"WIRELESS PATIENT HEALTH MONITORING SYSTEM USING IOT FOR COVID-19 PREVENTION".

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ABSTRACT:

Health has the prime importance in our day-to-day life. Sound health is important to try to to the daily work properly. As a results of the worldwide transmission of sever acute respiratory syndrome Coronavirus2 (SARS-CoV-2) and COVID-19 has evolved into an unprecedented pandemic. Internet of Things (IoT) enabled healthcare system is beneficial for correct monitoring of COVID-19 patients, by employing an interconnected network. This technology helps to extend patient satisfaction and reduces readmission rate within the hospital.

Covid-19 has become pandemic, spreading everywhere the planet . Scientists and engineers are working day and night to develop a vaccine, to evolve more testing facilities, and to reinforce monitoring systems. Mobile and web-based applications, supported questionnaires, have already been developed to watch the health of people . Internet of Things (IoT) are often wont to avoid the spreading of Covid-19. Internet of Things is an interconnection of physical devices and therefore the Internet. Devices are not only sense and record, but can also monitor and respond.

In this proposed system, we are going to monitor and keep record of patient health with the help of IoT and web application, system will monitor three parameter:

1. Temperature
2. Heart Rate
3. Oxygen level in blood.

As oxygen level in blood is very important parameter for patient who is found COVID-19 positive, proposed system will` send text message to family member about emergency alert using GSM modem.Here GSM modem 800C will be used to communicate with web application and send text message in emergency conditions.

Keywords ***: (IoT in Healthcare, IoT , web application, SIM800C, MySQL, PhpIoT).***

INTRODUCTION :

IOT Internet of Things is that the technology new connected through the web among different fields. The paper proposes the IOT based as a health monitoring system with Wi-Fi to detect the body parameters like temperature, pulse and also determine jaundice [1]. an internet based smart phone wise all the mobile connectivity anywhere anytime and therefore the sensor data are displaying via web application. the most aim of this research is to make and develop low cost meter for real-time in newborn based. From the compact sensors embedded within the patient's body, physiological data is collected consisting of varied necessary physiological parameters. Then alittle hardware capable of preprocessing the acquired data and a communication software to transmit that data. The sensors must be small, light-weight and not troubling the patient's mobility and movements. Those sensors must operate small, energy efficient batteries. The batteries are expected to be working continuously without charging and replacement.

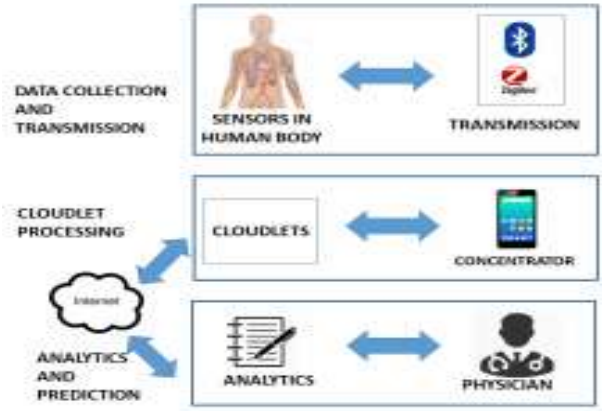

Fig1. Concept of IoT in HealthCare

An increase within the use of mobile technology and smart devices within the healthcare sector leads to a big impact on the planet . Potential development of new smart and powerful devices for monitoring of individuals' health, health experts are taking advantage of these technologies, thus a substantial improvement in healthcare in clinical settings and out of them. IoT allows integrating physical devices capable of connecting to the web and provides real-time health status of the patients to doctors. Chronic diseases such as diabetes, heart, blood pressure are remarkable in the world economic and social level problems. It can also provide a platform that allows public health agencies to access the data for monitoring COVID-19 pandemic. Fig. 1 shows the present trends of new cases of the top ten counties. New cases within the USA are increasing rapidly than in other countries.

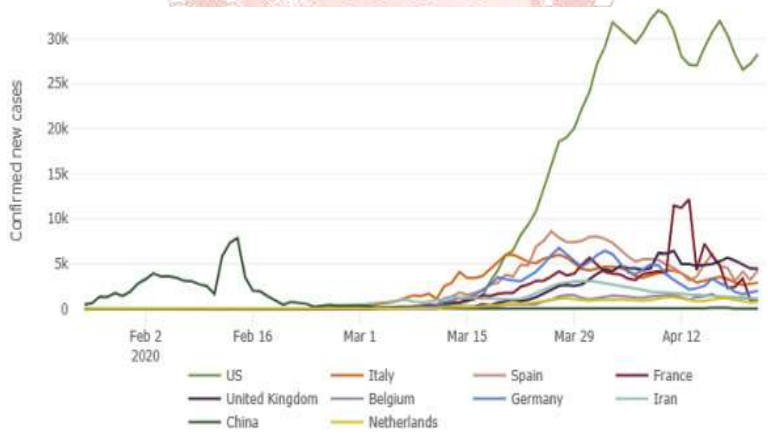

Fig. 2.Trends of new cases in the top ten countries [1].

COVID-19

Corona virus is transmitted to humans, birds, camels, pigs, rats, bats, and cats. Bat origin corona virus HKU2 was responsible for acute diarrhea syndrome in pigs in 2018. In November 2002, a novel beta corona virus resulted in nearly 8000 human infections and 774 deaths in 37 countries. In 2012, Saudi Arabia identified the Middle East Respiratory Syndrome (MERS) corona virus (MERS-CoV), which was the seventh member of the corona virus family. COVID-2019 is closely connected to other bat-origin beta corona viruses. Zhu et al. [2] COVID-19's first case was identified, and a cluster of unknown patients with beta corona virus pneumonia linked to the seafood wholesale market in Wuhan, China. A novel CoV (2019-nCoV) was detected in hospitalized patients in Wuhan, China, from December 2019 until January 2020. Evidence of this virus , discovery includes the identification of whole-, direct PCR, and bronchoalveolar fluid culture in three patients.

Phylogenetic studies indicated that 2019-nCoV falls into the genus beta corona virus, which provides for corona viruses found in humans, bats, and other wildlife (SARS-, SARS- CoV bat, and others) Guan et al.[3] analyzed the clinical characteristics of corona virus and extracted data from 552 hospitals in 30 provinces, autonomous regions, and municipalities in China from 1099 laboratory-confirmed COVID-19 patients through January 29, 2020. The patients 'median age was 47 years; the patients were 41.9% female. The primary composite outcome occurred in 67 patients (6.1%), including 5.0% who were admitted to ICU, 2.3% who were subjected to intrusive mechanical ventilation, and 1.4% who died.

ANALYSIS OF PROBLEM :

Oxygen percentage in blood is very crucial parameter for a patient who found COVID-19 positive along with the heart rate and temperature it's also very important to maintain the historical health related information of patient. The main target of this project is to monitor and send temperature, Heart rate(Pulse Rate) and Oxygen percentage in blood to remote web server for continuous monitoring and to maintain history of patients health. System will also alert family member of patient if any of three parameter found above or below threshold.

OBJECTIVES:

Integration of the IoT technology with e-Health solutions is the main focus here, that is, to show how IoT's main technology is useful in health care domain. Here we are going to use Blood pressure sensor, Temperature and Humidity sensor. Blood pressure sensor will be able to measure Systolic, Diastolic and Pulse Readings and send the reading to controller using UART Communication.

SIM900 GSM modem will create HTPP post request to web server to call php page and store reading in MySQL database. The data stored in database is now ready to publish to Doctor or family member to read the recent measured parameters. System will be always in operation and if found any measured blood pressure, pulse rate, temperature and humidity out of predefine range then system will send alert SMS to doctor and family member for help.

SYSTEM ARCHITECTURE :

The Architecture framework for IoT enabled e-health, can be best understood by visualizing the lifecycle of the various entities and their interactions. Fig 1 shows the proposed system architecture. The Architecture for e-health must consider the needs of each step in this life cycle and must address the effective and efficient execution of each function. The key to e-health architecture is to support an interoperable system of different types of devices, applications, and backend systems to enable the free flow information for precise and timely decision-making. The data flow architecture focuses on the source of the data, the destination the data and path the data. The source of the data is typically the sensor. The data can be either locally cached or sent to the upstream systems without storing in the sensor. The path taken by the data includes a gateway, which can also cache some of the data and do distributed processing.

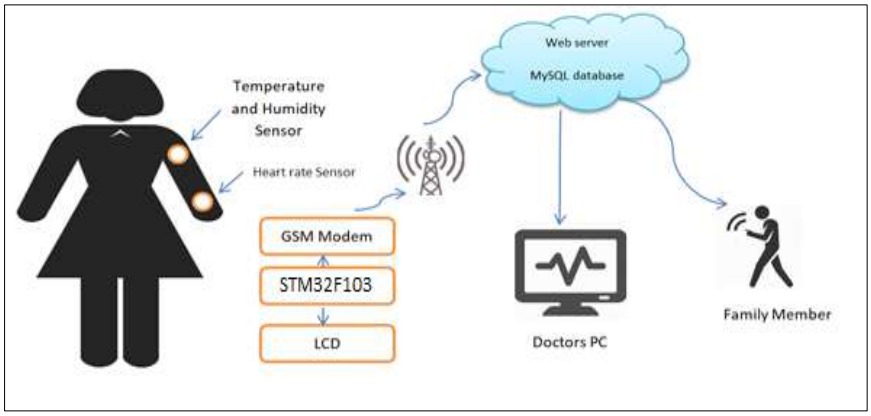

Fig 1: System Architecture

The family of STM32F103xx Microcontrollers consists of ARM Cortex-M3 32-bit RISC core, high speed embedded memories (Flash memory is up to 128 Kbytes and Static Random Access Memory (SRAM) is up to twenty Kbytes), I/Os (Input/Output) and peripherals which they're cooperating together by connecting to 2 APB (Advanced Peripheral Bus) buses. The STM32F103xx microcontroller includes many peripherals as well as two 12-bits ADCs, an Advanced Control Timer, three General Purpose 16-bit timers and also a PWM (Pulse Width Modulation) timer. It is also provided by two I²Cs (Inter-Integrated Circuit) and SPIs (Serial Peripheral Interface), three USARTs (Universal Synchronous / Asynchronous Receive Transmitter), an USB and a CAN (Controller Area Network) as the communication interface system.

MCU reads data from MAX30100 sensor using I2C protocol and temperature sensor using analog peripheral of STM32F103, after reading these sensor values MCU will command SIM800 to do and data transfer using HTTP protocol and put method. This data will be collected by web server using php web page and get stored in Mysql data base.

Once data is collected in Mysql data base of web server, data is now available to read an any time, so we are going to create a php page that will read data from data base and will display in on web page, for refreshing the live reading we have used jquery, by using jquery we called a update.php page in background in every 1 sec (1000ms).

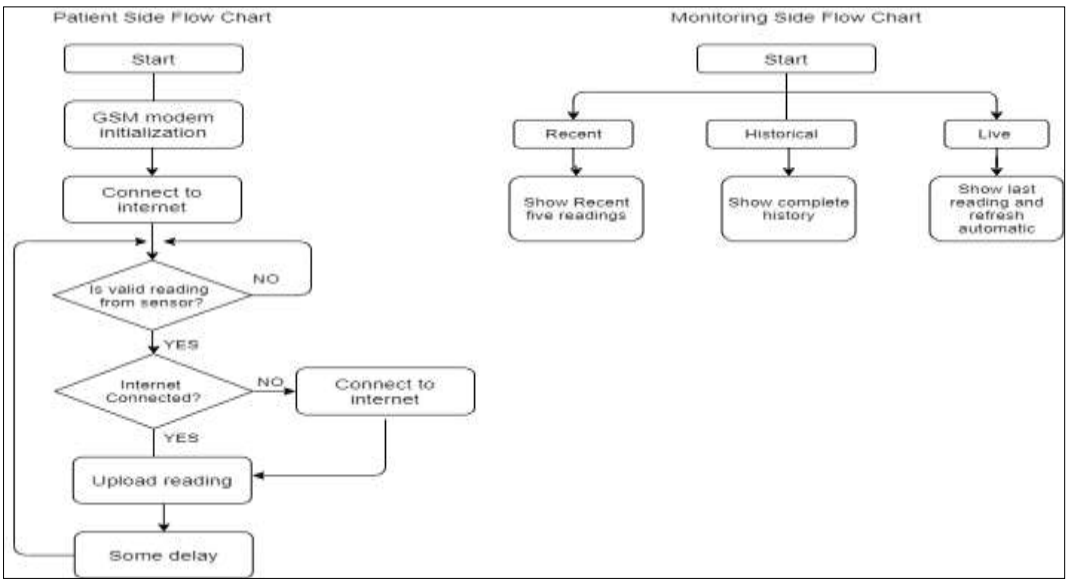

Fig 2: System Flow Chart

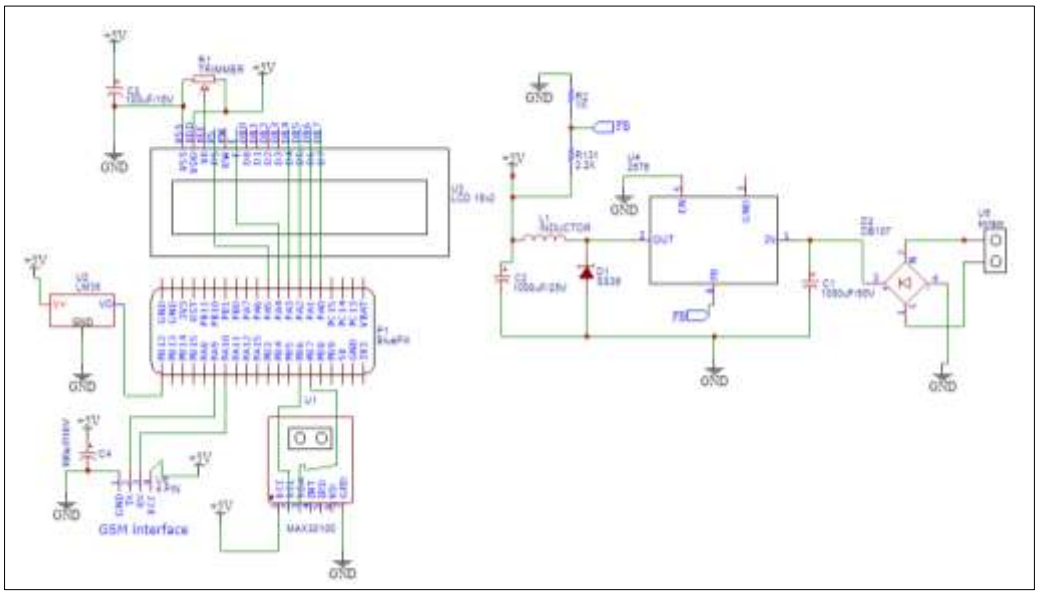

Fig3: Circuit Diagram

Fig3. shows circuit diagram for proposed system, LM2567 is a recommended part by SIM-com for supplying power to the GSM modem as GSM modem need current of nearly 2A when it's in transmission state, and in ideal state it consume about 200mA of current only. LM2576 is able to supply current of 3A so that's why LM2576 is the best option for supplying SIM800 modules.

Here 16x2 LCD is interfaced the system using 4-bit mode, it is also possible to interface LCB in 8-bit mode its it will be really complicated circuit to do so and will consume more time for soldering work, that why used LCD has a facility to communicate over 4 bit only. By using trimmer pot it is possible to adjust be contrast of LCD.'

INSTALLATION OF IDE AND TESTING

VS Code Installation:

Go to the official VS Code page to download and install the version that fits your environment.

Windows: installer ou ZIP, Install the PlatformIO IDE package for VS Code: VS Code has an extension manager (plugin) that can be opened via the View -> Extension menu or directly from the icon located in the sidebar, you can also invoke the extension manager with the CTRL + P key combination (or Cmd + P under macOS).Enter platformio in the search field.Click on Install to start installing the plugin and dependencies.

- **Create A New Project (STM32F103) :**

It is the time to move on to a small example to test it all out. Open the PIO home window (if necessary) and click +New Project to open the wizard for project creation.

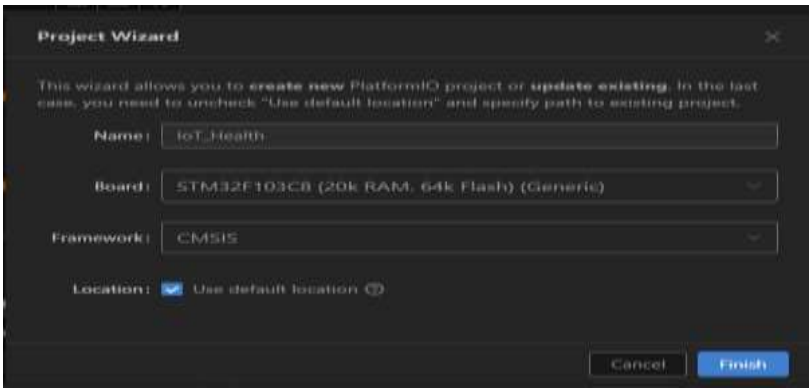

Fig-4 : New project wizard

Name the project then select the event board/ Controller from the list then select the specified framework from the available frame work list, click on finished and await the project to urge ready for you.

Once the project is prepared to create open main.cpp file and write lines of code and click on on build to create project, we will monitor any errors or warning during project building process on console window, if build finished successfully we will upload the code to focus on MCU using upload option, after upload IDE will automatically restart MCU and MCU will start running code.

Creating Data Base Table :

To create new tables inside a database, open the php My Admin tool, click on the **Databases** tab and click on the name of the specified database.

Fig5: Data base selection

On the new page that opens you will see a list of all the current tables inside the database and a section named **Create table**. In that section, in the **Name** field, input the desired new name of the table and then select the number of columns that the table should have via the **Number of columns** drop-down. When ready, click on **Go** to create the table.

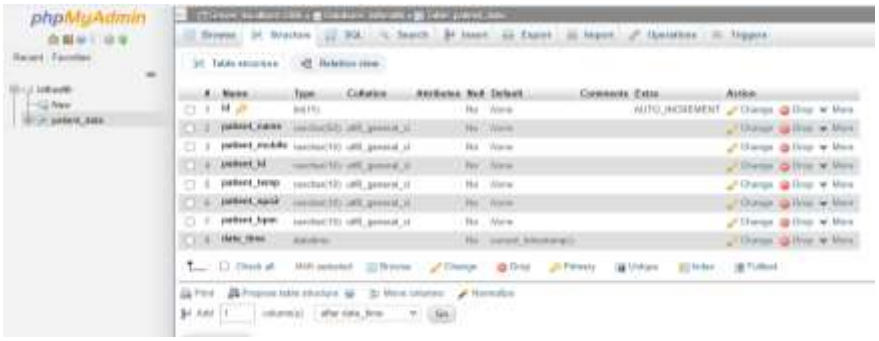

Fig 6: Table Elements

IMPLEMENTATIONS PHP PAGES :

PHP is one of those programming languages which are developed with built-in web development capabilities. The programmers can embed the code written in this popular server-side programming language seamlessly into HTML code through the Script tag. But the web developers cannot write large and complex websites and web application rapidly without executing PHP code through various web frameworks.

```
<?php   $servername = "localhost";
$username = "root";
$password = "";
$dbname = "iot_health";
        $conn = new mysqli($servername, $username, $password, $dbname);
        // Check connection
        if ($conn->connect_error) {
            die("Connection failed: " . $conn->connect_error);
        }
```

Fig-7: data base connection

Below is a script insert reading in data base ‘iotheath’ and table ‘patient_data’.

```
if ($conn->connect_error) {
die("Connection failed: " . $conn->connect_error);
}
$name= $conn->real_escape_string($_GET['nm']);
$mobile_number= $conn->real_escape_string($_GET['mo']);
$patient_id= $conn->real_escape_string($_GET['id']);
$heart_rate = $conn->real_escape_string($_GET['hr']);
$spo2 = $conn->real_escape_string($_GET['sp']);
$temperature = $conn->real_escape_string($_GET['tm']);
$sql="INSERT INTO patient_data (patient_name,patient_id, patient_mobile,patient_te
mp, patient_bpm, patient_spo2)
VALUES ('".$name."','".$patient_id."','".$mobile_number."', '".$temperature."','".
$heart_rate."','".$spo2."')";

if(!$result = $conn->query($sql)){
die('There was an error running the query [' . $conn->error . ']');
}
else
{
echo "Data Uploaded..!";
}
```

Fig 8 : Inserting reading

```
<script>
$(document).ready(function(){
 setInterval(function() {
    $("#div1").load("update.php");
}, 1000);
});
</script>
```

Fig-9: Java Script For Refreshing Live Reading

This script will update div1 id as below

```
<body>
</br>
 <h3> <center>Health Monitoring System</center></h3>
 <div id="div1"><h2 style="text-align:center;">Loading...</h2></div>
</body>
```

Fig-10: Html Page Of Live Reading

EXPERIMENTAL RESULT :

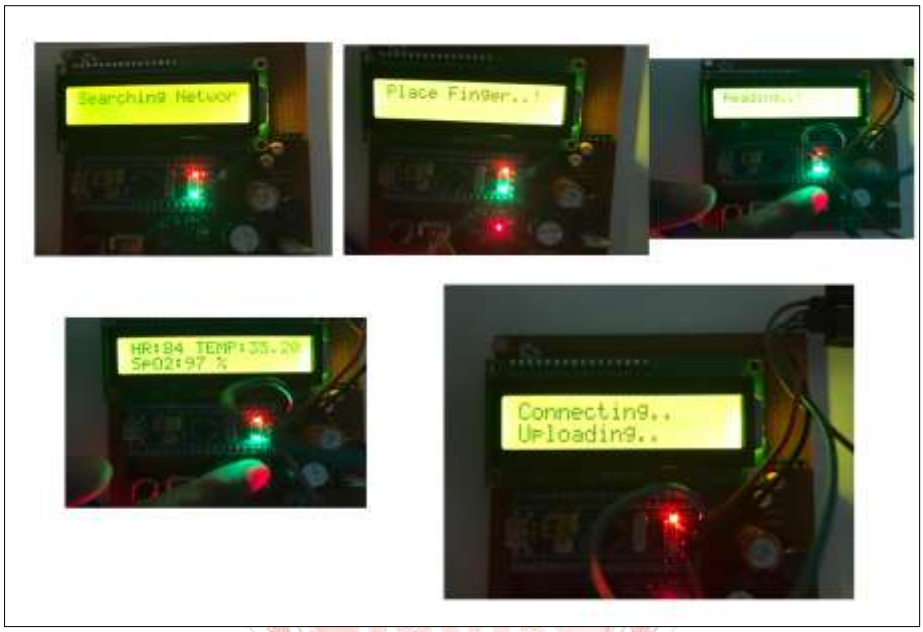

Fig-11: Hardware setup and results

Fig-11 : Home Page

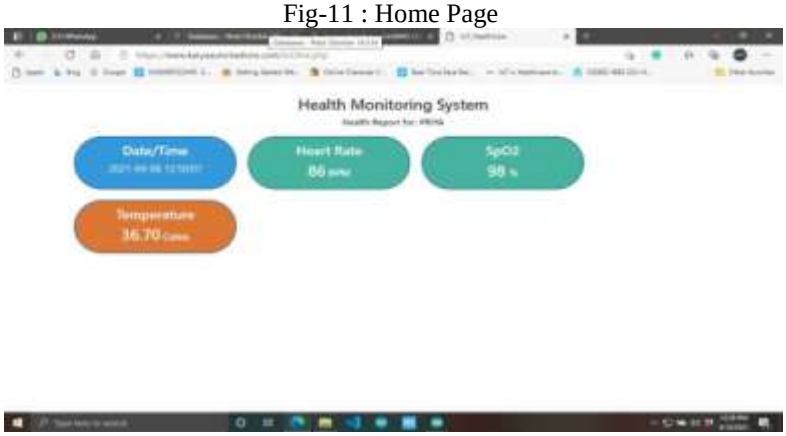

Fig-12 : Live Reading

Fig 13 : Recent readings

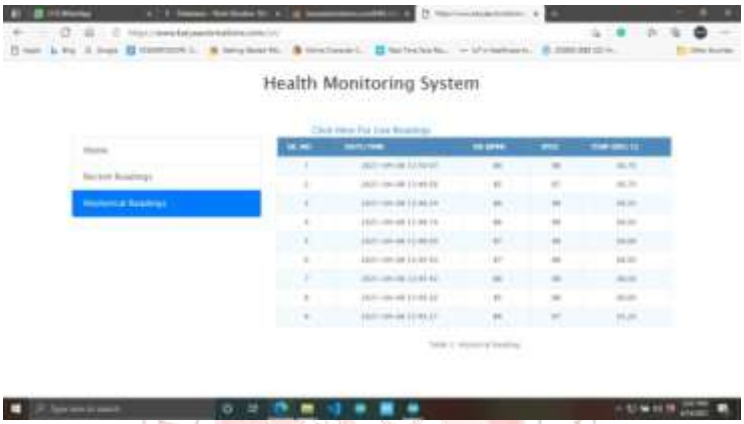

Fig 14 : Historical readings

CONCLUSION :

From the results of proposed system we can conclude that IoT is very important for monitoring the patient who is found positive for covid-19, as system will monitor and keep record of patient as well as monitor in live, doctor family member or nurse can keep eye on the health of patient thorough his/her mobile phone.

The system proposed by Rinto Priambodo and Trie Maya Kadrina[12], can only show the live health of patient, system is totally depends on android mobile phone as sensors are interfaced to android mobile phone and then phone will read the sensors and transfer that to the cloud. In this thesis the proposed system uses the HTTP protocol and separate device to monitor and upload the data to web server with can be extracted very easily, so proposed system is very convenient to design and cost effected as there is no need to use dedicated mobile phone to read parameters and upload them to cloud.

Proposed system has a facility to monitor live readings, recent five reading or complete history of patient, as system uses the Mysql data base it is possible to keep the reading of patient throughout his/her life.

FUTURE SCOPE :

In future it is possible to connect proposed system with the android mobile application so that connected devices can get notification in case of any emergency, in future it will be also possible to add more complex sensors like AD8232 ECG Monitor Sensor Module and keep the record of cardiac activity of patient, it will be also possible to trace a graph of historical data on android app on web application.

BENEFITS OF IOT IN HEALTHCARE :

Iot has many advantages to individuals, society, the environment, consumers and business, as with every technology there are some benefits with some drawbacks. Following table provide the list of major benefits we have from iot. Though, iot is very beneficial in the domain of the medical health care. Iot based applications and systems have transformed the world into an imaginary world which human of 90's thought about. Due to Iot there is revolutionary change in the field of internet communication; this has a lot of contribution in the growth of many challenging domains but especially in the field of medical things. This is the one of major reasons to close the gap between doctors, patient and healthcare.

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