, so it is processed via a low pass filter before being amplified by the opamp and read by the Arduino.

WIFI MODULE ESP8266 ESP-01

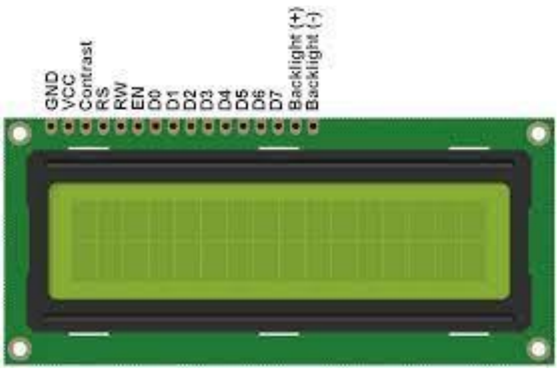
The ESP8266 WiFi Module is a self-contained SOC with an inbuilt TCP/IP protocol stack that can provide WiFi network access to any microcontroller. The ESP8266 may host applications or offload entire Wi-Fi networking tasks from another application processor. The ESP8266 ESP-01 is a Wi-Fi module that provides access to a Wi-Fi network to microcontrollers. Because the ESP-01 functions as a little computer, it is a self-contained SOC (System On a Chip) that does not require a microcontroller to operate inputs and outputs as an Arduino would. Depending on the ESP8266 version, up to 9 GPIOs are available (General Purpose Input Output). Thus, similar to how the Wi-Fi shield provides internet connectivity to the Arduino, the ESP8266 may be programmed to not only have access to a Wi-Fi network, but also to serve as a microcontroller. As a result, the ESP8266 is quite adaptable, and it can help me save money and space in my projects.



LM35 TEMPERATURE SENSOR

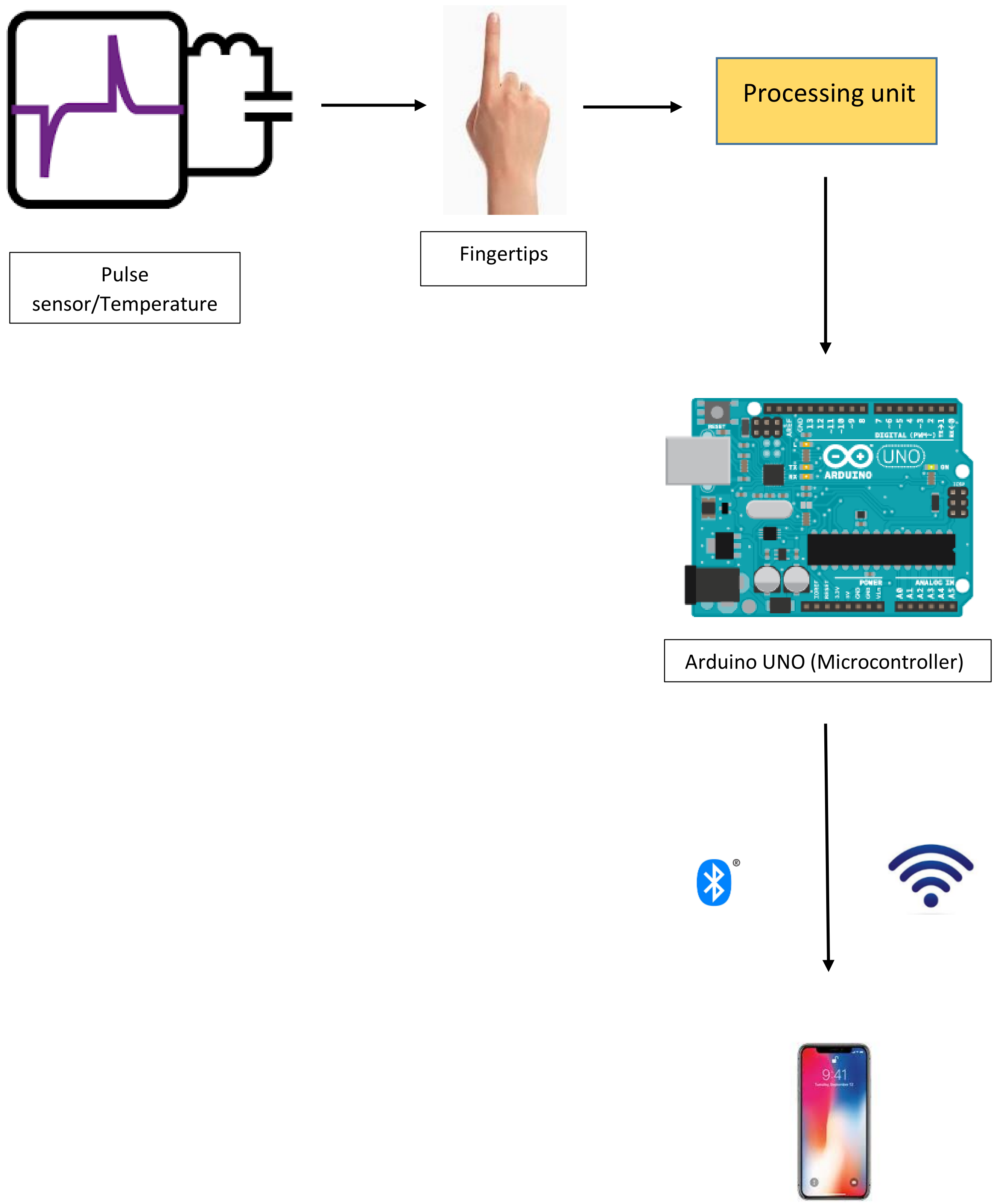
The LM35 is an integrated circuit sensor that measures temperature and produces an electrical output proportional to the temperature (in degrees Celsius). It can measure temperature more precisely than a thermistor. The output voltage of the LM35 is related to the temperature in degrees Celsius. This sensor is relatively precise, and its rugged design makes it ideal for a wide range of climatic situations. Furthermore, no external components are required to calibrate this circuit, and it has a typical accuracy of 0.5°C at ambient temperature and 1°C for the whole 55°C to +155°C temperature range. It has an operational voltage range of 4V to 30V and uses 60-uA current when in use, making it ideal for battery-powered applications.

LCD



Liquid-crystal display (LCD) technology is widely utilised in electronic displays. It is distinguished by the utilisation of liquid-filled crystals to generate images, as the name implies. LCDs are particularly good for this purpose due to their light-modulating characteristics. The light used to make the images is not always produced by the liquid crystals. Instead, they "promote" light generated by a separate device (backlight). While LCD displays come in a variety of layouts, the majority of them are built in the same fundamental way. They generate images by employing liquid crystals. The liquid crystals are incorporated in the display screen and are illuminated by some type of backlight. A 16x2 LCD can display 16 characters per line and has two such lines. Each character is presented in a 5x7 pixel matrix on this LCD. The intelligent alphanumeric dot matrix display has a resolution of 16 x 2 and can display 224 distinct letters and symbols.

BLOCK DIAGRAM



5.0 RESULT AND ANALYSIS

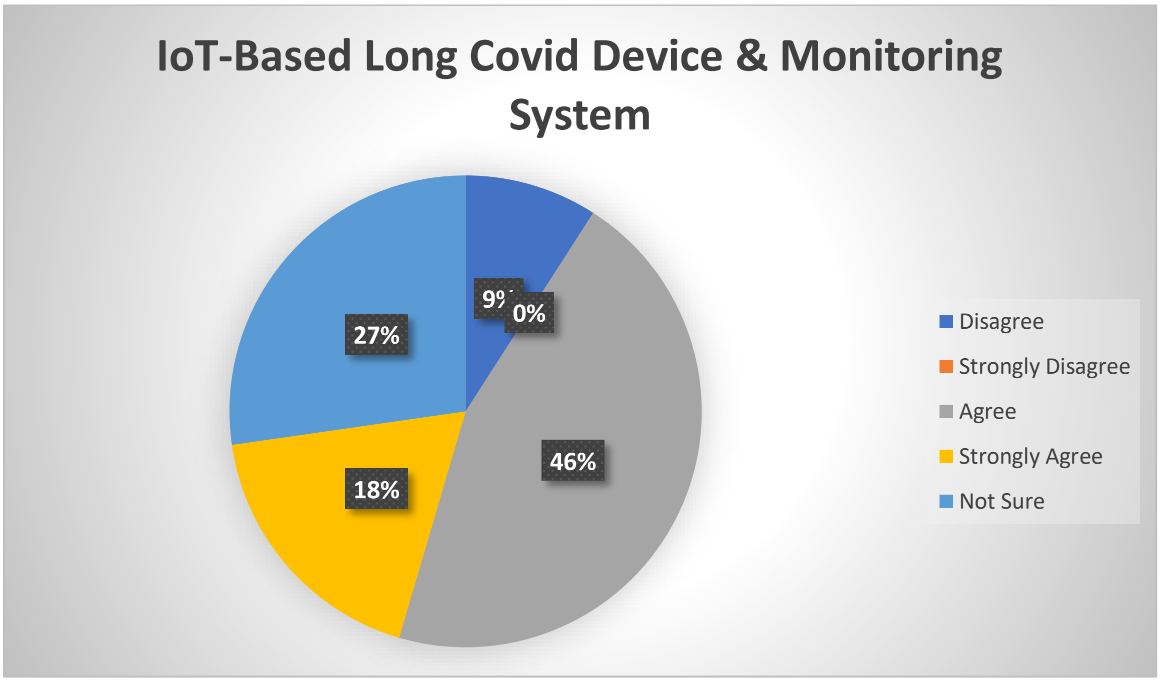


Figure 1: Respondence views on the innovation of IoT-Based Long Covid Device & Monitoring System

Self-identified professional stage of respondents who completed the feedback form. Figure 1 depicts the analysis of 30 randomly chosen respondents. According to the graph above, 46% of respondents agreed with the usefulness of IoT-Based Long Covid Device & Monitoring System. While 18% of respondents highly agree, 27% are unsure about building IoT-Based Long Covid Device & Monitoring System. Only 9% of people disagree, while 0% strongly disagree. This indicates that the efficiency of this IoT-Based Long Covid Device & Monitoring System is excellent.

CONCLUSION

At the end of this project, there are some advancements that can be seen via something like measuring. When making something, one of the most critical factors to consider is measurement.

The goal of this project is to highlight convenience and precision in the measurement process without the need of outdated measuring gear. It can help with many conditions in the measurement process and has a positive effect and impact on the user who uses it.

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