IoT Based Remote Monitoring System for Coronavirus Affected People

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

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APPROVAL

This Project titled "**IoT Based Remote Monitoring System for Coronavirus Affected People**", submitted by Md. Sadiqur Rahman and Emran Hossain to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 05.12.2020

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DECLARATION

We hereby declare that this project has been done by us under the supervision of **Tajim Md. Niamat Ullah Akhund, Lecturer, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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ABSTRACT

In modern occasions the whole global is experiencing the coronavirus pandemic. In this paper we will introduce an IoT primarily based electronic tool to be able to help the medical doctors and nurses at some stage in the pandemic duration. The tool will have the option to gather scientific data from contamination, encourage individuals and ship those records to our created cloud based database. The accumulated data that is collected can possibly be tested from our information server. This tool will contain a temperature sensor, humidity sensor, pulse oximeter sensor and heart price monitoring sensor. It's going to use the built-in Wi-Fi communique medium to send the amassed data into the server. Afterwards, the ones data may be used for studies functions, file making and similarly utilization via the medical crew.

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CHAPTER 1

Introduction

1.1 Introduction

Now our world is rushed by technology. There is several things that plays a vital role in our lives and one of them is Internet of Things or called as IoT in short. It has developed the environment what joins numerous frameworks to produce brilliant exhibitions in each assignment. So it is high time to develop a semi-budget a device that help us in this pandemic situation. This project will result in a device and a monitoring database server to store the information of the patient which leads the safety of doctors and nurses because they don't need to come in direct contact with the patient to collect samples and information as well as medical teams to do further research and development. This project is based on microcontroller and several sensors. We have tried to make it cost friendly and equipped with several necessary sensors to make it versatile and easy to use without direct contact. It will gather information from that point and push the gathered information to the cloud based premade database through Wi-Fi. This framework can be useful for different purposes.

1.2 Motivation

Bangladesh is a highly populated country. Moreover the amount of Covid affected people is increasing at a tremendous rate. But it is a matter of fact that we have limited doctors, manpower and medical equipment for these huge numbers of people. So we have developed a device that will help us to gather the vital information of the patients who might be Covid affected. Moreover this device will be much cost friendly thus its applications would be easy. Moreover, keeping doctors and nurses safe should be our top priority as they are risking their lives and they are our last hope.

1.3 Objectives

- ➢ To reduce risks of COVID affecting and physical efforts for monitoring affected patients
- ➢ To increase efficiency of information collection of huge number of affected patients
- ➢ To reduce further Covid-19 spread in society

1.4 Features

We can observe different boundaries of the patient by the help of this device. The user or doctors as well can monitor from anyplace on the planet. The purpose for this is that the information should be checked by visiting a site or URL. Our device will contain the following features:

- Collecting real time body temperature using thermal sensor
- Getting the percentage of humidity using humidity sensor
- Collecting the rate of Blood Oxygen level using oximeter
- Getting the real time heart rate of the patient

This IOT based patient observing device contains with three important and basic sensors i.e. Blood oxygen level sensor, Pulse detecting sensor, Temperature sensor and moistness sensor. The user need just a Wi-Fi area for monitoring the patients. The NodeMCU board sends the collected information to the cloud to a specific web server address.

1.5 Social Impact

It is a significant sensors based task. It has a lot of future usages and preferences on the social side. IOT Healthcare is the most mentioning area of the clinical domain. This project of ours is for suspected covid affected patients. This endeavor really shows obliging when family members need to go out for some emergency work. Impediment patients can use this endeavor. This device is very helpful who cannot go to doctors or need to keep an eye on the health at all time, would b e very helpful.

1.6 Report Layout

The project report contains 5 chapters. Outline of all the chapters along with brief summary is shown below through box-flow representation:

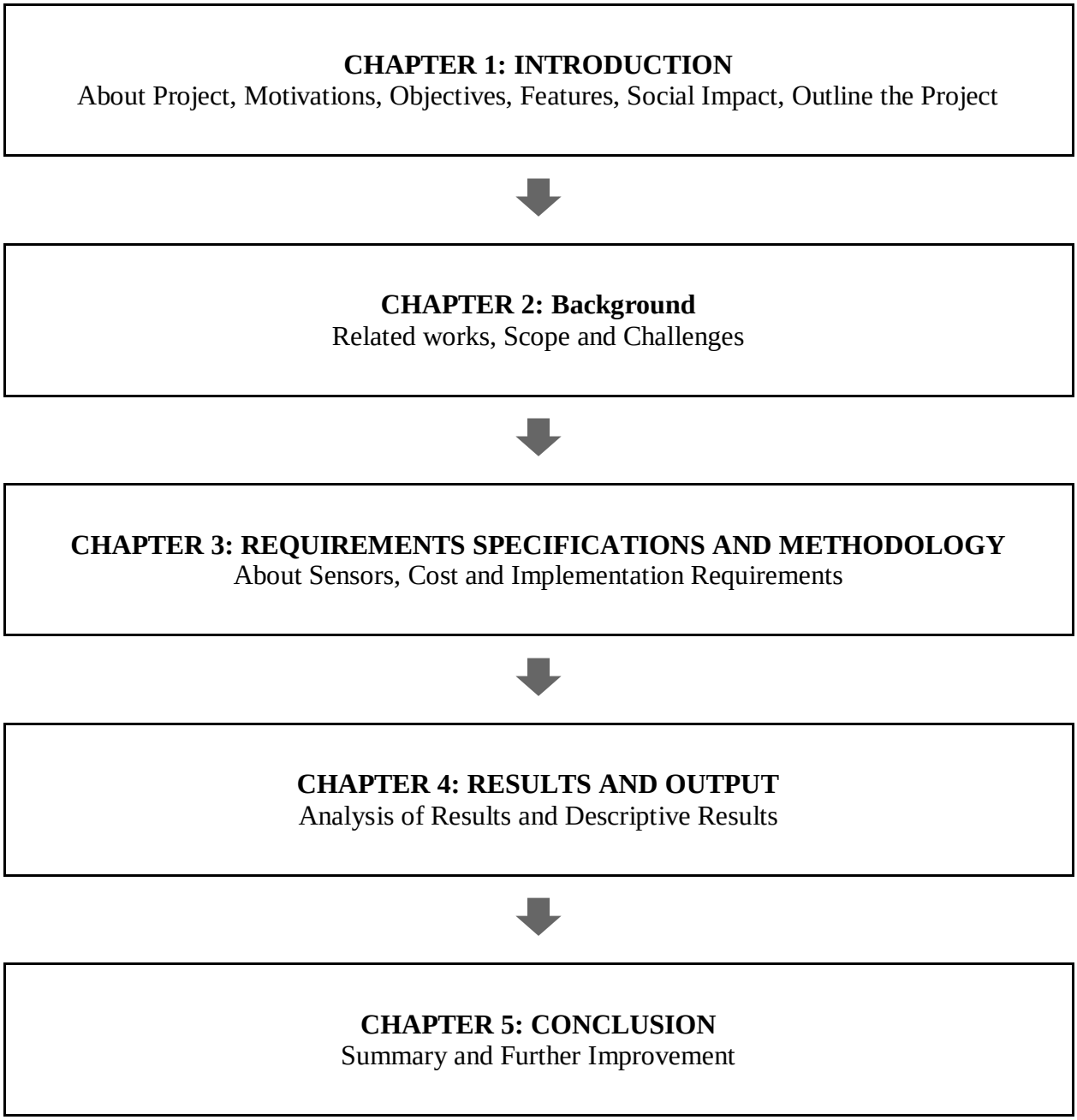

Fig 1.1: Outline of the Project

CHAPTER 2

Background

2.1 Introduction

We know last Year 31 Dec, 2019 in Wuhan, China, identified a dangerous virus called Covid-19 (Coronavirus). From this day the whole world faced a black shadow year for the impact of covid-19 virus. Each and every day for this virus there are more and more people affected. The covid-19 spread with a short time around the world. Every day the doctor testing more than 10 lakhs samples of a covid-19 n affected people in the world. And the person who tested the sample was also affected by the other affected person. Because we know by the breath of affected people, other people can also affect us. The last update of Covid-19 are affected about 1 core, 20 lakhs, 94 thousands, 127 people (28.11.2020). Day by day it increased and died all over the world 1,449,709 persons. In our country this virus makes our life also very dark. And day by day Bangladesh goes on a dead city and it spreads in our country very fluently. So we decide that we can decrease the percentages affecting people in the country. Then we create an idea or systems that IOT based monitoring systems for COVID-19 affected peoples. At first we just realize how we can take the affected people's sample without any kind of risk. We research on Google and we study about this type of problem or project and how we can solve this type of problems. We saw some similar projects as us like open source pulse oximeters for covid-19, non-contact thermometer, thermal detector, covid-19 detector and more. We also read some of this type of IoT based projects like detecting symptoms with raspberry pi, using smartphones to report sickness, mapping the outbreak, caring for patients with wearable, measuring air quality with IoT sensors, measuring temperature with the hit machine also. It can easily take human temperature, humidity of the human body and pulse of affected people without any kind of harmfulness. Whenever it ensures that all ranges are high then it should be mentioned that the given sample person is affected by the covid-19.

2.2 Related Works

According to some projects we read and read about this project field and we ensure that there are lots of small projects as our project. But detecting symptoms with raspberry pi is too much better than other projects. We just forward this type project. To fulfill our objective we need to make unique systems to take the temperature, humidity, and pulse to ensure that the person who is given a sample is affected by the corona. There are some unique systems that work in our ideal sides all over the world. But we can see mostly the use of temperature testing machines and it needs to be handled for a human hand too.

2.3 Scope of the Problem

From the problem, we will obtain:

- ➢ This activities control framework naturally not a remote organization manufacturer
- ➢ Sensors work in a restricted distance of the territory
- ➢ Decrease percentages of affected people of covid-19 but not fully prevent Covid-19
- ➢ We cannot take any kind of inner human body sample
- ➢ System error can cause wrong accuracy of the sample taken

2.4 Challenges

Whenever we study about our project then we see about 93 small projects as our project in the project hub. We saw some similar projects as us like open source pulse oximeters for covid-19, non-contact thermometer, thermal detector, covid-19 detector and more. We know that no other project is challenges free so by reading this type of project we saw that in each and every project the developer faced some challenges. We know that outside of our country's developers they cannot afford to buy a project's components because in foreign countries this type of project's components are very available. But we can see that some of these types of projects have faced big challenges like they developed a project but they can't get enough help from the government and we know most of the country cannot give funds for the small project.

CHAPTER 3

Methodology, Requirements Specification and System Design

3.1 Methodology

In our project, we used NodeMCU microcontroller which is low in budget and also is integrated with Wi-Fi. We have several sensors for collecting data from the COVID affected people. Such as Blood Oxygen Sensor, Pulse Sensor, Temperature Sensor and Humidity sensor for collecting moistness of the patient. To measure the blood Oxygen saturation and Pulse of the patient, we use MAX30100 Heart-Rate Oximeter Pulse Sensors. We can also add more different sensors to broaden the capability of our project. To present those gathered worth information an OLED modular display is available then those gathered information send to a free working cloud database name as ThingSpeak through Wi-Fi medium. We will connect the ESP8266 with our Wi-Fi by the SSID and Password then the device can permit data to the cloud database.

The detailed picture of our system and circuit design is in the following figures. The working procedure of our project is given below as algorithm:

Stage no. 1. Power on

Stage no. 2. Connect the Wi-Fi

Stage no. 3. In the event that association is alright, gather information with sensors.

Stage no. 4. Collect Temperature and Humidity with DHT11.

Stage no. 5. Collect Blood oxygen level and Pulse with MAX30100.

Stage no. 6. At that point sends the information to the proclaimed cloud worker

Stage no. 7. Reserve the information and make further moves.

Moreover, we use C++ language to program the device. The unit framework follows the stream graph referenced in Fig. 3.1.

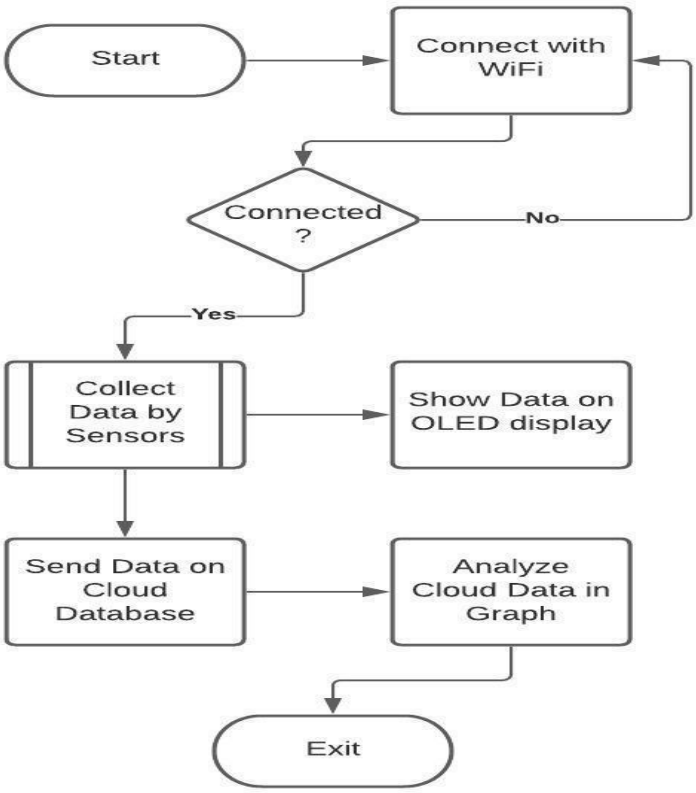

Fig. 3.1: Flowchart of Algorithm

The figure referenced in Fig. 3.2 shows how the information is gathered with sensors and shipped off the worker through Wi-Fi. Power source is likewise referenced.

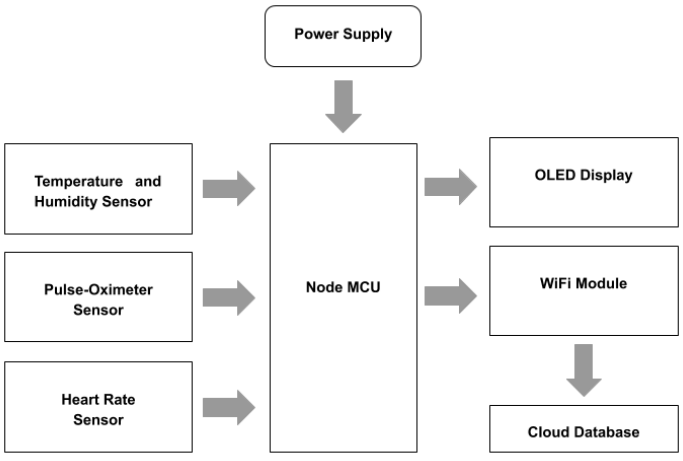

Fig. 3.2: Diagram of Block level

In the above diagram of block level, we can see our microcontroller and available sensors of our project. We also can see the database where all the data will be kept for monitoring and research purposes.

3.2 Requirements Specification

Wellbeing checking is a serious issue during this day and age but once its return to Covid influenced people, it gets a lot of touch-and-go. Attributable to absence of acceptable welfare perceptive, patients even as Coronavirus influenced, expertise the unwell effects of real medical issues even as it threatens the specialists and attendants.. Their square measures a lot of IoT gadgets currently to screen the soundness of patients over the net. Welfare specialists square measure in addition exploiting these savvy gadgets to observe out for his or her patients. With a vast lot of new medical services innovation, new businesses, IoT is quickly ever-changing the treatment trade. In our endeavor we've utilized the followings:

1) NodeMCU ESP8266 Microcontroller
2) DHT11-Temperature and Humidity Sensor
3) MAX30100 - Pulse-Oximeter and BPM Sensor
4) Heart Rate Sensor
5) Breadboard
6) Male and Female Connecting Wires
7) Power Cable
8) OLED Display

3.2.1 NodeMCU ESP8266 Microcontroller

Fig. 3.3: NodeMCU ESP8266

Table no. 3.1: Specifications of NodeMCU

Specification Chart	
Name	NodeMCU ESP8266
Working Voltage	3.3 V
Voltage Range	7-12 V
SRAM	64 KB
Number of Pins	16

Product Description

NodeMCU is a partner ASCII text document based code mostly and improvement board exceptionally focused for IoT based Applications. It has clock speed of 80MHz. It contains 128 PC memory unit random access memory and 4 megabytes of non-unstable capacity for storing projects code.

3.2.2 Temperature and Humidity Sensor - DHT11

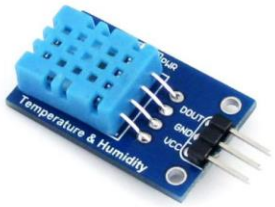

Fig. 3.4: DHT11-Temperature and Humidity Sensor

Table no. 3.2: Specifications of DHT11-Temperature and Humidity Sensor

Specification Chart	
Name	DHT11
Dimension	15.5mm x 12mm x 5.5mm
Max Current	2.5mA
Input Voltage	3-5V
Number of Pins	4

Humidity Range	20-80%
Temperature Range	0 to 50℃
Accuracy	Humidity 5%, Temperature ±2℃

Product Description

The DHT11 may be a basic, radical cheap digital temperature and humidness device. It uses a electrical phenomenon humidness device and a semiconductor to live the encompassing air, and spits out a digital signal on the information pin (no analog input pins needed). It's fairly easy to use, however needs careful temporal order to grab knowledge. It will get new knowledge from it once each a pair of seconds, thus once exploitation the library from Adafruit, device readings is up to a pair of seconds previous. It comes with a four.7K or 10K resistance that you'll need to use as a pull-up from the information pin to VCC.

3.2.3 MAX30100 Heart-Rate Oximeter Pulse Sensor

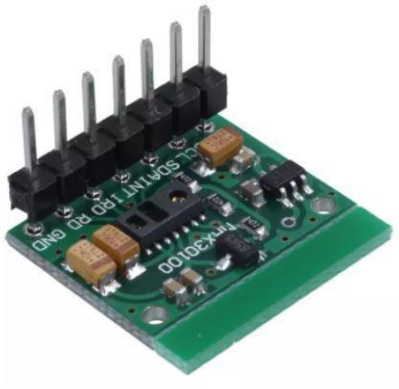

Fig. 3.5: MAX30100 Pulse-Oximeter Sensor

Table no. 3.3: Specifications of MAX30100 Pulse-Oximeter Sensor

Specification Chart	
Sensor	MAX30100 Heart-Rate Oximeter Pulse Sensor
Dimension	5.6*2.8*1.2 mm
Input Voltage	1.8-5.5V
Number of Pins	7
Number of LED	2

Product Description

It is an integrated pulse rate and oxygen level detector. Its associate optical detector that measure the absorbance blood pulse by a photo detector. This sensor has modified sensor of diode generate information from the tip of the finger. We can program it to do this work by C++. It has an I2C digital interface to talk with a variety of microcontrollers.

3.2.6 Connecting Wires

Fig. 3.6: Connecting Wires

3.3 Model Designing and Developing

3.3.1 Concept Design

According to our requirements, we have made a conceptual design. We have tried to standardize the design adopting all the required sensors, devices and microcontroller along it. If we need to upgrade or update anything, it should be done in conceptual design first. From this design we will design the final project and maintain a chain of designing. The following Fig. 3.11 is a conceptual design.

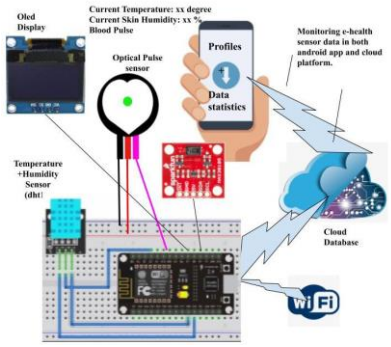

Fig. 3.7: Conceptual Design

3.3.2 Circuit Design

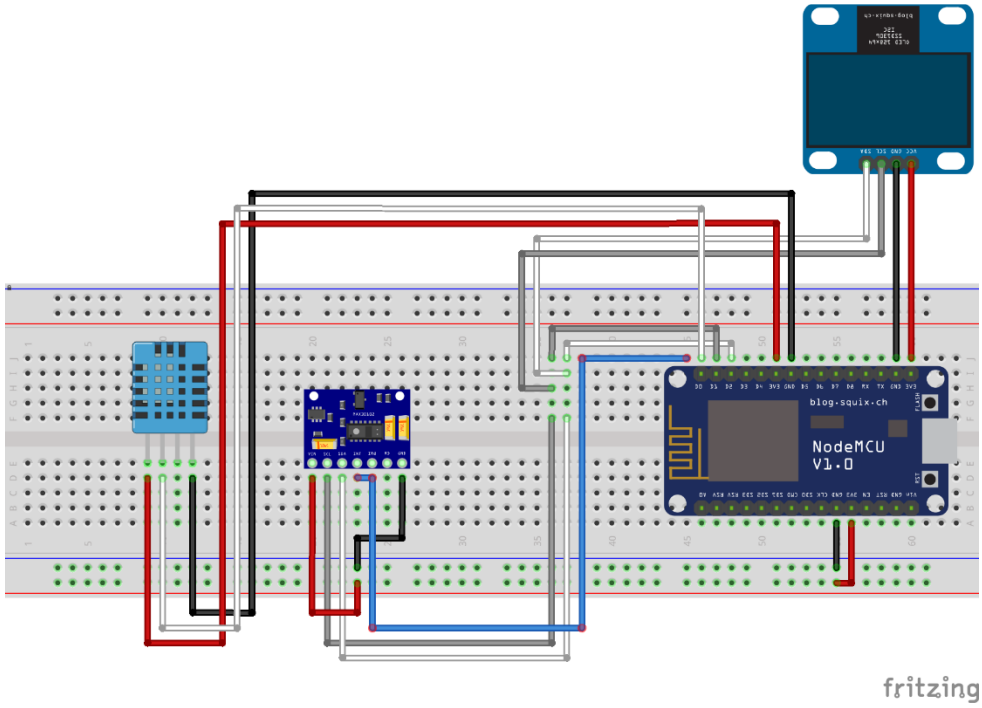

Fig. 3.8: Circuit Design of the Project

Components Required

- NodeMCU ESP8266 Microcontroller
- DHT11-Temperature and Humidity Sensor
- MAX30100 - Pulse-Oximeter and Heart Rate Sensor
- Breadboard
- Male and Female Connecting Wires
- Power Cable
- OLED Display

3.3.3 Pin Diagram

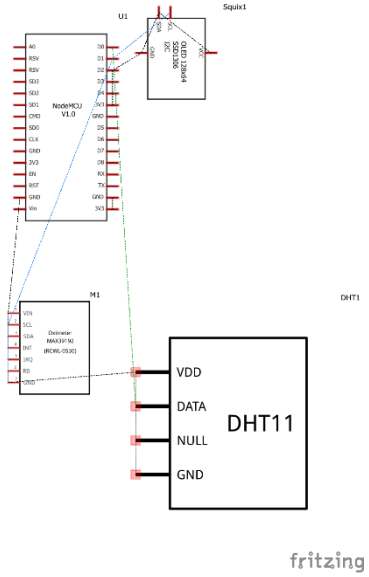

Fig. 3.9: Pin Diagram of the Project

The NodeMCU has three 3.3V outputs and three GRD pins for power. It has 2.4GHz Antenna for transmitting data. As shown in the pin diagram, we have connected OLED Display, DHT11 and MAX30100 in the 3.3V Output PIN and from D0 to D5 which results in Digital output. NodeMCU requires 5V Power supply to operate. It has a Vin and GND pin for transferring information from all the sensors to memory and then to the database.

3.4 Implementation Requirements

3.4.1 Node MCU (ESP8266) Installation

To install NodeMCU (ESP8266) on Arduino IDE, we have followed the following steps:

1. Open Arduino IDE.
2. Go to File
3. Select "Preferences"
4. Give “http://arduino.esp8266.com/stable/package_esp8266com_index.json”

in Additional boards manager:

5. Press the Ok key
6. Now, Select "Tools" > "Board" > "Boards Manager"
7. Type "Node MCU", then hit “Install”. Must connect your PC with the Internet.

8. Write code then Select “NodeMCU” board from the list
9. Connect NodeMCU with USB cable and upload the code.

3.4.2 Programming Language

To implement this project we need a programming language. We have used C as our programming language for this project. We use the language to run the hardware, receive data from the sensor, and display it in the display as well as to send it to the web server.

3.4.3 Database - ThingSpeak

We need to store the collected data into a web server. We have decided to use the ThingSpeak web server to store the data using POST method by NodeMCU Wi-Fi module. It is a free website that provides servers for educational purposes only. It has built in analysis widgets which help us to understand the data and express them easily for better understanding.

3.5 Summary of Project Cost

Table no. 3.6: Cost of the Prototype Project

No.	**Name**	**Price in BDT**
1	NodeMCU ESP8266	520/-
2	DHT11-Temperature and Humidity Sensor	150/-
3	MAX30100 Pulse-Oximeter Sensor	440/-
4	Heart Rate Sensor	750/-
5	OLED Display	420/-
6	Breadboard	100/-
7	Connecting Wires	20/-
Total Cost		**2400**

3.6 About Device

3.6.1 Temperature Getting Aptitude

We are using DHT11-Temperature and Humidity Sensor for this project. It's a easy, ultra ease but advanced hotness and stickiness receiver. It depends on a touch activating mugginess plate and a resistor which is strongly dependent on temperature to gauge the passing air from body, and lets out a forward sign on the information pin. It can get new information from a patient once after 2 seconds.

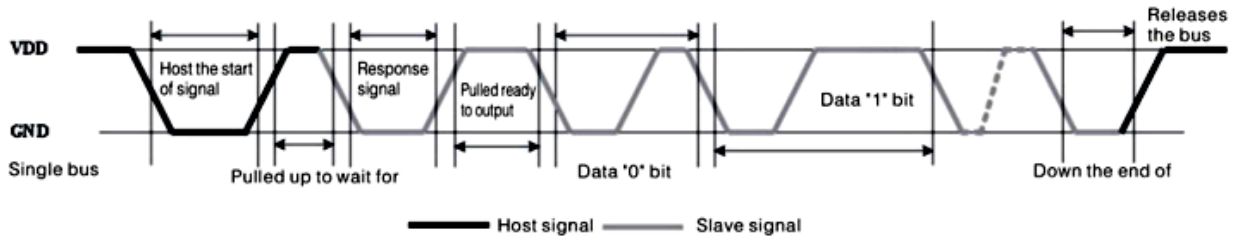

Fig. 3.10: DHT11-Temperature and Humidity Sensor Working Waveform

3.6.2 Humidity Finding Potential

We need to put the device close to the patient to detect the humidity level of the patient. It contains 1 Hz sampling rate per second. It is useful for 20-80% humidity with 5% exactness. During the usage of this device in 3.3V, the length of the connecting cable must be taken under 100cm to overcome the gap of line dropping in sensor supply which could cause bias of measurement. Otherwise it will lead to lack of line drop sensor supply, causing measurement bias. It has restricted long haul steadiness. It is touchy to dewing and certain forceful substances. Long term estimation is restricted because of required water hold and wick upkeep.

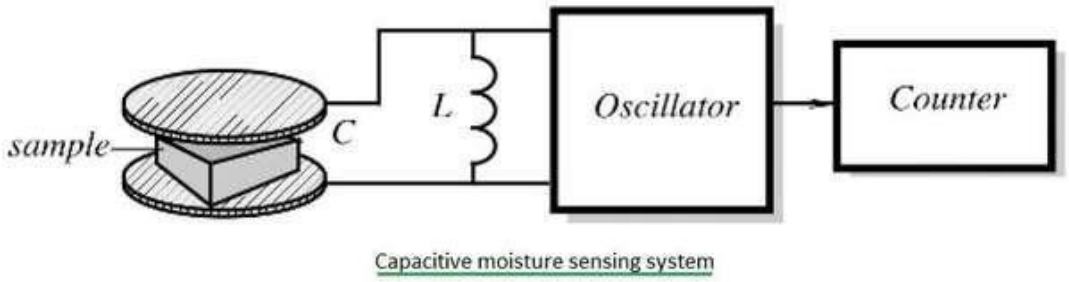

Fig. 3.11: Capacitive Humidity Sensing

3.6.3 Pulse Oxygen and Heart Rate Monitor Capability

Heartbeat Sensor includes red signal light which travel through the skin tissue then estimating intromission of blood by catching various measures of signal which get bended by shifting bulks of blood stream which happen during heart siphons. Next, signal-preparing calculations measure the position to transform crude data useful measurements i.e. pulse, breathing quantity, circulatory strain, and more. There are five primary difficulties that sway the precision of Pulse sensors today: Optical Noise, Sensor location on the Body, Skin tone, the Crossover problem and Low perfusion.

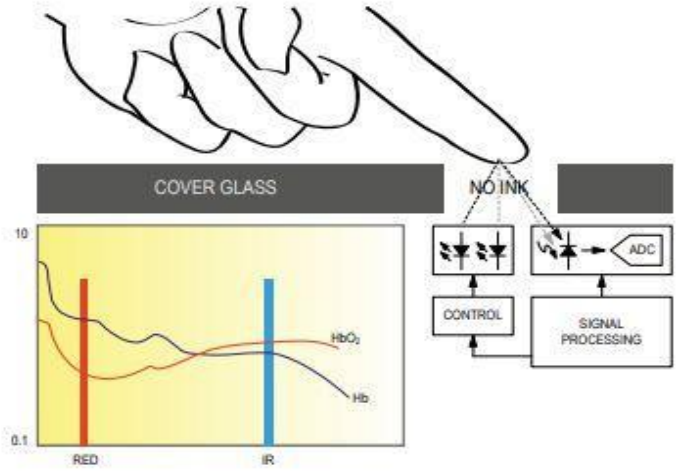

Fig. 3.12: Pulse Sensor Working Diagram

The live design of our project is shown in Fig. 3.15.

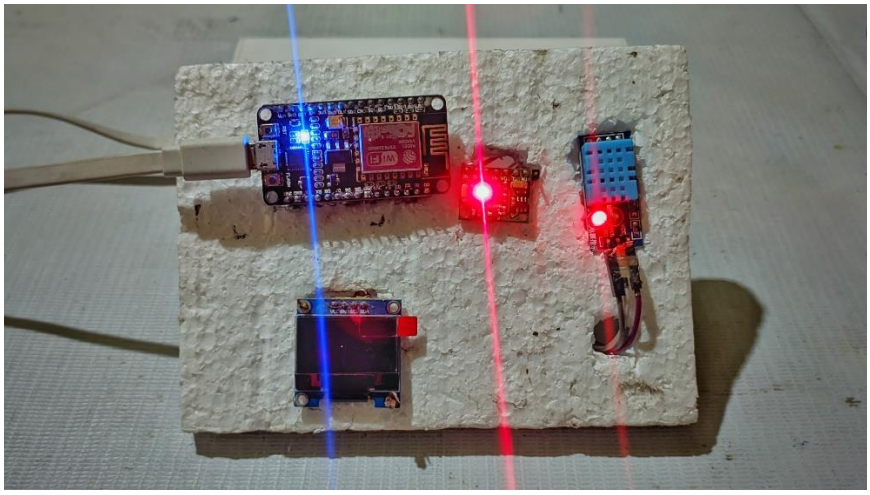

Fig. 3.13: Live Design of Project

CHAPTER 4

Results and Discussion

The monitor is additionally used severally. Generally, it's really effective for virus affected folks' observance. Once testing, we are going to Say it's going to be essential for doctors to safeguard themselves from being affected. Finally our device has obtained the stated results during testing:

- ➢ It will be placed close to the virus affected patient wherever risk consist for normal people.
- ➢ Collect data by sensors and Send them to cloud by Wi-Fi.
- ➢ Easy for upgrading with other sensors.
- ➢ The obtained information have been monitored by mobile and computers.
- ➢ Following address shows the live data of the patient: https://thingspeak.com/channels/1245518

The final prototype, data collection module NodeMCU ESP8266 with sensors is shown in Fig. 4.1 and the OLED monitor is shown in Fig. 4.2. We cannot use OLED and two different sensor at the same time. So we need to stop using one of the sensor for testing the display.

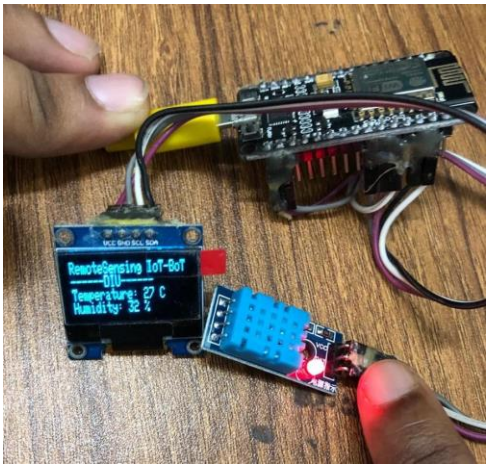

Fig. 4.1: The Working Prototype of Our Project

Fig. 4.2: OLED Monitor Display of Patient Status

The home page of ThingSpeak with information is presented in Fig. 4.3 as well as graph and gauge which is shown in Fig. 4.4. We can show the data in Blynk mobile application too which is shown

in Fig. 4.5. Now for this project we are using this free server to test that it can be connected with a custom server and mobile app too.

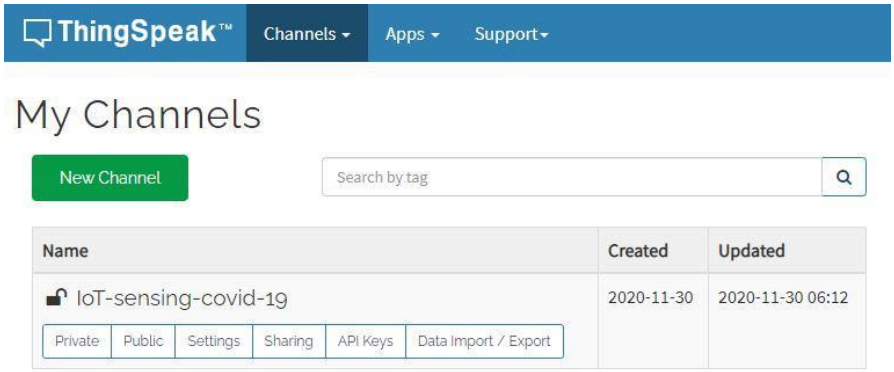

Fig. 4.3: ThingSpeak Home Page of Project

Fig. 4.4: Collected Data Graph in Cloud Server

Fig. 4.5: Collected Data in Blynk mobile apllication

The cloud server allows to download the information from the website in different file format such as csv, json or xml format. The information from the patient then visualize and analyze usign the built in matlab application from the ThingSpeak server as shown in Fig. 4.6. After that, we will conjointly take this information for research.

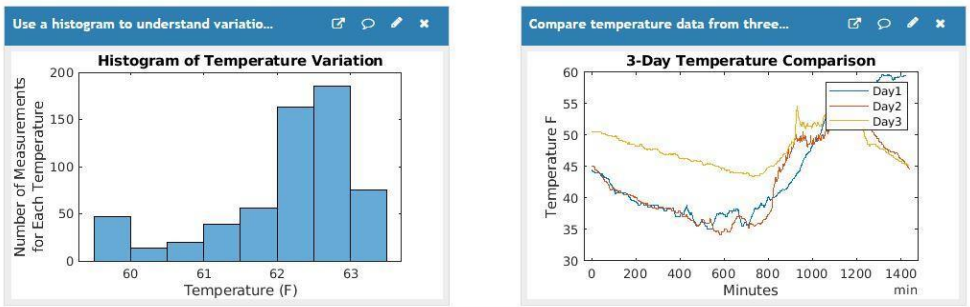

Fig. 4.6: Collected Data Visualization

CHAPTER 5

Conclusion

5.1 Future scope

We will be able to add a GPS sensor in this device for understanding, noticing, using the patient with the Node MCU. This tracking will discover the location or the locale of the patient. By then it will send this region to the cloud that is the IOT using the Wi-Fi module. By then specialists can discover the situation of the covid affected patient in the event that they need to make some preventive move. We can moreover add a Blood Pressure Sensor and ECG sensor consequently we can in like manner look at the BP of the patient also. Adding an external Display screen for live looking into the current status of the patient will moreover be possible. Also we can make an Android Application to show the data into our phone using Bluetooth accessibility.

5.2 Conclusion

We have implemented this project on several normal humans as well as patients. We have collected the data on the server from them and analyzed those data thoroughly and verified using a professional machine as well. The final result was very good and accuracy was about 97.8% at a preliminary stage. It helps the doctor to collect information without going near to the patient and maintain the safety.. Finally, after a lot of research and analysis, we confirm that our project is very effective for patients, doctors and general people for daily life usage.

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