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Smart Health Surveillance System

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Abstract: In these times, due to covid-19 pandemic there is lot of pressure on our healthcare systems. Continual monitoring of health status of patient is crucial to save lives of patient. The proposed system measures six parameters- Body Temperature, ECG, Heart Rate and Oxygen level, Room Temperature and Humidity. These health parameters are then sent to smartphone using Wi-Fi module. Doctors can watch live health status of patient on smartphone or computer Web page.

Index Terms **-IOT, Health, Health Monitoring, Wireless, NodeMCU.**

I. INTRODUCTION

1.1 HEALTH UNCONSCIOUSNESS

In Recent Years, there has been rapid increase in the rate of diseases spreading all around the world. Furthermore, the mortality rate of the chronic diseases is increasing day by day. The chronic diseases like cardiovascular and diabetes are increasing at astonishing rate. It is even estimated that by 2040 there will millions of people suffering from diabetes. Although Chronic Diseases are not completely curable, we can prevent them by taking care of our body and mind. For that we should follow healthier lifestyle and look after ourselves with a pleasant mind.

1.2 TECHNICAL BACKGROUND

1.2.1 Existing patient Monitoring Systems

Patient monitoring systems are broadly classified into two main categories:
1) Bedside patient monitoring systems 2) Remote patient monitoring systems
1) Bedside patient monitoring systems:
It is referred as hospital patient monitoring systems which are used to monitor patient within walls of hospital or doctor's clinic. It is a typical patient monitoring system with a collection of chords, sensors and screens that surrounds patient's bed. Like ECG machine, Blood pressure machine, etc.
2) Remote patient monitoring systems:
It is referred to as home patient monitoring systems that are used to monitor patients remotely outside the hospital or clinic. A smart watch that sends data about a patient's heart activity to a doctor while the patient is at the office is an example of a remote version of the typical ECG machine.

1.2.2 Existing Systems for Electrocardiogram

In a conventional 12 Lead ECG, ten electrodes are placed on patient's limb and on the surface of heart.

1.2.3 Existing Systems for Body Temperature Measurement

Existing Systems for Body Temperature Measurement include mercury in glass thermometer, contactless infrared thermometer etc.

1.3 PROPOSED SOLUTION

The proposed system will measure five health parameters- Humidity, Body Temperature, ECG, Heart Rate and Oxygen level. The advantage of the system is that a doctor from a distance can monitor patient's condition.

1.4 PROBLEM STATEMENT

a. Existing systems to measure health parameters are costly and fixed.
b. Existing systems are not wireless for monitoring remotely located patient.

1.5 OBJECTIVE

Our objective is to develop a healthcare system which is cost efficient and can monitor remotely located patient.

II. LITERATURE REVIEW/SURVEY

2.1 REVIEW OF PROPOSED SYSTEMS BY OTHER RESEARCHERS

In [1], the system designed for ECG monitoring using IoT based Blynk Application. The ECG sensor AD8232 is connected to Arduino Uno microcontroller which a WiFi module ESP8266. Sensor collects the biological information of the patient's heart and processed by Microcontroller it is sent to the Blynk Server via Wi-Fi module. At the other end doctor can see the patient's ECG on mobile/desktop's Blynk App.

In [2], the system is designed with ESP32 microcontroller which has both Wi-Fi and Bluetooth capabilities. In this work, sensors which are used here are Temperature Sensor and Heart beat and SpO2 sensor. These sensors are brought in contact with the human body which helps to monitor the health condition without disturbing the daily schedule of the patient and the result of these health parameters are then forwarded to database server which can be accessed by mobile or desktop through Blynk App at the Doctor's end. Health monitoring system consists of OLED display, sensors and Microcontroller (Wi-Fi module) to transmit health related data to doctor and patient's relatives. OLED display is provided to show instant results to the patient. Here Researcher used DHT11 as a temperature sensor and MAX30100 is used to measure heart beat rate (BPM) and oxygen saturation (SPO2). Microcontroller reads data as given by temperature sensor and heart rate sensor, processing it gives the output in the form of digital and it gets directly displayed on OLED and this sent to the database server. These data can be accessed from the cloud by the authorized users using the IoT application platform. The sensor values of the patient are displayed on the Blynk app.

In [3], Arduino Uno microcontroller with the NodeMCU is used to to get the patient's health data from the sensors to the doctor via IoT Blynk application. It has a Battery with it which makes it portable system. The sensors used are Temperature Sensor (LM35), ECG sensor (AD8232), Heart Rate and SPO2 sensor (MAX30102). The data got from these sensors are processed by Arduino and sent to the NodeMCU over Wi-Fi to the Blynk database. Patient's Biological data can be accessed by doctor through Blynk Server.

In [4], IOT based Blood pressure monitoring system is developed with Rasberry pi 3 microprocessor.Rasberry Pi 3 is an ARM based credit card sized SBC (Single board computer). Zigbee Wireless System is used for transmission. Zigbee Wireless System comprises of two parts transmitter part and receiver part. Transmitter part collects the data (output readings) from blood pressure circuit and transmits it to designated receiver. MPS20N0040D-S is Wheatstone bridge sensor IC that is used to measure pressure.

In [5], the designed system consists of sensors to measure Heart Rate and Blood oxygen level (MAX30100) and body temperature (MLX90164), which connects to a Microcontroller (ATmega2560) by using synchronous serial communication protocol inter-integrated circuit (I2C). ATmega 2560 access the internet via ESP826601 using Wi-Fi technology. The collected biological measurements from the sensors are forwarded to an IoT cloud and display the results of these sensors on the OLED attached to the hardware. The health care providers benefit from this system because it allows observing patients remotely without being physically in contact with the patient.

2.2 RESEARCH GAP

Until now the projects that we have seen included maximum of 3 to 4 parameters and use of these parameters is very costly. But in this project we are adding upto 6 parameters for the better use of machine to improve the health conditions of patient and make sure people can know the health issues they have so that they can improve their health and lifestyle.

III. PROJECT DEVELOPMENT

3.1 METHODOLOGY

The aim of this project is to design a remotely accessible health monitoring system with the help of IoT device ESP32. This system will be used to measure the biological parameters of our body which are Electrocardiogram (ECG), Body Temperature, Heart pulse rate and Oxygen Saturation (SPO2) and Environmental parameters like Room Temperature and Humidity. ESP32 with the help of its Wi-Fi module will send the data obtained from sensors to the web page which will be accessible by patient and doctor.

3.2 PROPOSED SYSTEM

3.2.1 Block diagram

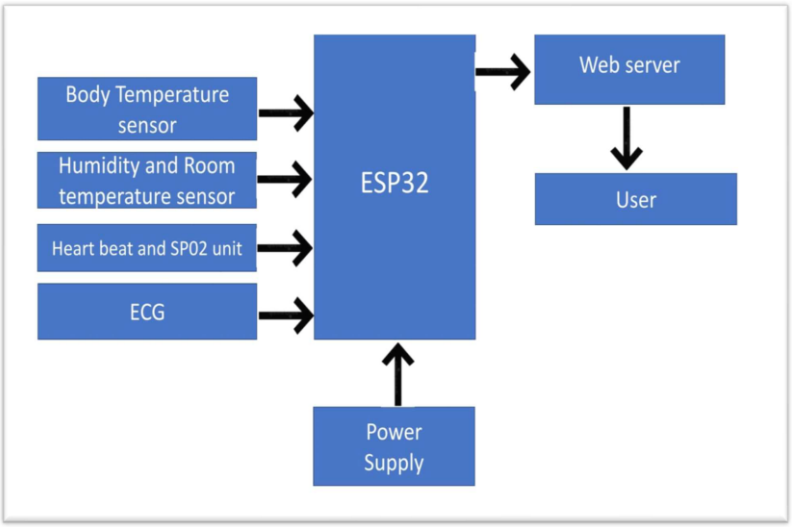

Fig.3.1: Block Diagram

3.2.2 Working of proposed System

In proposed System power supply is given to ESP32. Various sensors like Body Temperature sensor, Room Temperature and Humidity sensor, Heart beat and SPO2 sensor, ECG sensor are brought in contact with human body provide data to the NodeMCU ESP32. NodeMCU processes this data and sends to the Web server through the Wi-Fi module. Then this data can be viewed by user on Web Page.

The components used in the system are: -

1. MAX30102

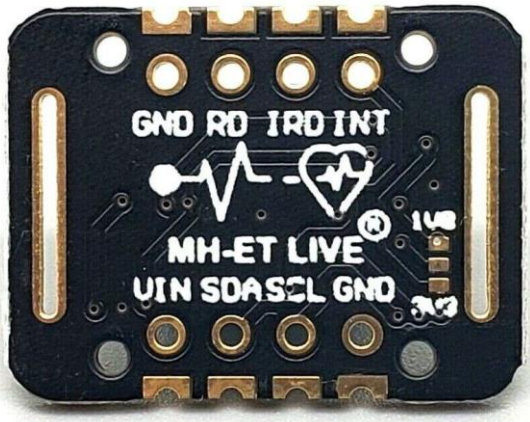

Fig.3.2: MAX30102 Module

[6] The MAX30102 uses a method called photoplethysmography to measure the heart rate of someone. This method shines light on the skin and the perfusion of the blood is measured. One of the practical aspects of this approach is that it is possible to differentiate between the light reflected by the blood of an artery (produces an AC output) and other components of the body such as bones and tissues (produces a DC output). The photo-diode in the sensor then converts the light to current that we can use as comprehensible data. To counter difficulties such as skin tone differences LEDs with different wavelengths are used. In the MAX30102 there is an extra green LED for this purpose.

2. DS18B20

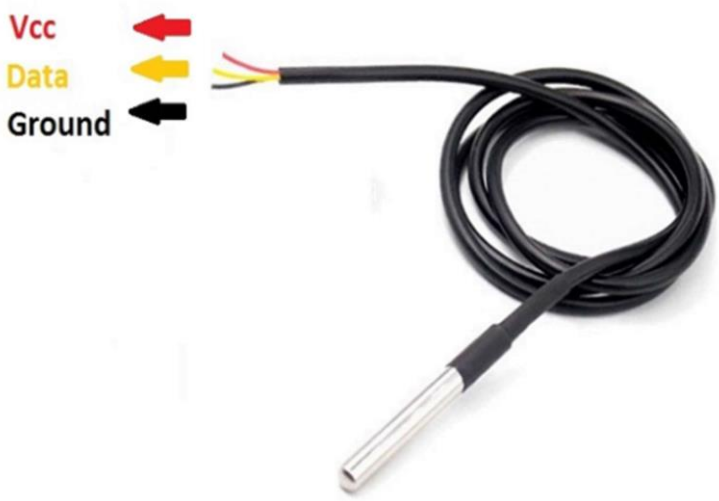

Fig.3.3: DS18B20

[7] DS18B20 digital temperature sensor works on a single bus and it has 64-bit ROM to store the serial number of component. It can get quite a few DS18B20 sensors connected to a single bus in parallel. With a microcontroller, you can control so many DS18B20 sensors that are distributed around a wide range. So the sensor is widely used in these fields, including 16 HVAC environmental control, temperature detection of building, instrument and machine, and process monitoring and control. The number of sensors in the parallel connection cannot be over 8; otherwise, brownout will happen and the signal transmission will turn to be unstable. As a result, multi-point temperature measurement will fail.

3. AD8232

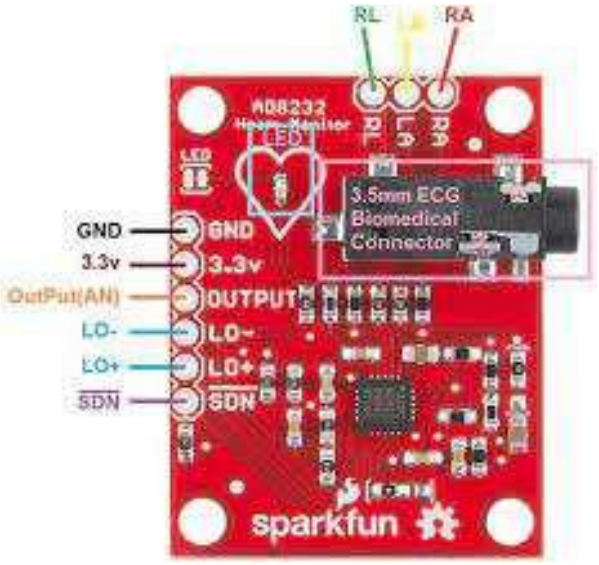

Fig.3.4: AD8232 Module

[8] This sensor is a cost-effective board used to measure the electrical activity of the heart. This electrical activity can be charted as an ECG or Electrocardiogram and output as an analog reading. ECGs can be extremely noisy, the AD8232 Single Lead Heart Rate Monitor acts as an op-amp to help obtain a clear signal from the PR and QT intervals easily.

4. DHT11

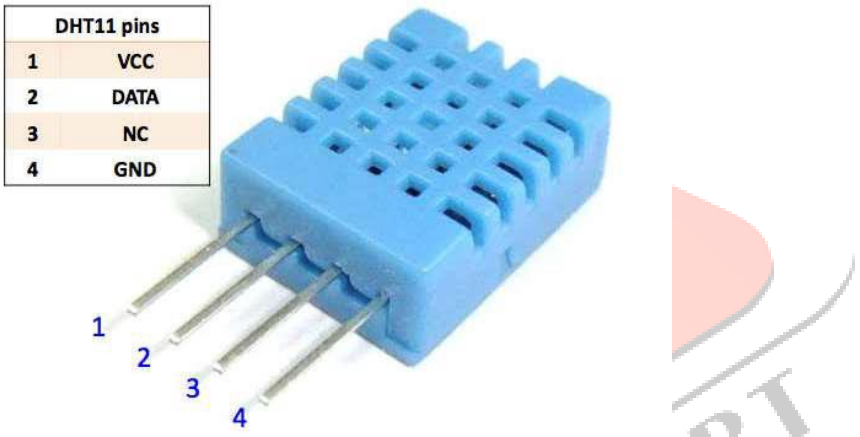

Fig.3.5: DHT11 Module

[9] DHT11 digital temperature and humidity sensor is a calibrated digital signal output of the temperature and humidity combined sensor. It uses a dedicated digital modules capture technology and the temperature and humidity sensor technology to ensure that products with high reliability and Excellent long-term stability. Sensor includes a resistive element and a sense of wet NTC temperature measurement devices, and with a high-performance 8-bit microcontroller connected.

5. ESP 32 NODE MCU

Fig.3.6: ESP32 NodeMCU

ESP32 is capable of functioning reliably in industrial environments, with an operating temperature ranging from –40°C to +125°C. Powered by advanced calibration circuitries, ESP32 can dynamically remove external circuit imperfections and adapt to changes in external conditions. ESP32 is highly-integrated with in-built antenna switches, RF balun, power amplifier, low-noise receive amplifier, filters, and power management modules. ESP32 adds priceless functionality and versatility to your applications with

minimal Printed Circuit Board (PCB) requirements. ESP32 can interface with other systems to provide Wi-Fi and Bluetooth functionality through its SPI / SDIO or I2C / UART interfaces.

3.3 DESIGN

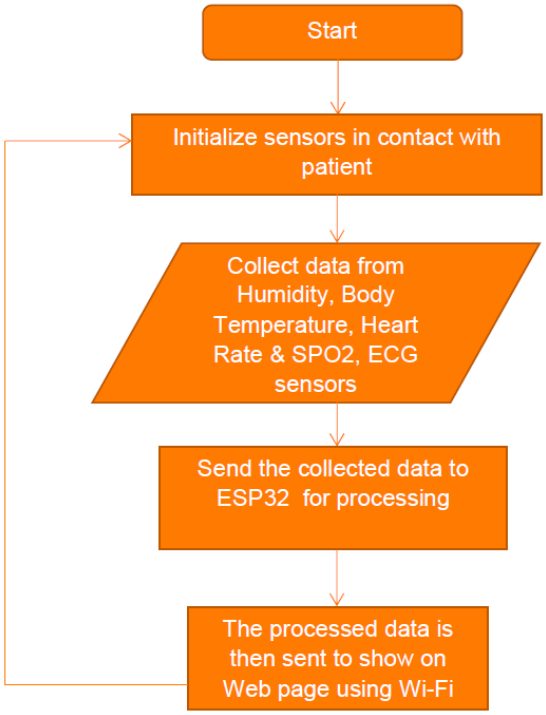

Fig.3.7: Flowchart

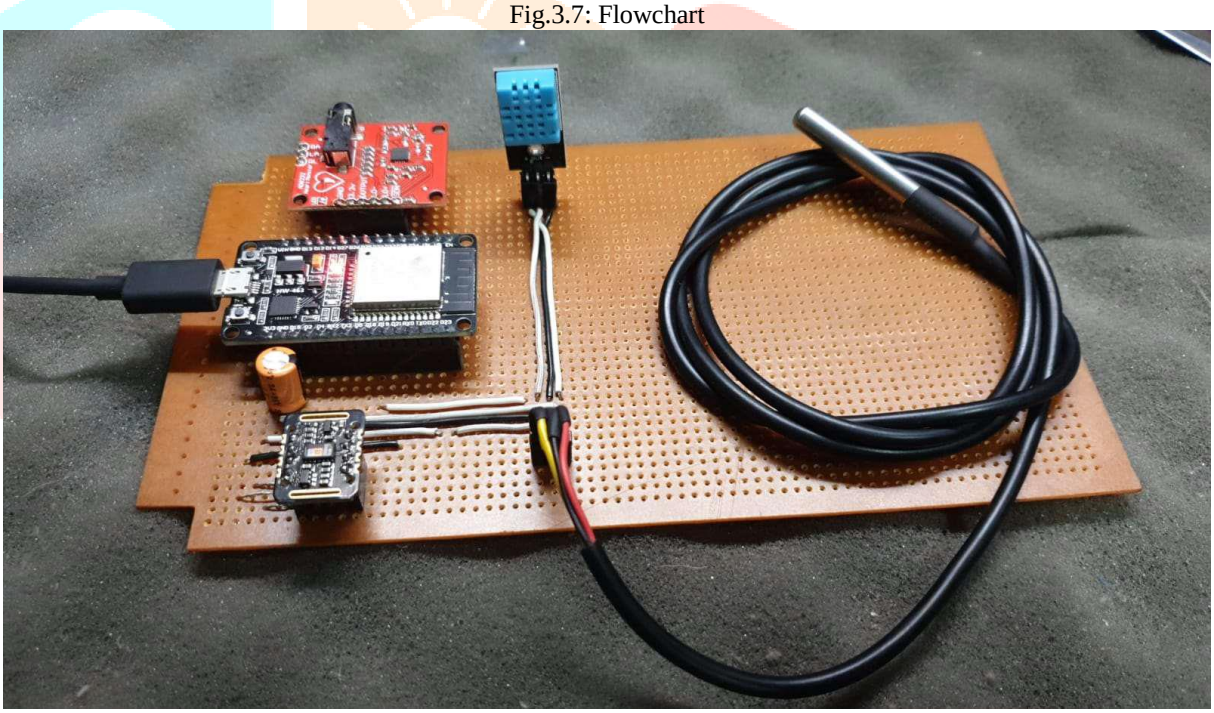

Fig.3.8: Design

3.4 SOFTWARE

The Arduino IDE is an open-source software, which is used to write and upload code to the Arduino boards as well as ESP32. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++. Here, IDE stands for Integrated Development Environment.

3.5 LIMITATIONS

The limitations of this project are highlighted in the following, but we will take it to greater heights by providing different implementations for future work. As per the research gap, more parameters can be implemented by making it easily accessible and more efficient. Even if this system has more parameters, we are making it will still be inexpensive as compared huge systems or machines.

IV. IMPLEMENTATION

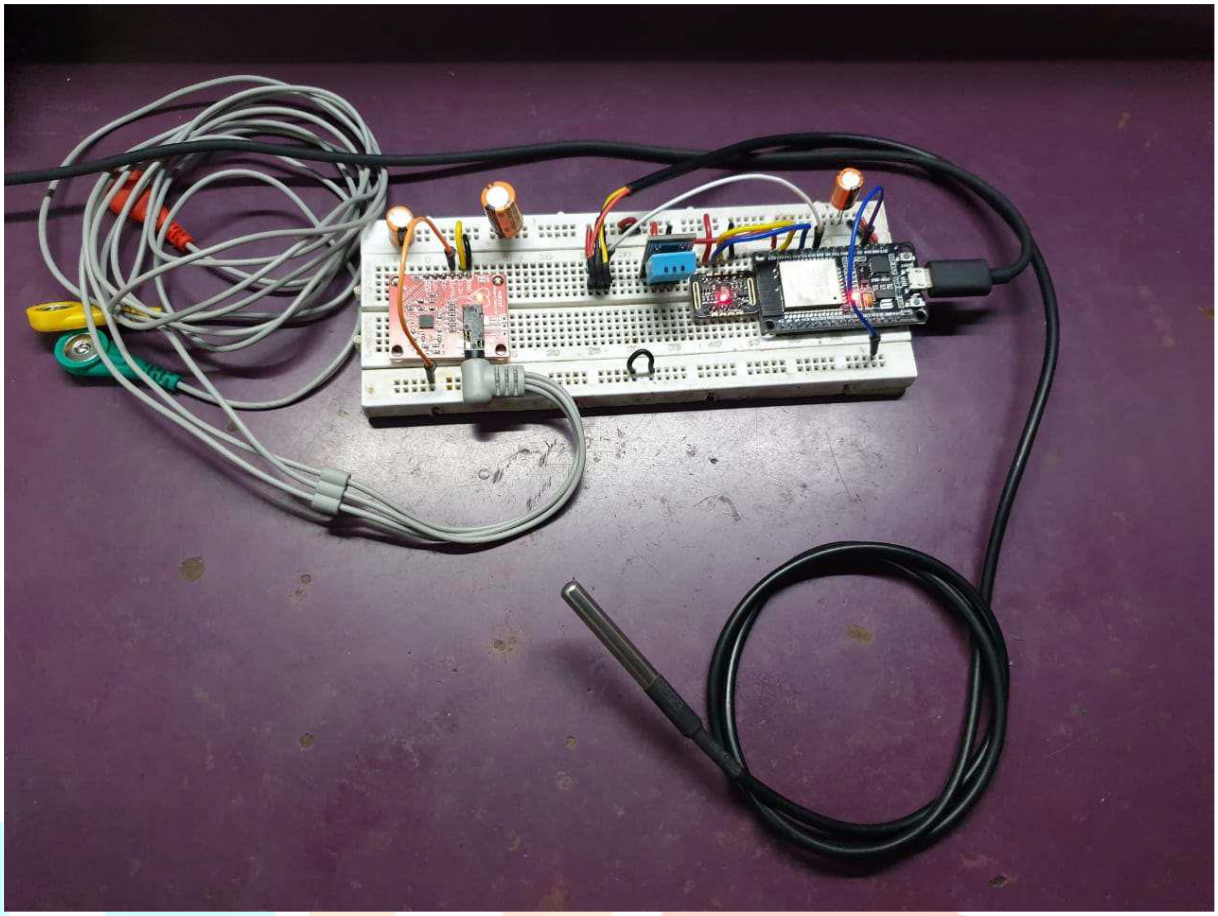

Fig.4.1: Implementation

V. RESULTS

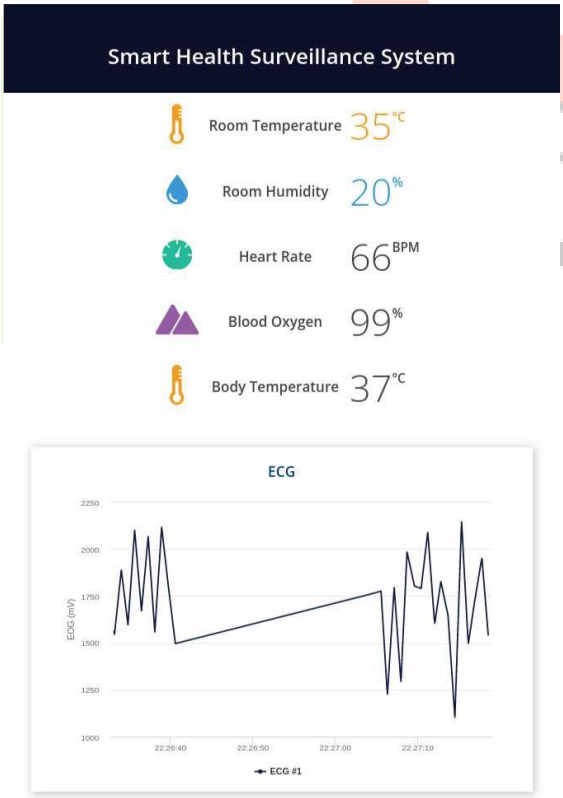

Fig.5.1:Webpage

VI. FUTURE WORK AND APPLICATIONS

5.1 FUTURE ASPECTS

In future, the smart health surveillance system will provide increased independency and mobility for elders, sick , physically and mentally disabled people. Maintaining a healthy lifestyle is becoming more and more impossible due to busy schedules. This system will provide the necessary arrangements needed during our busy lifestyle for better health aspects.

5.2 APPLICATIONS

Various applications for smart health surveillance system :-
1) ECG Monitoring
2) Room and Body Temperature Monitoring
3) Oxygen saturation Monitoring
4) Heart Rate Monitoring
5) Remote Monitoring

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