AN IOT BASED COVID PATIENT HEALTH MONITORING SYSTEM IN QUARANTINE

An UndergraduateCAPSTONE Project
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Faculty of Engineering
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A CAPSTONE Project submitted to the Faculty of Engineering, American International University - Bangladesh (AIUB) in partial fulfillment of the requirements for the degree of Bachelor of Science in theirmentioned respective programs.

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DECLARATION

This is to certify that this project is our original work. No part of this work has been submitted elsewhere partially or fully for the award of any other degree or diploma. Any material reproduced in this project has been properly acknowledged.

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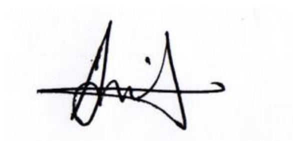

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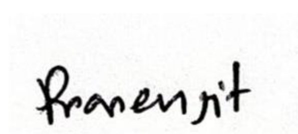

APPROVAL

The CAPSTONE Project titled **AN IOT BASED COVID PATIENT HEALTH MONITORING SYSTEM IN QUARANTINE** has been submitted to the following respected members of the Board of Examiners of the Faculty of Engineering in partial fulfillment of the requirements for the degree of Bachelor of Science in the respective programs mentioned below on **January 2023** by the following students and has been accepted as satisfactory.

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ABSTRACT

COVID-19 patients could benefit greatly from IoT-based health monitoring devices during the current pandemic. In this work, an Internet of Things (IoT)-based system is introduced for real-time health monitoring that makes use of vital signs such as a patient's temperature, heart rate, and oxygen saturation. A liquid crystal display (LCD) in this system displays the observed temperature, heart rate, and oxygen saturation, and it may be synced with a mobile app for instant access. The proposed IoT-based technique was validated through testing with five human volunteers using an Arduino Uno-based device. The technology yielded encouraging results; the information it gathered can be stored rapidly. When tested against other commercially available devices, the system's results were confirmed to be reliable. It's possible that Internet of Things-based tools could save lives during the COVID-19 epidemic.

Chapter 1

INTRODUCTION

1.1.Overture

There is a global pandemic brewing owing to the Corona virus. Even casual human contact is sufficient to propagate this virus. Since the number of doctors has decreased in proportion to the rising number of COVID patients, minor symptoms are treated by isolating people at home. Patients who must remain confined at home without regular medical supervision must take special care to protect their health and immunity. One of the most significant developments of late is the increased sophistication of patient monitoring systems. Present circumstances call for a more contemporary strategy. For proper diagnosis and counseling, they must make a trip to the patient's ward [1]. To begin with, the patient needs to be admitted to a hospital, where biological devices can be placed next to the patient's bed, and the healthcare providers need to be there at all times. The difficulty with the conventional method is that there is a risk of doctors and other medical staff contracting COVID from treating infected patients. Patients are educated in order to help them with these two issues. Smarter use of technology can help us fix the problem stated above. Sensors and high-tech microcontrollers have become increasingly important in recent years for monitoring and detecting various physiological characteristics within the human body. To address these two issues, our system provides patients with guidance on how to recognize health issues and take preventative measures. Second, there must be access to a dependable patient monitoring system at all times. It is possible to employ technology more effectively to remedy the aforementioned situation. Recently, sophisticated microcontrollers have played an important role in health care sensors. Physical contact and continuous monitoring of vital signs of the human subject. A variety of sensors are used in our system to collect data on the patient's vitals (temperature, heart rate, pulse, etc.). As designed, this approach can be utilized to keep COVID patients socially isolated while still allowing for routine checkups. In addition, the data collected by the sensors is relayed wirelessly to the doctor, cutting down on the need for costly follow-up appointments. The IoT platform included into the system facilitates the remote transfer of real-time patient data to the host device. If doctors keep track of their patients' vitals on a daily basis and examine the data graphically, they can quickly see any dangerous spikes in body temperature or drops in oxygen levels. With the use of an LCD screen and a wireless internet connection, a micro-controller can monitor a patient's vitals and relay that information to a web server (wireless sensing node). Using IoT, an alert is sent out regarding the patient if there are any sudden changes in their heart rate or body temperature. Over the Internet, this device also displays time-stamped readings of a patient's temperature and heart rate in real time.

1.2.Engineering Problem Statement

The number of people infected with the covid epidemic is rising quickly. Doctors require a lot of patience and tolerance to keep tabs on all the covid patients [2]. The first obstacle we're trying to overcome with this IoT-based COVID-19 Patient Health Monitor in Quarantine is the fear of infection felt by doctors and their families. In real time, this device will track the patient's vital signs. The patient's core temperature and heart rate will be tracked using this apparatus. Since the coronavirus and similar pathogens pose serious risks to public health, this system was developed to monitor the well-being of patients and immediately notify the appropriate authorities if they required medical attention. The system's components include a power adapter, wifi module, LCD display, blood pressure and heart rate sensor, temperature sensor, and an alarm.

1.3.Related Research Works.

1.3.1. Earlier Research

1.3.1.1. An IoT-based system for effective COVID patient health monitoring with SVM decision making

Since the COVID-19 coronavirus epidemic began, billions of extra people have fallen victim to the sickness. The key method for reducing the spread and mortality rate is self-quarantine and constant monitoring. Innovations in the Internet of Things (IoT) provide up possibilities in a wide range of contexts, such as smart cities. The Internet of Things and machine learning together provide a promising answer to the problem of 24/7 patient monitoring and alert. An Internet of Things (IoT) based covid patient health monitoring system was introduced in this work that made use of an Arduino controller [3]. The suggested Arduino-based system includes a pulse sensor, oximeter, and temperature sensor. The Support Vector Machines (SVM) machine learning technique is also applied to the problem of predicting and warning patients about potential health risks. Using a dataset compiled by the WHO from patients of varying ages, an SVM model was trained. The findings of the implemented system demonstrate that the proposed method improves classification accuracy while decreasing costs.

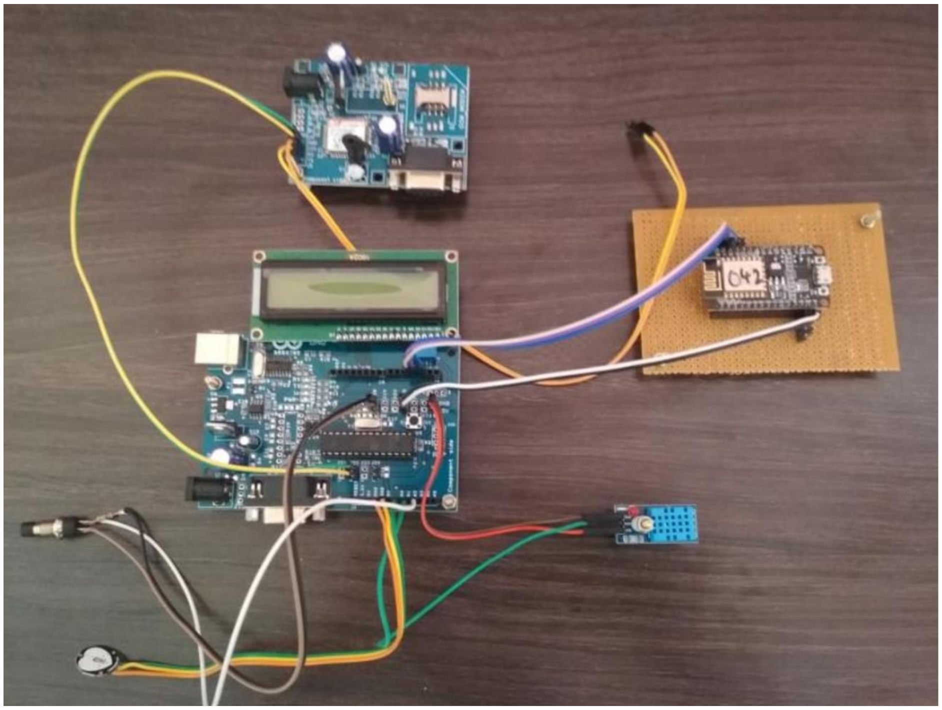

Figure 1.1: Hardware implementation –Test bed [3]

1.3.1.2. Wearable IoTs and Geo-Fencing Based Framework for COVID-19 Remote Patient Health Monitoring and Quarantine Management to Control the Pandemic

The severe acute respiratory syndrome (SARS) epidemic disease COVID-19 is becoming increasingly prevalent. Technology has yet to solve the problem of managing and monitoring COVID-19 patients. Timely diagnosis of COVID-19 and the subsequent isolation of susceptible and infected individuals is the primary and most pressing of the essential issues at hand. COVID-19 is transmitted through personal contact with an infected person. Having sufficient medical facilities and the availability of medical staff in rural and urban areas that have a high number of patients owing to the pandemic are issues faced by every country in the world. The rapid spread of SARS-COVID is likely attributable to the aggressive treatment protocol. In this research, we present a framework for smart health monitoring that makes use of wearable Internet of Things (IoT) devices and Geo-fencing to keep tabs on people who may become infected with and who have COVID-19, as well as to manage their isolation and quarantine. Wearable sensors, an

Internet of Things gateway, a cloud server, and a client application layer for visualization and analysis are the four tiers that make up the proposed system [4]. The layer of wearable sensors includes GPS and Wi-Fi Received Signal Strength Indicator collection in addition to biomedical sensors for physiological parameters worn by the user in order to keep tabs on their health and place them within a virtual geo fence. In order to facilitate data transfer at any time and place, the IoT gateway layer implements a Bluetooth and Wi-Fi based wireless body area network. Users can authorize remote monitoring over the cloud using Raspberry Pi and Thing Speak cloud for data analysis and web-based application layers. Minimizing the spread via personal contact is made possible by the presence of susceptible and patient circumstances, real-time sensor data, and Geo-fencing. Findings validate the usefulness of the proposed framework.

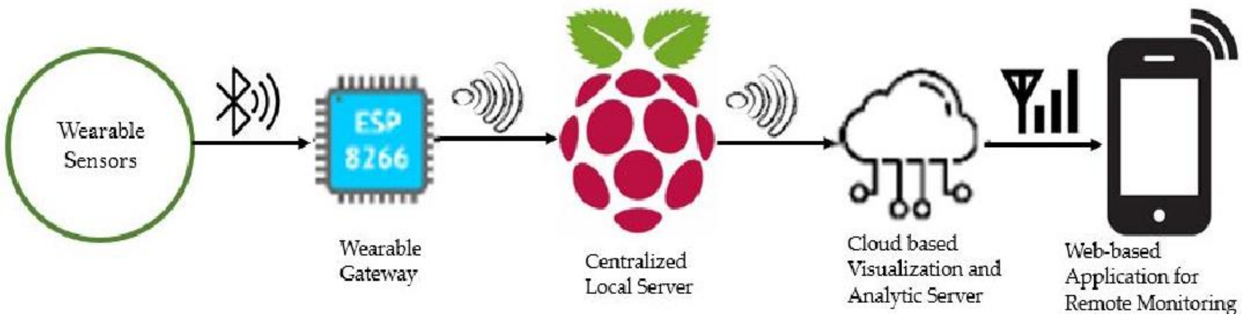

Figure 1.2: Overview of the proposed IoT based framework for Geo-fencing and remote monitoring of COVID-19 susceptible and patients [4].

1.3.1.3. Covid Patient Health Monitoring Using IoT During Quarantine

The very name "COVID" is enough to strike fear into the hearts of every person on Earth. Because of the increased contagiousness and extreme attractiveness of the Corona virus, isolating patients is essential, but medical professionals also need to check for the virus. Corona instances are on the rise, making it harder for doctors to monitor the health of their individual patients. To combat this, we developed a web-based, Internet-of-Things-based patient monitoring system that can keep tabs on a large number of people who have contracted the Corona virus [5]. The system monitors the patient's temperature, respiration rate, and pulse oximeter readings. As soon as our system detects a health problem, the patient can use the emergency help button. Through the Internet of Things, this will remotely notify both the doctor and the caretaker. The goal of our system is to keep track of each patient's health and check for signs of the Corona virus before it spreads.

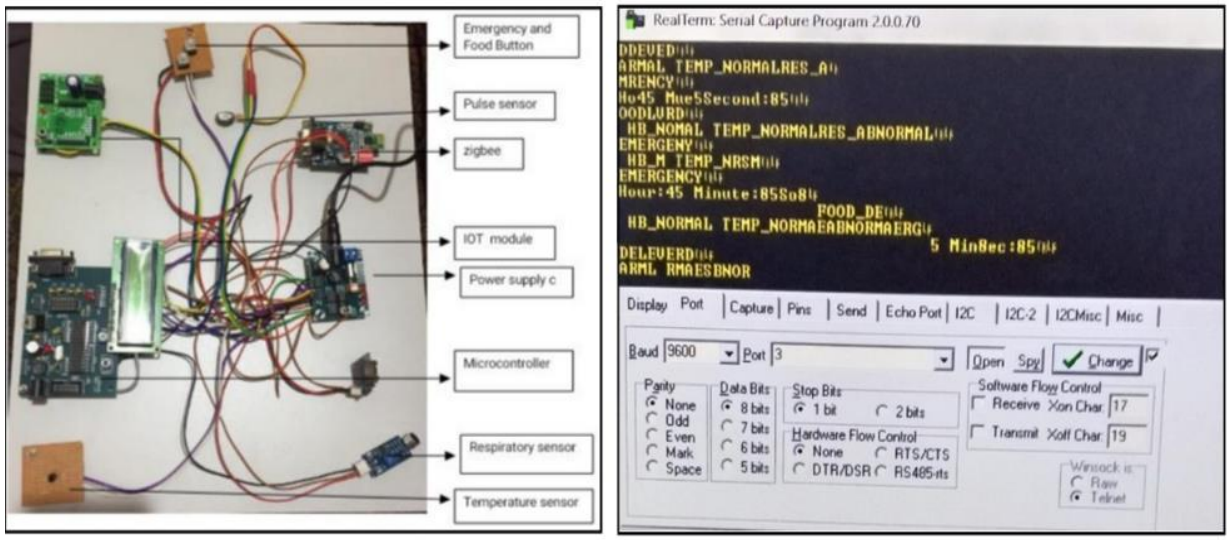

Figure 1.3: Covid Patient Health Monitoring Using IoT during Quarantine [5].

1.3.2. Recent Research

1.3.2.1. Low-Cost IoT Based Wearable Respiratory Sensor for Covid-19 Patients

The three main Covid-19 symptoms are shortness of breath, coughing and fever. Patients who have tested positive with COVID-19 are typically self-quarantining at this time. There have been cases of Covid-19 patients in home quarantine being rushed to the hospital in critical condition. That's why we need electronic health records and remote patient monitoring technologies. Although the author proposes a number of e-health monitoring solutions, few of them are well suited to tracking COVID-19. Typically lack any sort of function for keeping tabs on a person's breathing rate. In addition, many commercially available e-health devices lack IoT connection and can only save data locally. As part of this study, we presented an inexpensive Internet of Things (IoT)-based respiratory sensor for monitoring the respiratory rate of Covid-19 patients undergoing home quarantine. Your breathing rate will be sent to Google Clould over WiFi, where you can view it on your computer or mobile device. Alert message will be sent if the respiration rate surpasses an unhealthy threshold. The proposed gadget was tested with five samples and yielded a 100% accuracy on respiratory rate measurement. The price of the proposed prototype is substantially cheaper than that of existing respiratory monitoring devices. The proposed device could lower the mortality of home quarantine Covid19 patients

1.3.2.2. Wearable Device for Observation of Physical Activity with the Purpose of Patient Monitoring Due to COVID-19

Late in 2019, a novel coronavirus subtype (COVID-19) was discovered in humans in Wuhan, China. Furthermore, COVID-19 spreads through droplets, making quarantine essential for stopping the spread and allowing for physical recovery. This newfound urgency poses a significant test for cutting-edge diagnostic and surveillance tools. The Internet of Things (IoT) is helping to find answers to these sorts of issues. In this study, they presented a wearable instrument capable of continuous monitoring of both internal and external temperatures and humidity levels. In addition, this device will automatically send an alert to the relevant party through the system. When a person's temperature rises above a certain point, an alarm is sent out. To determine if a possible increase in temperature may be ascribed to physical activity, we created an algorithm that detects exercise using an accelerometer and gave it the name "Continuous Displacement Algorithm." The individuals in charge of the quarantined individual can then connect via nRF Connect or another centralized application to get a clear view of the situation. In this study, we used an Arduino Nano BLE 33 Sense, which is equipped with a 9-axis IMU, various temperature and environmental sensors, and more. This device was able to accurately measure wrist temperatures from 32 degrees Celsius to 39 degrees Celsius in all conditions, with a battery life of more than 12 hours, the ability to charge quickly (500 milliamps), and the use of the BLE 5.0 protocol for wireless data transmission and low power consumption. A 1D Convolutional Neural Network (CNN) was also used to determine if a person has a fever by factoring in their level of physical activity. Results from the 1D CNN showed how it may be used to learn about user health in the context of the COVID-19 pandemic.

1.4. Critical Engineering Specialist Knowledge

Here, we offer a strategy for monitoring low- to medium-density crowds using a vision-guided COVID Surveillance robot (CS-robot) and wall-mounted CCTV cameras. In this study, we refer to these kinds of incidents as breaches, or breaks in social distance. In static circumstances, when a violation is detected, the robot prioritizes non-compliant groups of people depending on their size, then autonomously navigates to the largest group and encourages them to observe the social distancing norms by displaying a warning message on a mounted screen [7]. In dynamic settings, the robot determines which groups require attention first based on their relative movement to the robot. Our robot uses to move independently toward non-compliant groups of people while avoiding obstacles, CS-navigation robot's system, receives inputs from low-cost visual sensors such an RGB-D camera and a 2-D LIDAR, and pedes-train identification and tracking algorithms, which detect and classify non-compliant pedestrians based on their violations of social distance limits, are also utilized.

1.5.Stakeholders

Patients infected with COVID-19 could benefit greatly from health monitoring systems built on the Internet of Things (IoT). This research provides an Internet of Things (IoT)-based system, a real-time health monitoring system that makes use of the patient's measured values of core vital signs (such as temperature, heart rate, and oxygen saturation) during critical care. The system's LCD displays the user's current temperature, heart rate, and oxygen saturation, and it syncs with a mobile app so that the data is always at their fingertips. There were five people used to validate the proposed IoT-based method's accuracy [11]. The technology showed encouraging results; the information it gathered can be stored rapidly. Results from the system were reliable when compared to those from other commercially available tools. During the COVID-19 epidemic, IoT-based tools may help save lives.

1.6.Objectives

The following goals are intended to be achieved by conducting the related work:

1.6.1. Primary Objectives

- Create a system for remote patient health monitoring, which will allow for the diagnosis of patient health without the need for direct patient interaction.

- The necessity for a low-cost, quick-response alarm mechanism is unavoidable, as is the proper implementation of such a health monitoring system, which allows for safer diagnosis in the case of a patient isolated at home.

1.6.2. Secondary Objectives

- Portable Internet of Things systems can be used to gather patient data and transmit it wirelessly to a location where it can be analyzed or stored for future reference.

1.7. Organization of Book Chapters

Chapter-2: Project Management

In this Chapter, the project Gantt chart has designed in this project management chapter. Then, analysis the different related issues as such strength of this project, weakness and opportunities.

Chapter-3: Methodology and Modeling

In this methodology chapter, the proposed designed with block diagram also mathematically

Chapter-4: Implementation of Project

In this the modified chapter, the proposed model will be described

Chapter-5: Results Analysis & Critical Design Review

All the graphs and project analysis will be shown

Chapter-6: Conclusion

Chapter 2

PROJECT MANAGEMENT

2.1.Introduction

Project management is the practice of coordinating the activities required to complete a project in a timely manner while adhering to predetermined budget, time, and quality standards. There is a finite amount of time and money available, and the ultimate results of a project must be delivered within those parameters. One of the main differences between management and project management is that the latter has a final deliverable and a set duration. This means that a project manager needs not only technical expertise, but also the ability to lead a diverse team and an understanding of the commercial world. The success of a project is often guaranteed by the application of project management techniques. When it comes to project management, it's vital to have a clear vision of the objectives of the project, the resources this project needs, and achieve it. Getting down to business is the focus of this section. Project management's end goal is to ensure that the project's objectives and outputs are completed successfully. Additionally, it comprises the identification and control of potential risks, coupled with a detailed budgeting procedure and cross-organizational communication.

2.2.S.W.O.T. Analysis

A cost and differentiation position and strategic planning can be assessed using the SWOT (strengths, weaknesses, opportunities, threats) framework. Internal and external elements, as well as present and future potential, are weighed in a SWOT analysis. A Strengths and Weaknesses (SWOT) Analysis is a tool used to objectively evaluate these aspects of a company, its activities, or its position in its industry. The company must maintain precision in its analysis by focusing on actual situations rather than hypothetical ones. The document should serve as a roadmap, rather than a strict set of instructions.

Strengths

- Patients need not register in advance, and their implied consent will be honored.
- Considering the pandemic, the risk of exposure is reduced because of the lack of face-to-face counseling with patients.
- With no need to factor in transportation costs or other miscellaneous expenditures, your out-of-pocket total is bound to be lower.
- By utilizing Teleconsultation, primary and secondary healthcare become available to everyone, and human resources are better utilized.
- Patients are becoming more at ease with teleconsultations as a result of recent technological developments.

Weaknesses

- It is not appropriate to use telemedicine consultation when patient counseling is required or when "breaking terrible news" must be delivered.
- The quality of information shared is low.
- Patients who cannot read or write will not be able to use telemedicine services.
- Inquiry calls are more common than consulting calls.
- It is challenging to coordinate referral and transport services for patients who live in different states.
- The achieved patient data quality is poor.
- Patients are not being physically checked on.
- Unfortunately, qualified workers are in scarce supply.
- It's possible that you won't be able to see the same doctor for follow-up care.

Opportunities

- Telemedicine has the potential to enhance the referral system.
- The hub-and-spoke structure allows for the use of point-of-care technology, which improves patient diagnostics.
- The development of an Electronic Health Record (EHR) and its association with a patient's Unique Health Identification Number (UHIN) allows for the digitalization of formerly paper-based medical records (UHID).

- The patient's geolocation can aid in the preliminary examination of an outbreak.
- So that privacy invasions and medico legal problems don't arise, certain guidelines should be provided.

Threats

- The lack of a centralized system for keeping records is a key drawback of teleconsultation that could cause medico legal problems.
- It's possible that not every teleconsultation will be attended to by the same doctor.
- Patients' ability to maintain confidentiality during doctor visits is compromised.
- Inadequate internet speed or network issues may result in subpar medical care for patients.
- Patients aren't informed enough about telemedicine services

2.3.Schedule Management

Using time variables, a schedule management framework organizes the various activities and tasks that make up a project. Describes the steps that must be taken in order to finish the project on schedule and on budget. Having a framework in place to manage schedules is essential for getting projects started, keeping tabs on their development, and finishing on time.

2.4.Cost Analysis

Sl	Equipment	Cost
1	ESP8266 Wi-Fi Module	420tk
2	Heart Plus Blood Pressure sensor	4000tk
3	16X2 LCD display	225tk
4	10K Thermistor	10 tk
5	Adapter 12V 1 Amp	400tk
6	Buzzer	15tk
7	Atmega328 U4	666 tk
	Total	6500Tk

2.5.P.E.S.T. Analysis

2.5.1. Political Analysis

Making a choice that applies to everyone in a group in the same way and using power to influence the actions of others are two of politics' defining characteristics. Businesses must first consider the political climate of a country before investing there. Political risk, defined as "governmental or societal actions and policies originating either within or outside the host country and negatively affecting either a select group, or the majority of foreign business operations and investments," can be exacerbated by a number of external factors that must be taken into account. Successfully navigating the macro environment necessitates careful management of political risk. The political risks of a country, and other hazards than politics, can be better understood with the help of a country risk assessment. The term "political considerations" refers to the impact that government policy has on the economy. Ideology-based forms of government, state versus private sector ownership, nationalism, economic activity protection, traditional conflict, and government stability are all examples.

2.5.2. Economic Analysis

Before expanding internationally, companies should recognize that "alongside their domestic environment," they also operate in a foreign environment and an international environment. Organizational policies developed for the United States may not be optimal in a foreign setting and/or a global setting characterized by varying economic conditions. The potential of a market can't be estimated without first understanding the economy. A few examples of important economic indicators are (a) the total value of all final goods and services produced (gross national income), (b) the total value of all domestically produced goods and services (gross domestic product), (c) GDP per capita, which measures purchasing power, (d) purchasing power parity (PPP), which measures purchasing power to compare standards of living (including exchange rate of a currency), (e) income distribution, and (f) private investment.

2.5.3. Social Analysis

An individual's cultural background consists of their "beliefs, rules, techniques, institutions, and artifacts". Culture is something that a people develop over time and that serves to define their shared identities and the spaces in which they live. There are a few key characteristics that Aesthetics, (b) beliefs and values,

(c) religion, (d) material culture, (e) education, (f) language, and (g) social structure are all examples of culture. Organizations are impacted by cross-cultural interactions between the domestic and international settings. It is crucial that these things be studied thoroughly in order to be completely prepared for conducting business outside of the domestic context, since doing so can lessen the psychological gap and confusion between the familiar and new culture.

2.5.4. Technological Analysis

Invention and original thought can be sparked by technological advancements. One definition of innovation is "a technological change new to the firm and the economy that has disseminated into the economy and been adopted by the enterprise," while another defines invention as "a new combination of preexisting knowledge." firm". In this sense, an invention might be considered an example of innovation. The pace and trajectory of technical progress define the nature of the contemporary technological landscape. The technical abilities and tools that shape the transformation of inputs into outputs are the technological elements that drive these developments. Technical macro environmental characteristics include (a) the appropriability of rents associated with the product (patents, development time, learning curve efficiency, and sales and service effort that underlie the innovation); (b) the size of the product's value net (links with suppliers and producers); and (c) the standard setting process (by market forces or formal procedures) that influences when a technological design.

2.6. Professional Responsibilities

An engineer's responsibility is to ensure the reliability and viability of a product, process, or system. Engineers need strong interpersonal and group work skills to complete projects successfully. There needs to be clear communication between engineers, clients, and companies. These additional tasks fall under the purview of engineers:

- The practice of creating detailed blueprints
- Making projections and setting spending limits for projects
- Establishing the limits of the undertaking
- Experimentation design in engineering
- Creating technical reports for customers
- Filling out regulatory paperwork that is important for safety
- Projects that are finished on schedule and under budget
- Spreading the word about what you've learned to your clients and coworkers

2.6.1. Norms of Engineering Practice

The term "norm" is used to describe generally accepted ethical principles. Using normative design principles, designers can strike a balance between technological and ethical possibilities. In this way of thinking and making, engineers are mandated by law to conduct impact assessments to ensure that their creations will have a positive influence on society at large. When running a business, it's essential to make your employees feel valued. Managers in the engineering field should make improving their employees' skillsets a top priority if they want to get anything done. The manager must have a transparent development strategy and regularly check in with employees to discuss their strengths, areas for improvement, and career goals.

2.6.2. Individual Responsibilities and Function as Effective Team Member

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Sadman Rahman	18-36199-1	Hardware lead and Chapter 4,5
Habiba Akter	18-39035-3	Simulation and designing and Chapter 3
Prasenjit Sarker	18-38647-3	Software lead and Chapter 1,2

2.7. Management Principles and Economic Models

Through the use of simplified descriptions of reality, economists are able to generate testable hypotheses about economic behavior. Economic models are inherently subjective due to the lack of a universally accepted standard for measuring economic performance. Economists' opinions on what's required to account for the world as they see it will vary. There are two primary categories of economic models: theoretical and empirical. The goal of theoretical models is to derive provable implications about economic behavior from the assumption that agents maximize specified objectives within well-defined model constraints (like an agent's budget). They provide in-depth analyses of complicated issues, such as how to deal with market failures and the effects of asymmetric knowledge (when one party to a transaction knows more than the other). On the other hand, empirical models make an effort to translate the qualitative predictions of theoretical models into more precise numerical outcomes. A theoretical model of an agent's consumption behavior, for instance, might suggest that spending would grow in proportion to the agent's income. To attempt to put a monetary value on the typical percentage increase in spending that occurs with a percentage increase in income, the theoretical model would be empirically adapted.

2.8.Summary

Discussed in this section are the project's objectives, budget, task management, and SWOT analysis, as well as any potential dangers or advantages. Researchers can have faith in their decision to carry forward with the study because of what they have learnt from past initiatives and expense estimations. Due to the specified stakeholders, many more people will be able to take use of a wide variety of new possibilities.

Chapter 3

METHODOLOGY AND MODELING

3.1. Introduction

Over the past decade, healthcare monitoring systems have become increasingly technologically focused and essential. Humans have a problem with sudden deaths from a variety of illnesses, and this is largely owing to a lack of timely medical attention. The major objective was to create a trustworthy IoT-based patient monitoring system for healthcare providers to keep an eye on their patients, whether they're in a hospital or at home, as part of an IoT-based integrated healthcare system, with the end goal of providing better treatment. With the use of sensors, a data collecting unit, a microcontroller (in this case, an Arduino), and some custom software, we were able to create a wireless healthcare monitoring system that can be used on the go to keep tabs on a patient's vitals in real time. Data such as the patient's temperature, heart rate, and EEG are transmitted to the doctor's smartphone, where they are displayed and saved. In this way, IoT-based patient monitoring systems are able to keep a close eye on their patients' health and intervene when necessary. Wearable technology has allowed for the remote monitoring of a person's health through the use of wireless communications, medical sensor technologies, and data-collection systems. They are sensors and wearable technology includes not only Smartphone's, headphones, and wristwatches, but also garments, wristbands, glasses, socks, hats, and shoes. The sensors of a healthcare monitoring system are its nervous system. This means you can count on them. The ideal sensors would be compact, silent, precise, quick to transmit data, energy efficient, and effective. Wearable it is difficult to find sensors that meet the requirements of both precision and small size. In the case of wearable sensors, however, the outputs are more important, and they must be relatively precise so that the doctor can make judgments based on them. Sensors of medical quality are bulky, awkward to move around, and demanding of specialist tools and personnel in order to function properly.

3.2.Block Diagram and Working Principle

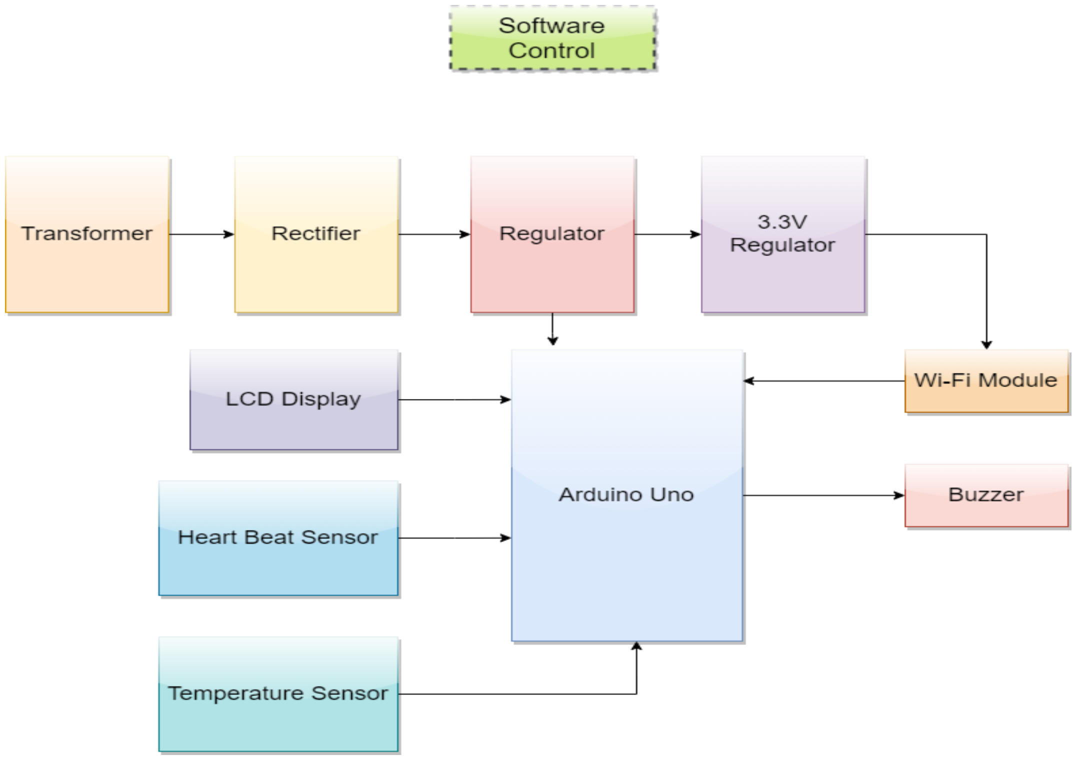

Figure 3.1: Block Diagram

The process of system management was visually mapped out with the help of a block diagram and a flowchart. By design, the cycle stream guides crucial times throughout all phases of a system's lifecycle. When working with electrical or electronic equipment, circuit diagrams were used for everything from initial design and manufacturing to troubleshooting. These diagrams had real value for a complex system. In Figure 1, we see a block representation of the suggested system. As can be seen in the system's block diagram, once the power is turned on, the sensor immediately begins reading data. In this case, the system incorporates two distinct sensor types to record arterial oxygen saturation (SpO2), heart rate, and body temperature. The analog values measured by the sensors are passed to the Arduino, which subsequently digitizes the information. The server simultaneously updates an LCD display and provides the measured data to the mobile app. Users can track their body temperature, oxygen saturation (SpO2), and heart rate all from their mobile app and device. See the system's flowchart in Figure 2. With power on, the gadget begins taking readings and transmitting them to the master controller (an Arduino Uno or Node MCU). The measured value is sent to a central server via the Node MCU. When the SpO2 is below 95% and the HR is below 60 or above 90, the system notifies the doctor and the patient, and displays the data on the screen. There is an LCD display on the device and a mobile app that show the user the measured value. The entire circuit system's block diagram is depicted in Figure 3. This schematic depicts the hardware components of the system, including the Arduino Uno, node MCU, Bluetooth module, SpO2 sensor, temperature sensor, and power supply. This circuit schematic was created in the Proteus Design Suite environment. Pressing the on switch activates the fully mechanized setup. After the data has been collected by the sensors and sent to the processing unit, it may be accessed by the mobile application.

3.3.Modeling

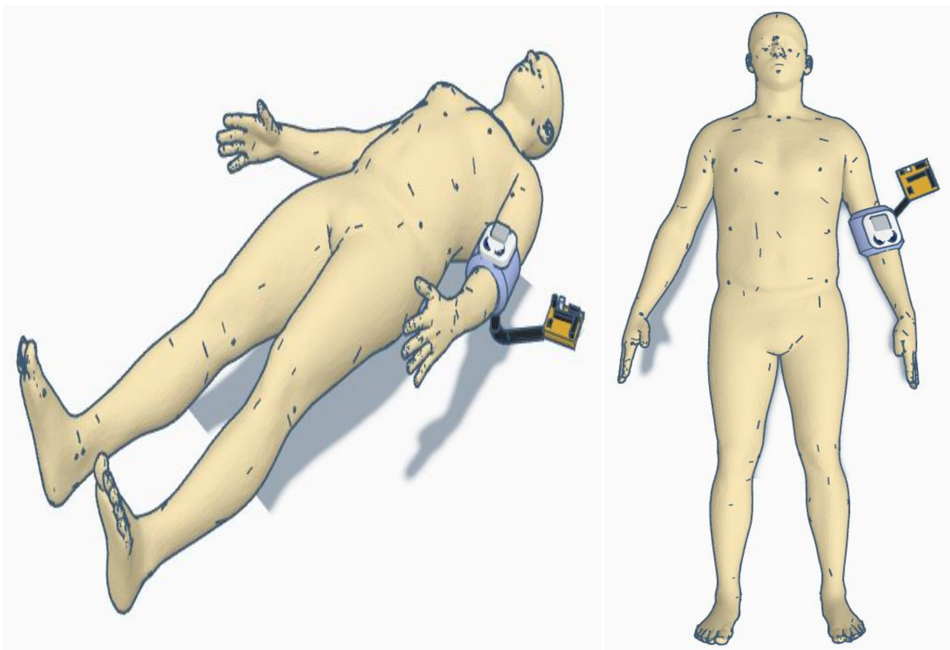

Figure 3.2: 3D design

3.4.Summary

The healthcare industry is large and has many subsets. Clinics, hospitals, pharmacies, home health agencies, long-term care facilities, drug producers, and medical device makers all play a role in the healthcare delivery system. Products and services for health and wellness, as well as insurance providers and government agencies, are also involved. Provide assistance to customers [6]. This section offers a summary and critical evaluation of recent studies on Internet of Things-based healthcare monitoring systems.

Chapter 4

PROJECT IMPLEMENTATION

4.1. Introduction

The spread of the corona virus has prompted calls for widespread screening, and telemedicine is ideally positioned to facilitate this. Remote monitoring has emerged as a new and remarkable way as telemedicine has grown over the past decade. Prevention of the corona virus demands widespread, constant community involvement. For the COVID-19, in particular, there are specific operational and configuration includes that are suited to remote checking. Specific use cases for checking include data collection during pandemics and the acquisition of continuous clinical input. Remote monitoring is becoming as an important tool for payers, providers, and public health authorities alike as telemedicine continues to develop and expand [1]. As a result, the health of those under quarantine may be monitored remotely thanks to the Internet of Things and the wireless sensor network. Every single patient will have the ability to take the exam at any time. The patient's vital signs, such as heart rate, temperature, and blood pressure, will be continuously tracked [2, 3]. Through the WSN network, the system will notify a doctor or caretaker if the value surpasses an unsafe threshold. This allows the care provider to act immediately. The corona virus has accelerated the need for a fresh look at and engagement with crisis response. Technological progress and the modernization of society have provided the foundation for telemedicine, and now is the time for this and other forms of "computerized wellness" to prove their worth.

4.2. Required Tools and Components

4.2.1. Arduino Uno

Arduino boards like the Arduino Uno, Arduino Due, Arduino Mega, and Arduino Leonardo are all available for purchase. There are 20 I/O pins on an Arduino Uno; 14 digital and 6 analog. There are 54 digital I/O pins, 12 analog inputs, and 2 analog outputs on the Arduino Due. There are 54 digital I/O pins, 16 analog inputs, and no output pins on the Arduino Mega board. A total of 20 digital I/O pins, 12 analog inputs, and no output pins are available on the Arduino Leonardo [26]. The Arduino Uno was utilized as the main controller for the system since its pin arrangement was a good fit for our needs. As an

ATmega328p-based open-source microcontroller board, it is a household name. Arduino software can be used to program this microcontroller. It's an integral part of the system and acts as a bridge between the sensors and other IoT devices.

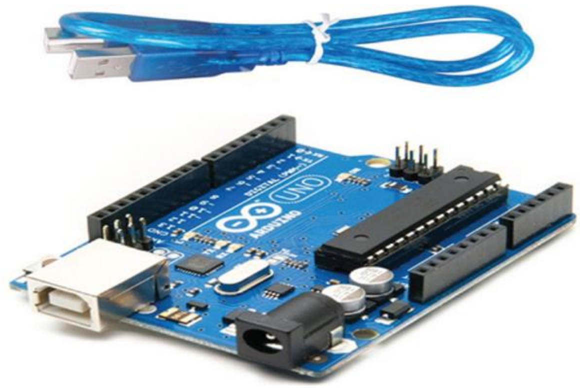

Figure 4.1: Arduino Uno [12].

4.2.2. Pulse Sensor (MAX30100)

There is a sensor called MAX30100 that can check your heart rate and oxygen saturation levels. Figure 5 is a representation of the early version of the SpO2 pulse oximeter (MAX30100). Saturation of peripheral oxygen (SpO2) is a measurement of the percentage of hemoglobin that is oxygenated in the blood. The normal range for SpO2 in a human organism is 90–100%. Here, a MAX 30100 pulse oximeter worked just fine. Accurate readings are obtained through the integrated pulse oximeter and heart rate sensor. Therefore, this sensor is well suited for the system since it uses two LEDs, a photo detector, improved optics, and low-noise analog flag handling to distinguish between pulse oximetry and heart rate inputs.

Figure 4.2: Pulse Sensor (MAX30100) [13].

4.2.3. Node MCU

The ESP8266 microcontroller has Wi-Fi functionality and the node MCU has a wireless system that can transfer data to a server, we utilized the ESP8266 as the wireless module for this system. The node MCU can talk to the Bluetooth module thanks to an asynchronous receiver-transmitter serial communication module. A 3.3 V operating voltage and 7–12 V input voltage are supported by the ESP8266 microcontroller used in the node MCU. The SRAM is 64 KB in size, and the flash memory is 4 MB. It includes one analog input pin and sixteen digital I/O pins. A PCB antenna [30]. Is included within the node MCU. The heart rate, oxygen saturation, and temperature readings are transmitted to the server via the wireless module in the node MCU. This part was selected because it creates a connection between the server IP and the node MCU, allowing the measured value to be retrieved via a mobile app. Node MCU is both a development board and a free, open-source firmware written in the Lau programming language. This part is essential to our setup because it was developed with Internet of Things applications in mind. The prototype ESP8266 microcontroller used in the node MCU.

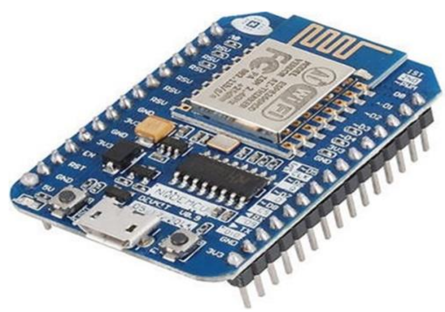

Figure 4.3: Node MCU ESP8266 [14]

4.2.4. LCD Display

The liquid crystal display (LCD) is a well-known example of an alphanumeric LCD display module. It's handy in a number of systems thanks to its 16 columns and 2 rows. The heart rate, oxygen saturation, and body temperature readings were all shown on this screen. Here, each letter is displayed as a matrix of pixels. The LCD screen requires a voltage of between 4.7 and 5.3 V to function. When there is no ambient light to illuminate it, its current draw is only 1 mA [33]. Figure 9 depicts an early version of an LCD screen.

Figure 4.4: LCD [14].

4.2.5. DS18B20 Heat Sensor

Sensor DS18B20 for use with 1-wire communication. A pull-up resistor on the data pin of the microcontroller is all that's needed; the other two pins are for controlling the device. When transport is not being run, the pull-up resistor maintains a high condition on the line. The temperature can be measured accurately with this sensor. A 2-byte register within the sensor will not contain the temperature it measures. By transmitting the data in a structured format, it may be analyzed using the 1-wire method. Sending a ROM command or a functioning command to check the values is both possible.

Figure 4.5: DS18B20 Sensor [15].

4.3. Implemented Models

4.3.1. Simulation Model

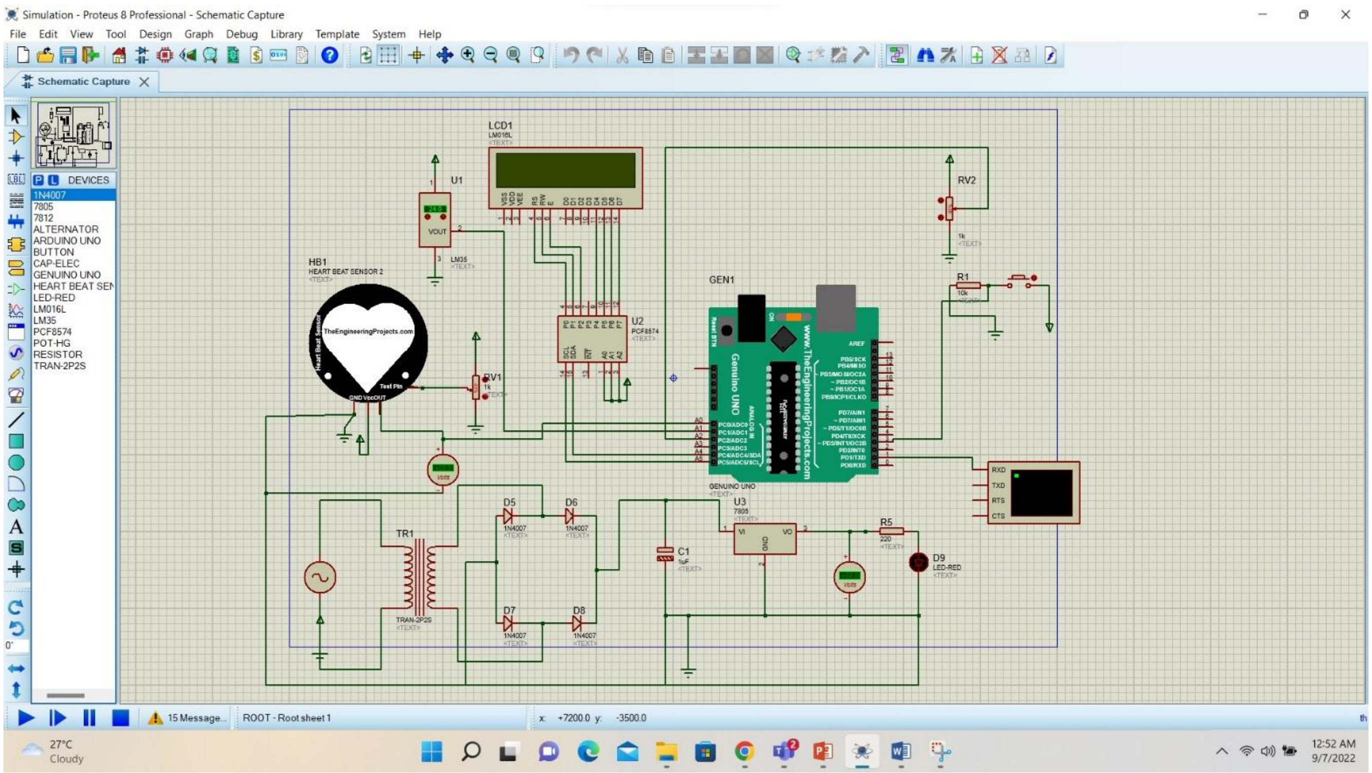

Figure 4.6: Proteus Simulation

4.3.2. Hardware Model

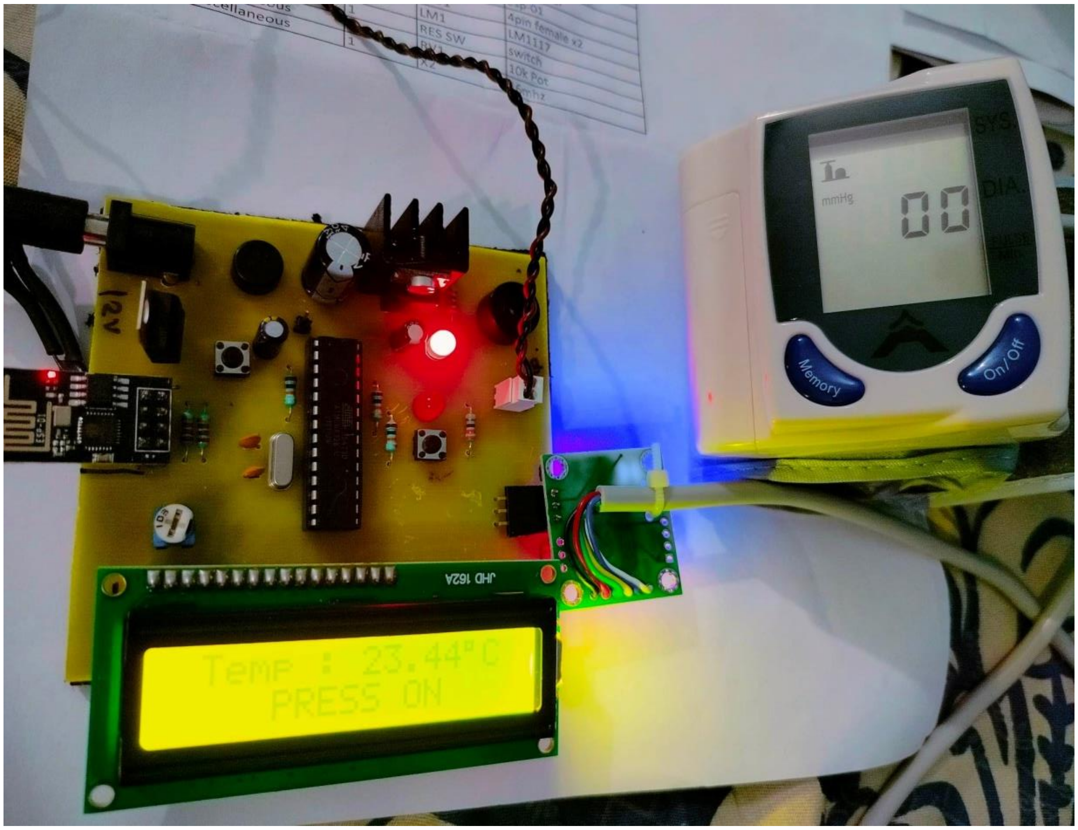

Figure 4.7: Hardware model

4.4.Engineering Solution in accordance with professional practices

Patients suffering from the covid epidemic are quickly multiplying at this time. Doctors require a lot of patience and tolerance to keep tabs on all the covid patients. We are developing this IoT-based COVID-19 Patient Health Monitor in Quarantine to alleviate the primary issue, which is the fear of infection among doctors and their families. The patient's vitals will be tracked in real time by this device. This gadget is for measuring the patient's temperature and heart rate. The system consists of a power adaptor, wifi module, LCD display, blood pressure/heart rate sensor, temperature sensor, and an at mega 328p microprocessor. As we all know, coronaviruses and similar pathogens pose serious risks to human health and safety.

4.5.Summary

The Internet of Things (IoT) plays a crucial role in cutting-edge use cases like smart cities, smart homes, education, healthcare, transportation, and defense operations. Because they allow for safe, real-time remote monitoring of patients, IoT applications in healthcare greatly enhance the standard of care provided and, ultimately, the lives of those who benefit from it. In this survey, we'll look at what's new in Using the Internet of Things to improve healthcare monitoring systems. The importance and value of IoT healthcare systems are discussed, along with the benefits of using such a system. We conduct a comprehensive literature assessment of recent investigations towards healthcare monitoring systems based on the Internet of Things. Effectiveness, efficiency, data protection, privacy, security, and monitoring across systems are compared in this research study. We also categorize healthcare monitoring sensors and discuss wireless and wearable sensor-based IoT monitoring solutions. We also go into depth on the difficulties and unanswered questions surrounding QoS, privacy, and security in healthcare. At the study's conclusion, recommendations and suggestions for healthcare IoT applications are presented, along with directions for the future based on several emerging technological tendencies.

Chapter 5

RESULTS ANALYSIS & CRITICAL DESIGN REVIEW

5.1. Introduction

IoT is developed after extensive study of existing methods and tools in the field of electronic communication and information processing. It has the potential to improve life for city dwellers. Cost-effective healthcare systems that can efficiently manage and provide a wide range of medical services while decreasing overall expenses [3-6] are in high demand as the world population grows at an incredible rate and as the frequency of chronic diseases increases. The Internet of Things (IoT) has lately emerged as a primary area of development, making it possible to improve healthcare monitoring systems. The goal of the Internet of Things healthcare monitoring system is to correctly track individuals and to connect various services and things across the world via the Internet in order to gather, share, monitor, store, and analyze the data created by these things [7]. IoT, on the other hand, is a new paradigm in which all physical things that are part of an intelligent application (such as a smart city, smart home, or smart healthcare) are addressed and controlled through the network. Using sensor networks on the human body will greatly aid in the important tasks of disease diagnosis and patient monitoring. Also, you can get to the data whenever you choose, wherever you happen to be [8].

5.2. Results Analysis

5.2.1. Simulated Results

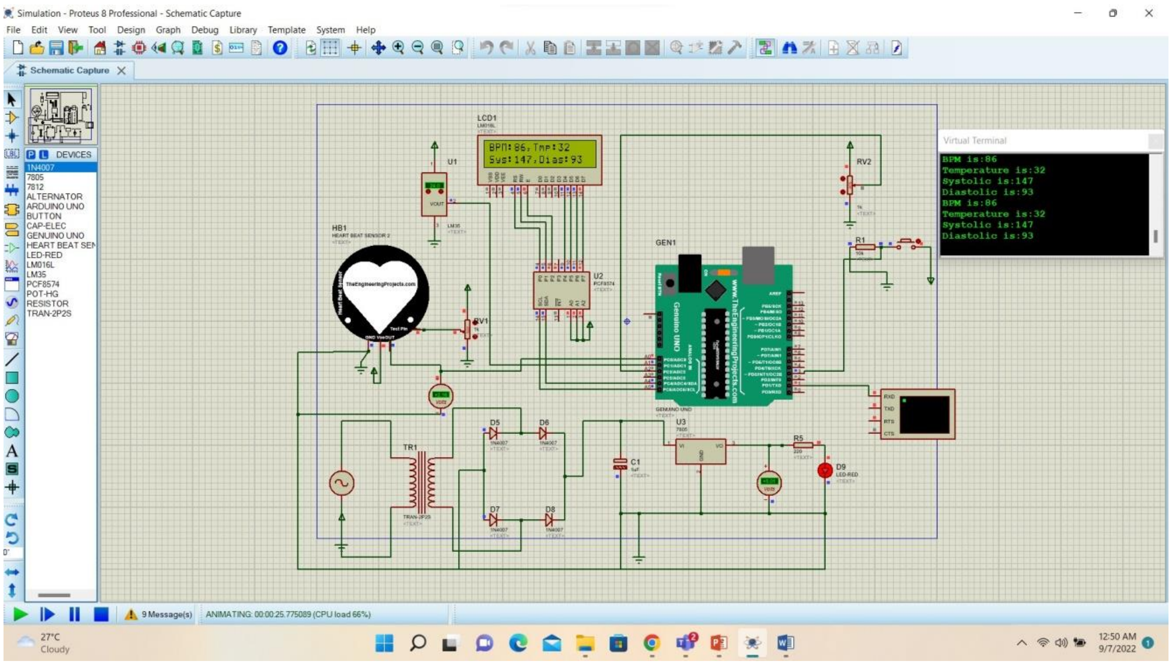

Figure 5.1: Proteus Simulation

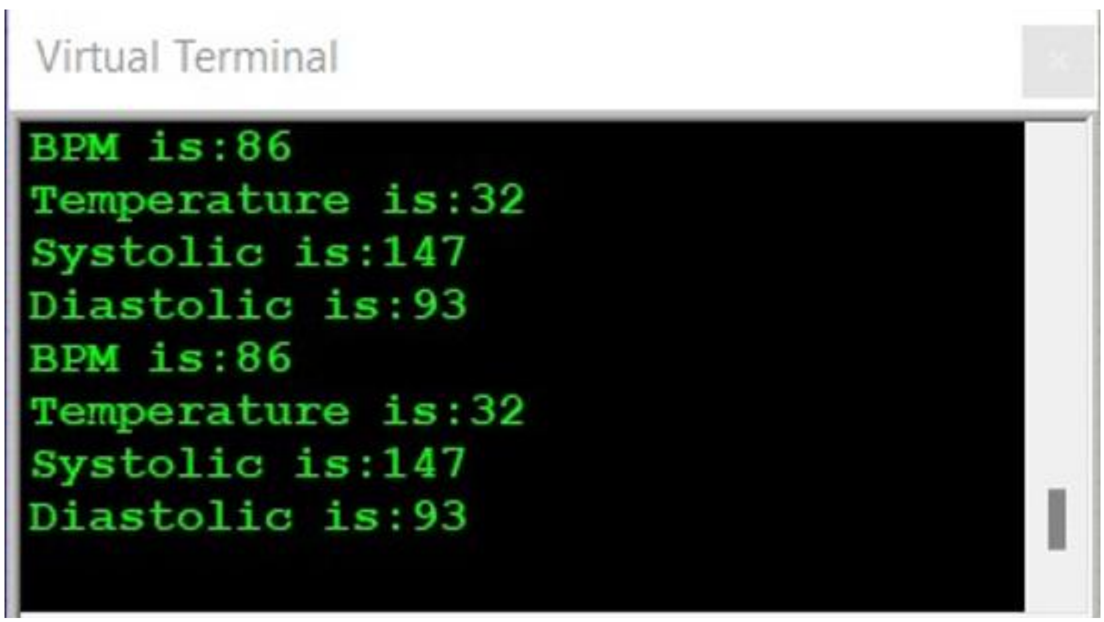

Figure 5.2: Proteus Simulation Result

5.2.2. Hardware Results

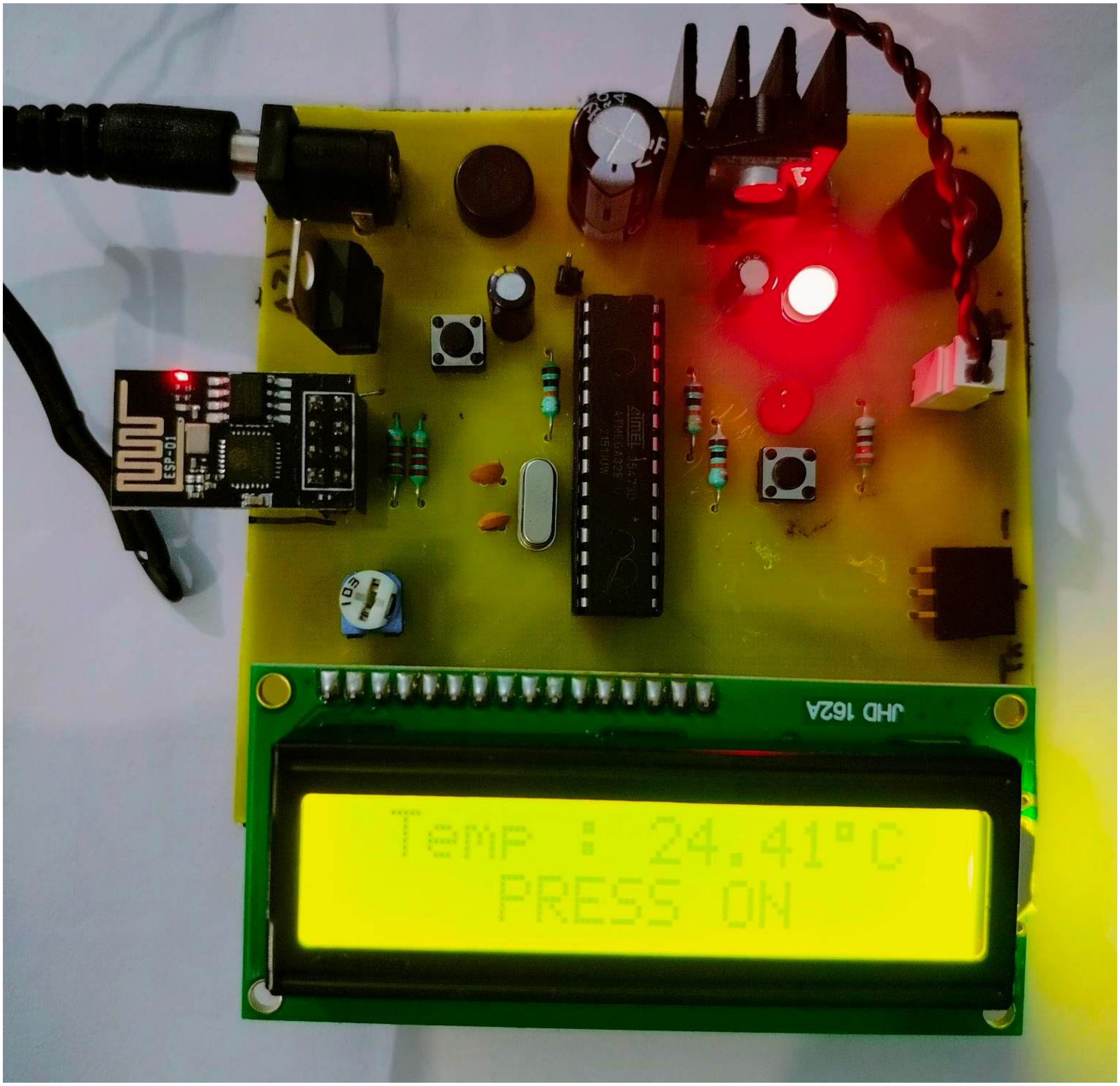

Figure 5.3: PCB Assemble

There are two components to the system: the hardware itself, and a mobile application. Both components are necessary for the system to function, and consumers will get benefits from employing both. The circuit design and flowchart used to construct this system are depicted in Figures 5.2 and 5.3, respectively. A diagram of the test version of the system is shown in Figure 18. Here, a node microcontroller unit (MCU), a Bluetooth module, a liquid crystal display (LCD), a buzzer, a pulse sensor, a temperature sensor, and a host microcontroller unit (H The system displays the measured data, including heart rate, SpO2, and core temperature, and sounds an alarm if the heart rate or SpO2 readings are outside of a predetermined range. This early version of the system is intuitive and straightforward. Being a lightweight prototype, it can be transferred conveniently. Since everything is in its proper place, the end result is good.

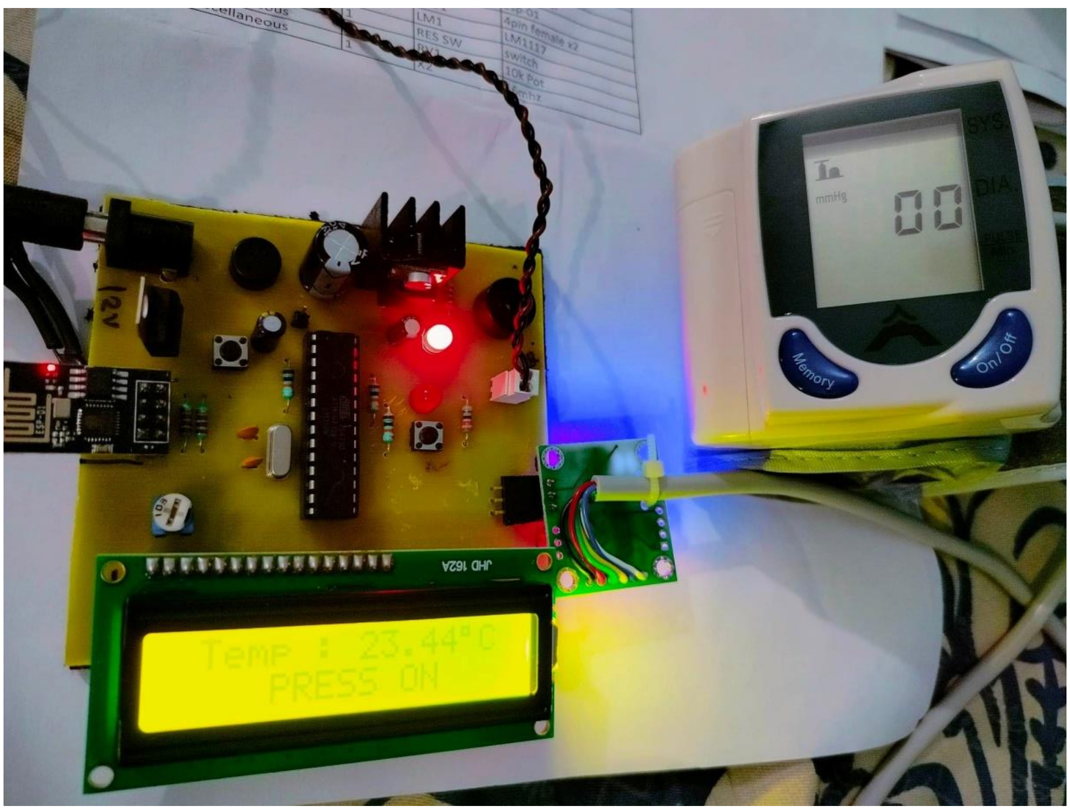

Figure 5.4: Atmega Connected with the pressure sensor

A standalone analysis of the system confirmed its sufficient functionality. Therefore, the project's system design and implementation were successful, and the users' data were measured accurately. Two key components work together to form the whole system. The system's LCD and accompanying mobile app both display measured values of the user's vital signs.

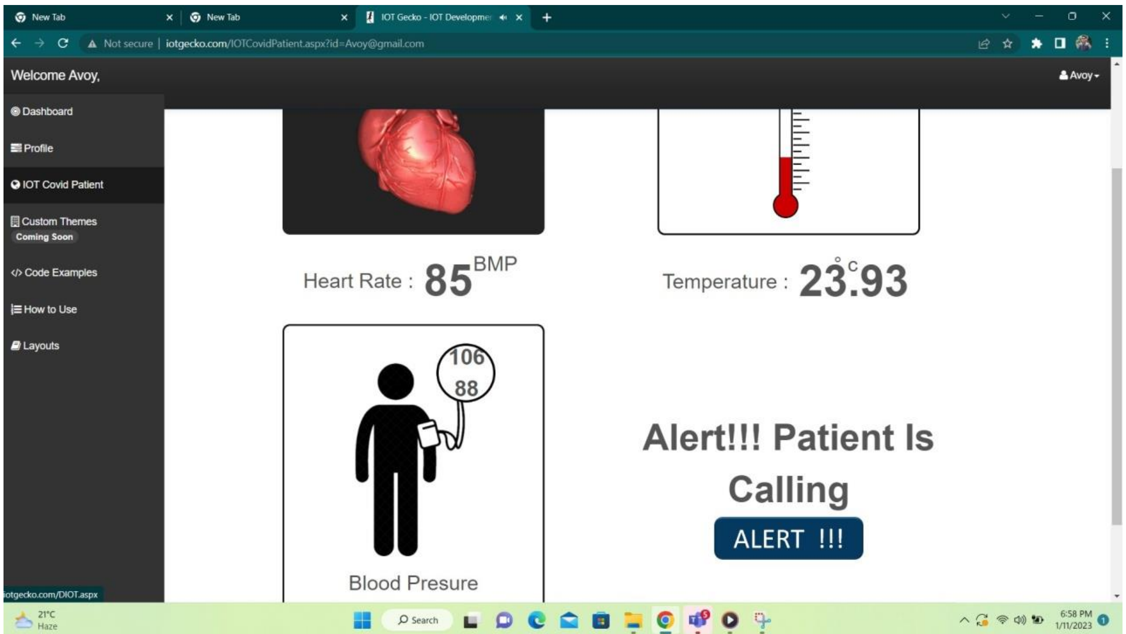

Figure 5.5: Web application Interface

New users can create an account by supplying the usual login information: a user name, an email address, and a password. After signing up, the user will be redirected to a new interface with a login button, and their information will be stored in the cloud-based service firebase. The user can enter the mobile app by tapping the login button. This screen will load after you log in successfully. The patient's measured data is accessible by pressing the normal user button. Using the doctor portal, doctors may keep an eye on their patients' vitals and other tracked data. Another option is a logout link. The mobile app has a logout option users can use to sign themselves out. Displays a typical interface for operating a device. Whenever the patient selects the "regular user" tab, this window will pop up. A user's oxygen saturation and heart rate data are displayed in this interface after clicking the check health condition button. Inputting the patient's SpO2, temperature, and pulse rate into the mobile app is as simple as tapping a button to establish a connection with the server. The measured SpO2, pulse rate, and temperature curve is depicted in Figure 15(b). To access the COVID-19 patient portfolio, the user will see a screen similar to

Figure 5.5 when they click on the link. The doctor can view the patient's measured temperature, SpO2, and pulse rate by clicking the check patient button, as depicted in Figure 5.5.

Figure 5.6:whole project setup

A live human being was used to test the technology. The user's vital signs and their measured values are depicted in Figure 19. The user can view the measured data for their heart rate, SpO2, and temperature on the LCD and through mobile applications. One of the core features of this system is the transmission of data to a mobile app. This device is user-friendly and easy since it allows users to access the necessary data via a mobile app. This system fulfilled its intended function.

5.3.Comparison of Results

As the number of people living in poor countries continues to rise, so do their healthcare needs. Due to the high contagiousness of the covid-19 virus, it is essential to confine infected persons while simultaneously having medical examiners monitor the health of covid-19 patients. As the number of people in quarantine grows, it becomes more difficult to monitor their health. Here is an example of a recommended machine layout for an IoT-based Wi-Fi sensor network. Its usual function is to collect and relocate the many sensors used for monitoring patients in healthcare facilities. The wireless local area network (Wi-Fi) in this program communicates with various sensors—including a thermometer, a blood pressure monitor, and a pulse oximeter—in the immediate vicinity of the transmitter. These sensors are attached directly to the patient and record data on the client's condition through the usage of sensors. A similar set of data is being transmitted wirelessly to the medical agent's receiver position, from which he would undoubtedly harvest all updates in their clients' medical statuses. In addition, it will actually remind people through voice message when it's time to take their medication. One loud bell will be placed next to each bedside in case of an emergency. When the patient presses the emergency button, the alarm will sound.

5.4.Summary

Thousands of people are dying every day as a result of the COVID-19 pandemic, creating a global health crisis. If treatment is given at the right moment, deaths can be reduced. Numerous measures have been adopted to guarantee effective treatment, such as routinely checking the patient's pulse, SpO2, and temperature. However, a COVID-19 patient's oxygen level falls over time, and the patient can quickly perish if emergency measures aren't performed. In light of the foregoing, we designed a state-of-the-art IoT-based health monitoring system specifically for people with COVID-19. An Internet of Things (IoT) mobile app serves as the system's brain, relaying signals in times of crisis to both the treating physician and the patient. This technology can therefore be used efficiently by anybody everywhere in the world. Being an IoT-based system allows for the addition of more advanced features in the near future.

Chapter 6

CONCLUSION

6.1. Summary of Findings

Several isolation facilities for patients infected with Covid-19 are set up during the pandemic. Isolating patients is crucial since the disease is so contagious, but doctors also need to keep an eye on their progress. Because the symptoms of this unique virus vary widely from strain to strain, it is challenging for frontline healthcare workers to avoid contracting the disease. It can be difficult to keep tabs on the health of a large number of patients who are isolated in a rural area or at home [25]. The number of seriously ill individuals and the severity of their conditions both continue to rise. An Internet-of-Things-based remote healthcare system that tracks vital signs is presented as a solution to this issue; this would allow for the rapid tracking of many corona virus patients. Sensors collect data on vital signs including heart rate, oxygen saturation, and temperature, which are then sent to a microcontroller-based system that then shares the information with the world via the Thing Speak platform. If something seems off, or if the patient touches the emergency button, an alert will be sent. Thanks to this setup, doctors may safely watch their patients from a distance. It is possible for a single physician to treat over 500 patients simultaneously. Extreme changes in health status will trigger an instant notification to the attending physician. In this difficult era, this system aids in obtaining readings of various bodily parameters of patients, collecting and sending data to the server, and using the recorded data in the monitoring system, all while protecting healthcare professionals from contracting any infectious diseases.

6.2. Novelty of the work

To deal with the present COVID outbreak, we have established designated Covid 19 Quarantine Centers. Patients with covid should be quarantined constantly since the disease is so contagious, but doctors also need to check on their health frequently. As the number of confirmed cases rises, it becomes more challenging to monitor the health status of all the isolated individuals. These are the most significant issues: First, doctors should check in on their patients frequently. Second, for the sake of surveillance alone, the doctors are exposed to a potentially deadly virus. The number of people who need to be watched by doctors is growing rapidly. We're here to help by creating a system for remote IoT-based health monitoring of numerous covid patients simultaneously. The patient's heart rate, body temperature, and blood pressure are all tracked by the system's many sensors [26]. After that, it sends the information via wifi transmission by hooking up to a wifi internet connection. A microcontroller controls the entire system. The IoT Gecko platform (IoT development platform) sends and receives patient data over IOT so that it can be shown on a remote device used by the covid patient. If a patient has a medical emergency and clicks the IoT device's "help" button, a remote alarm is delivered via IoT. The temperature sensor, together with the blood pressure and heart rate sensor, are linked to the system. Then we just need to wrap the sensor around the patient's wrist and attach the blood pressure and heart rate monitor. After being powered on and displaying the patient's blood pressure, it is uploaded to the IoT display with a single click. We'll use the system-integrated temperature sensor to keep an eye on things. We will demonstrate the increase in temperature by lighting the lighter in front of the sensor. As the camera approaches the temperature sensor, the temperature rises and the data is uploaded to the Internet of Things.

6.3.Cultural and Societal Factors and Impacts

With the development of the Internet of Things (IoT), the information system has the potential to alter our society in the same manner that other technologies have in the past. The effects of the Internet of Things (IoT) on management and globalization are discussed in this study [27]. Decision making, communication, economics, social/cultural behavior, science, military strategy, and politics are all influenced by the Internet of Things and how it develops. The Internet of Things has been a boon to numerous industries, including transportation, healthcare, entertainment, finance, and academia. With the widespread use of AI-based systems and the IoT, there will inevitably be an increase in both the frequency and severity of security breaches and attack vectors in the computing realm. This new technology will undoubtedly have some unintended consequences, which will necessitate a systemic approach to their management.

6.4.Limitations of the Work

Since all of the linked devices send data in real time, protecting users' privacy is a major concern with IoT. If the data transfer between the two ends is not encrypted, sensitive information could be compromised. This information can be used by criminals for their own ends. Managing this much data in real time could introduce errors. Although IoT has the potential to save healthcare costs, the initial investment and ongoing upkeep of all the necessary equipment can be fairly pricey. If you enjoy the blog and think it would be helpful to others in the AI community, please forward this message to them. Those interested in mastering the finer points of Deep Learning, Data Science, and Machine Learning should continue their education. Proceed with Expansion [28].

6.5.Future Scopes

Injured patients or those living in remote places may have trouble getting to the hospital. As a result, they can consult their doctors via video chat. Help reduce healthcare costs and boost productivity. To keep track of their health, patients can use this app on their smartphones. The positive effects of are expected to Patient outcomes will improve and healthcare management expenses will decrease as a result of enhanced IoT and tailored therapy [29]. With the help of IoT technology, doctors can monitor their patients from afar and organize appointments more effectively. Patients can also lessen their reliance on medical professionals and the probability of receiving incorrect medical treatments in hospitals and clinics by enhancing the quality of care they receive at home. As a result, it's possible that both the quality of medical care and patient safety will increase, while the cost of treatment would drop. The Internet of Things has the potential to greatly improve medical care. In the near future, people will be able to use a health monitoring system from the convenience of their own homes, which will greatly improve efficiency in healthcare facilities. Densely dispersed Internet of Things sensors are needed for constant body and environmental monitoring. The results of this work will allow for better monitoring of chronic disease management and recovery. IoT will allow for reliable data connections from a variety of locales, opening the door to the future of virtual consultations for remote medical care.

6.6.Social, Economic, Cultural and Environmental Aspects

6.6.1. Sustainability

The spread of Coronavirus has exploded in recent years. In March of 2020, the WHO issued a global pandemic alert for COVID-19. The CDC in the United States and the WHO in other countries kept tabs on the pandemic's effects and posted updates on their respective websites. COVID-19 is used for this purpose in the medical field, specifically in monitoring the well-being of patients. The effectiveness of medical devices is improved by the IoT because wearable devices can be used to keep tabs on patients' health data in a way that eliminates the need for human intervention. Through a gateway, medical devices send the patient's data to the IoT, where it can be stored and analyzed. Finding a way to keep track of everyone who has been affected from different locations is a major challenge for the widespread use of cloud computing in medical applications. As a result, cloud computing in IoT provides a substantial answer to the problem of inexpensively tracking individuals and enhancing the medical industry's capacity to diagnose and cure disease. Constant attention is paid to the patient's heart rate, oxygen levels, and respiratory rate.

6.6.2. Economic and Cultural Factors

Bringing up issues of cultural diversity may not be comfortable ground for a healthcare provider to explore. However, it is a crucial aspect of becoming a good doctor. Diagnosis and treatment are heavily influenced by cultural norms and practices, especially by biological causes but also by social ideas. It is important for medical professionals to understand the following cultural factors in order to provide better treatment for their patients. Whether at home or abroad, everyone carries with them a set of values and ideals that were instilled in them by family and friends. Asians and Pacific Islanders, for instance, have a strong cultural emphasis on family. Family honor and family interests are often prioritized over individual needs. Health care providers would do well to keep such scenarios in mind. Those that are devout don't treat their faith as a side interest. It's a lifestyle, and that can create complications for conventional treatment. There will be dietary preferences to take into account when defining any form of nutritional plan, such as the fact that Jews, for example, abstain from specific foods due to their religion. Still others might shun medical attention because they attribute their condition solely to divine intervention. One of the most influential cultural factors is the patient's actual physical reaction to the drug. Some people of non-Caucasian ancestry may have problems with the drug's metabolism, which could significantly impact their course of treatment. Compared to individuals of other cultures, Caucasian patients are better able to tolerate a larger range of drugs.

6.7. Conclusion

This research takes a thorough look at the many parts of the system and their respective contributions. It lays out a variety of options for achieving this system's planning goals. Our goal from the start was to create a system that could be used in the present pandemic and was based on a well-organized application. Patients with COVID-19, as well as those with a wide variety of other respiratory illnesses like COPD and asthma, can benefit from this device. Because of the system's low price, lack of patient discomfort, and adaptability, health checks can be performed in a variety of settings and on a wide range of patients. It also sends out instantaneous notifications to family members and medical professionals whenever a situation arises that calls for immediate attention. This method can help reduce the patient population by ensuring that everyone, even those in remote areas, has access to high-quality medical treatment in Bangladesh. Differentiating evidence of any medical illness early on might assist the patient take important actions, which may save the patient's life. Therefore, we need to deploy sophisticated health monitoring systems to ensure that everyone's life is safe. Overall, this technology is crucial in the healthcare field as it has the potential to extend the average human lifespan. Future iterations of this device can incorporate more sensors to track a wider range of human physiological states.

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Appendix A

Datasheet of the ICs used

```
#include <SoftwareSerial.h>

#include <LiquidCrystal.h>


#define esp_baudrate 115200


LiquidCrystal lcd(6, 7, 8, 11, 10, 9);

SoftwareSerial myserial(13, 12);    // RX, TX for blood pressure sensor

SoftwareSerial esp8266(3, 2);     // rx,tx for esp8266


#define help_tone buzz, 2000, 200


const int temp_sensor = A3;

const int help_switch = A0;

const int buzz = A4;

const int help_led = A1;


String id = "niks1137@gmail.com ";
```

```
String pass = "6380";

String ssid = "iot";

String pass_key = "project1234";


String data_pressure;

char  buff[15];


String send_data_string;

unsigned char alert = 0;

unsigned char system_alert = 0;


const int no_of_data = 5;

String main_data[10];

int sensorValue = 0;

unsigned int tempVal = 0;

float cel;

unsigned char alert_flag  = 0;

int  sys_u = 130, dia_u = 90, temp_l = 24, temp_u = 37, pulse_l = 30, pulse_u = 120;

int sys, dia, p, stay = 1;
```

```
void setup()
{
  esp8266.begin(9600);
  Serial.begin(9600);
  myserial.begin(9600);
  lcd.begin(16, 2);

  pinMode(temp_sensor, INPUT);
  pinMode(help_switch, INPUT);
  pinMode(help_led, OUTPUT);
  pinMode(buzz, OUTPUT);
  digitalWrite(help_led,HIGH);
  digitalWrite(buzz,LOW);
  lcd.clear();
  lcd.print(F("  COVID Patient "));
  lcd.setCursor(0, 1);
  lcd.print(F(" Health  Monitor "));
  delay(2000);
  digitalWrite(buzz,HIGH);
  send_data_string = String(sys) + '*' + String(dia) + '*' + String(p) + '*' + String(cel) + '*'
+ String(system_alert) + '*' + alert;
```

```
  Serial.println("send_data_string = " + String(send_data_string));

  send_parameters();

  delay(4000);

  lcd.clear();

}


void loop()

{

   myserial.listen();

   if (myserial.available())

   {

     while (myserial.available())

     {

       data_pressure = myserial.readString();

     }

     data_pressure.trim();

     data_pressure.toCharArray(buff, data_pressure.length() + 1);

     if (sscanf(buff, "%d,%d,%d", &sys, &dia, &p) == 3)

     {

       lcd.clear();
```

```
      lcd.print(F("sys | dia | puls"));
      lcd.setCursor(0, 1);
      lcd.print(sys);
      lcd.setCursor(7, 1);
      lcd.print(dia);
      lcd.setCursor(12, 1);
      lcd.print(p);
      read_temperature();
      process();
      read_helprequest();
      delay(500);
      send_data_string = String(sys) + '*' + String(dia) + '*' + String(p) + '*' + String(cel) +
'*' + String(system_alert) + '*' + alert ;
      Serial.println("send_data_string = " + String(send_data_string));
      send_parameters();
      delay(3000);
     }
    myserial.end();
   }
   else
   {
```

```
    read_helprequest();
    read_temperature();
    if(alert == 0)
    {
      main_display();
    }
    else
    {
     help_display();
     delay(200);
    }
  }
  myserial.listen();
  delay(1);
}


void read_temperature()
{
 float next_val = 0.00;
 for (int t  = 0; t < 1000; t++)
```

```
  {
    float prev_val = analogRead(temp_sensor);
    next_val = next_val + prev_val ;
  }
  tempVal = (next_val / 10000);     // depend on vlaue of resistor use in ckt
  float mv = (tempVal / 1024.0) * 5000;
  cel = (mv / 10);
  Serial.print("temperature: ");
  Serial.print(cel);
  Serial.println("C");
  delay(100);
}


void read_helprequest()
{
   unsigned char i = 0;
   if((digitalRead(help_switch) == LOW) && (alert_flag == 0))
   {
       delay(10);
       alert = 1;
```



```
      alert_flag = 1;

      digitalWrite(help_led,LOW);

      digitalWrite(buzz,LOW);

      help_display();

      send_data_string = String(sys) + '*' + String(dia) + '*' + String(p) + '*' + String(cel) +
'*' + String(system_alert) + '*' + alert;

      Serial.println("send_data_string = " + String(send_data_string));

      send_parameters();

   }

   else if((digitalRead(help_switch) == LOW) && (alert_flag == 1))

   {

      delay(10);

      alert = 0;

      alert_flag = 0;

      digitalWrite(help_led,HIGH);

      digitalWrite(buzz,HIGH);

      send_data_string = String(sys) + '*' + String(dia) + '*' + String(p) + '*' + String(cel) +
'*' + String(system_alert) + '*' + alert;

      Serial.println("send_data_string = " + String(send_data_string));

      send_parameters();

   }
```



```
}

void process()
{
  if((sys > sys_u) || (dia > dia_u))
  {
     system_alert = 1;
  }
  else if((p < pulse_l ) || (p > pulse_u))
  {
     system_alert = 2;
  }
  else if((cel < temp_l ) || (cel > temp_u))
  {
     system_alert = 3;
  }
  else
  {
     system_alert = 0;
  }
```

```
  delay(200);
}

void help_display()
{
   lcd.clear();
   lcd.print(F("  PATIENT NEED  "));
   lcd.setCursor(6, 1);
   lcd.print(F("HELP      "));
}

void main_display()
{
   lcd.clear();
   lcd.print(F(" Temp : "));
   lcd.setCursor(8, 0);
   lcd.print(cel);
   lcd.print((char)223);
   lcd.print('C');
   lcd.setCursor(4, 1);
```

```
    lcd.print(F("PRESS ON   "));
    delay(200);
}



void send_parameters()
{
  esp8266.listen();
  esp8266.print(send_data_string);
  delay(5000);
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print(F("Uploaded To IOT"));
  delay(200);
  esp8266.end();
}
```

Appendix B

iThenticate Plagiarism Report

AN IOT BASED COVID PATIENT HEALTH MONITORING SYSTEM IN QUARANTINE

ORIGINALITY REPORT

14%

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