Low-cost GSM & Real-time based Healthcare and ventilation system

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19BEE0171

Abstract— This paper exhibits the design and development of a mobile patient-monitoring system by using three sensors in one system. In earlier times, in areas of large disasters, healthcare service providers conducted vital signs measurements manually, recorded them on papers and communicated over the radio, but with drastic increase in the number of patients it led to chaos among the healthcare providers. The advanced technologies has led to increasing expenses in the healthcare sector, so the proposed mobile sensor based system will not only be technologically advanced but will also be cost effective. The system consists of mainly three sensors: blood pressure sensor, temperature sensor and a pulse oximeter module. The sensors will be integrated into one system using NodeMCU. The data is collected from the sensors and the data will be uploaded on cloud, which will allow the healthcare provider to view it. In this paper we have measured the four vital parameters and presented them.

Keywords— Blood pressure sensor, temperature sensor, pulse oximeter, wireless system.

I. INTRODUCTION

During a calamity, the mismanagement among the healthcare providers, poor communication and limited number of resources leads to inefficiency in providing quality care. The increasing cost of healthcare and cost of living along with drastic increase in world population, has led to scarcity of resources and a need for a real-time, noninvasive, compact mobile system for patient monitoring. This paper demonstrates a model which combines three sensors namely, blood pressure sensor, temperature sensor and a pulse oximeter module into one system. The pulse pressure variations generate minute vibrations which are converted into electrical energy which is proportional to the arterial blood flow. Oxygenated red blood cells have the ability to absorb infrared light within the range of 800-1000 nm whereas deoxygenated red blood cells absorb infrared light within 600-750 nm, this principle is used by MAX30100 to measure oxygen saturation levels and it has an added advantage of being non-invasive . The model is coded and created using Arduino IDE which is an open source software. It uses a little modified and user-friendly version of C++ as its coding language. NodeMCU has a WiFi module which allows transmission of the collected data to the cloud via the Internet and is also inexpensive . The proposed model also aims at minimising costs and optimising accuracy of the received data through signal processing.

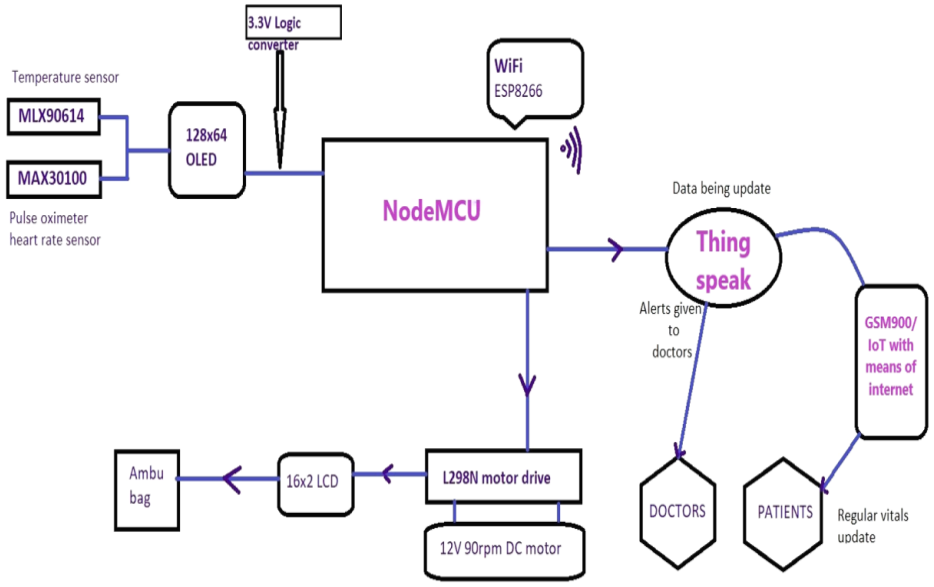
II. EXISTING WORK

Wan-Young Chung et al., describes a monitoring system that consists of two modules, the first is a chest sensor belt which contains a 3-axis accelerometer and two electrodes for acquiring the patient's ECG signal, the second is a wrist pulse oximeter for obtaining photoplethysmograph (PPG) and heart rate.

A wearable sensor network node is used to communicate between the two sensor modules and the base station [11]. The shortcoming of this system is that it could measure only two vital signs. Muhammad Wildan Gifari et al., had worked onan equipment with an ECG, which uses AD8232 for acquiring the ECG signal from the patient. It focuses on the study of the twelve lead ECG by using only three electrodes. It uses 978-1-5386-9353-7/19/$31.00 ©2019 IEEE 2 Bluetooth for transmission of data however in order to obtain a cleaner signal the data needs to be debugged [3]. Mohamed A. Abd El Ghany et al., describe a patient monitoring system that uses commercially available products from ACCU-CHEK and BOSO and integrates into one system and performs data processing on it [12].

All these papers either use only two parameters for the patient or Bluetooth transmission for the data. This is where our project comes into picture since it checks four vital signs of the patient, real time data is transmitted by using simple sensors to achieve the same, and thus minimising the cost.

III. METHODOLOGY



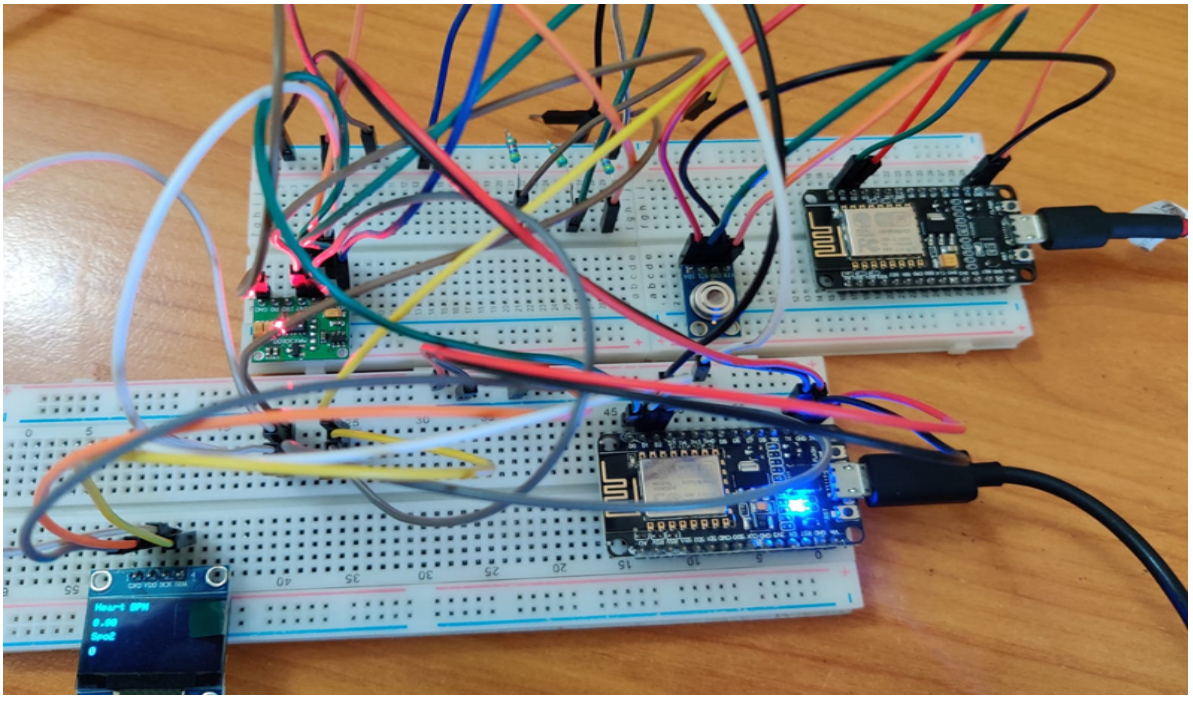
A. Architecture for Portable Patient Health-Monitoring System

The functioning block diagram of the mobile patient monitoring system is shown in figure 1. It first collects the data from the sensors i.e pressure sensor, pulse oximeter, temperature sensor. The data is collected and then sent through the NodeMCU to the cloud. After the required processing is done on this cloud stored data, the data will be able to view it from the hospital before the patient arrives.

B. Algorithm for NodeMCU Esp8266 NodeMCU is an open source IoT device enabled through Wi-Fi. It is connected to sensors through which it will receive the sensor data. It will send the sensor data collected over WiFi to Thingspeak which is an online IoT analytics platform. Thingspeak is equipped with Matlab, which will allow us to perform data processing on the received data.

C. Hardware set-up

MAX30100 has been used to measure Oxygen Saturation of the blood and heart rate.This module operates at an Operating Voltage and Continuous Power Dissipation with 1.8 V – 3.3 V and 464 mW respectively.



The figure shows the developed hardware system of the patient monitoring system with the integrated sensors.

D.Comparison of our project with three-layered IOT architecture

● Device layer:- The sensors (MAX30100 and MLX90614) acquire the data from the patient's body and send the data to the NodeMCU.

● Network layer:- The data from the sensor preprocessed and processed in this layer(the raw data is converted to structured data) and the data is send for visualisation in application interfaces.

● Application layer:- The data is reflected in the OLED and the information is sent to the Blynk app for remote monitoring.

IV. RESULTS AND DISCUSSIONS

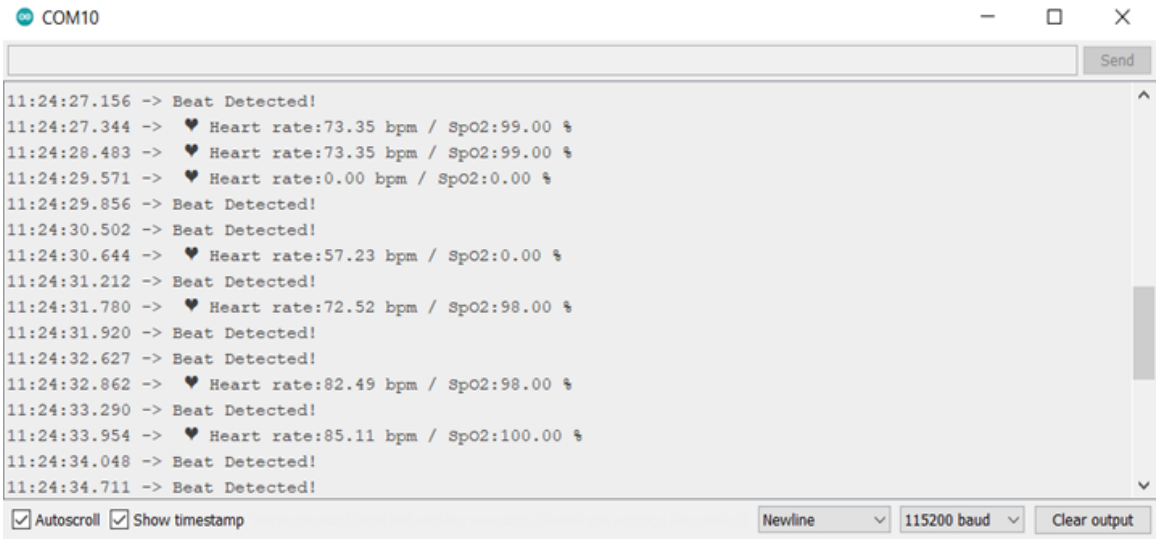
The system was developed and the sensors were connected to measure the vital parameters.

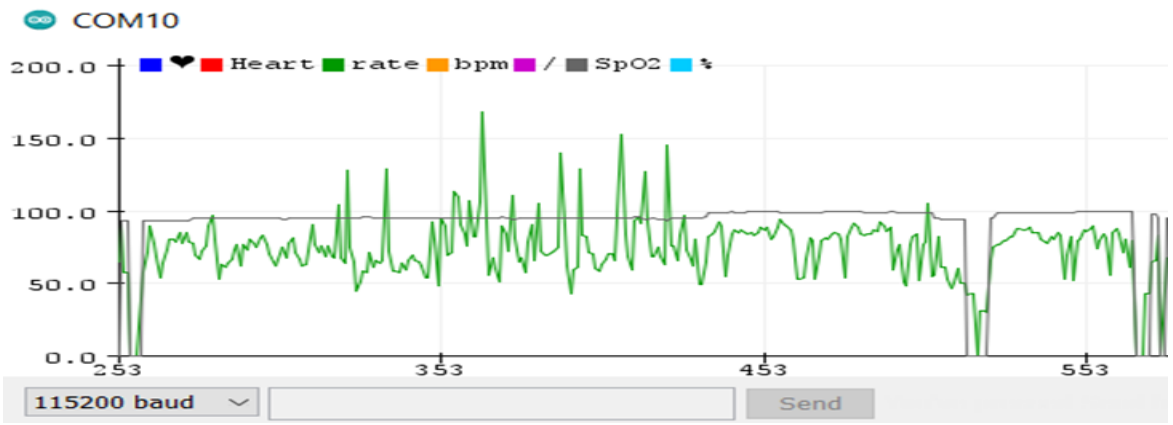
Blynk-App

The output visualisation of the temperature(ambient and object), heart beat rating and SpO_2

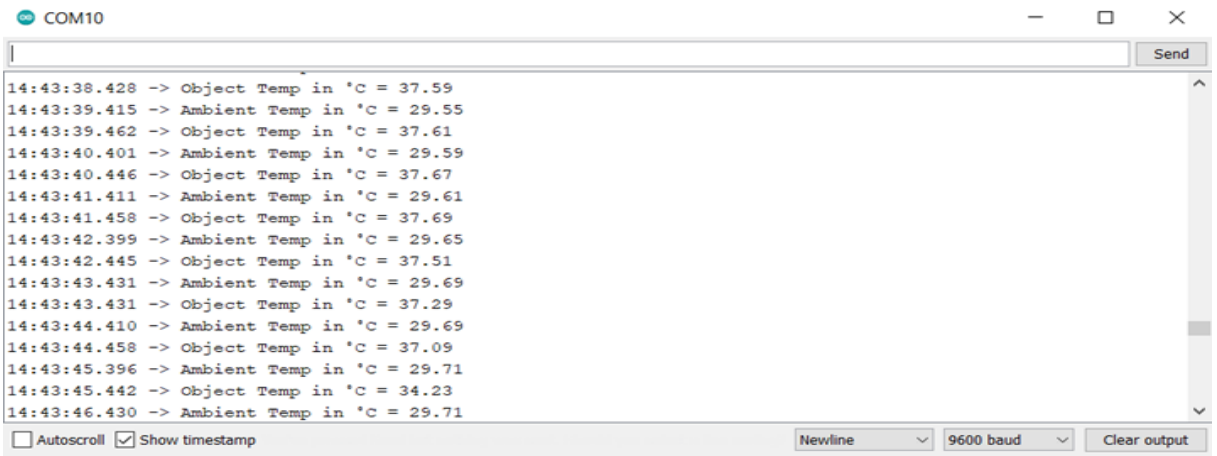
Serial Plotter

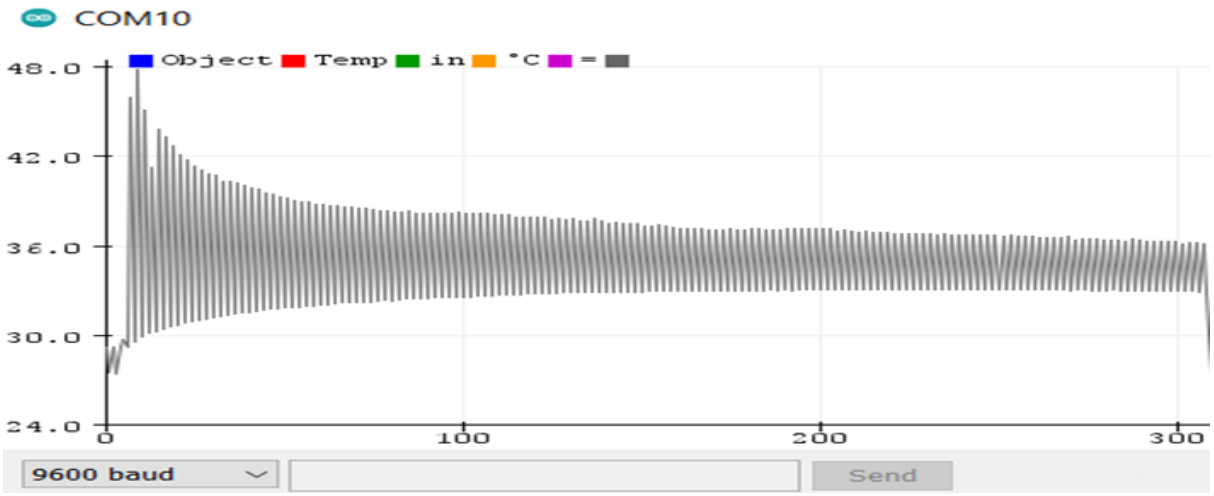
1.) BPM and SpO_2





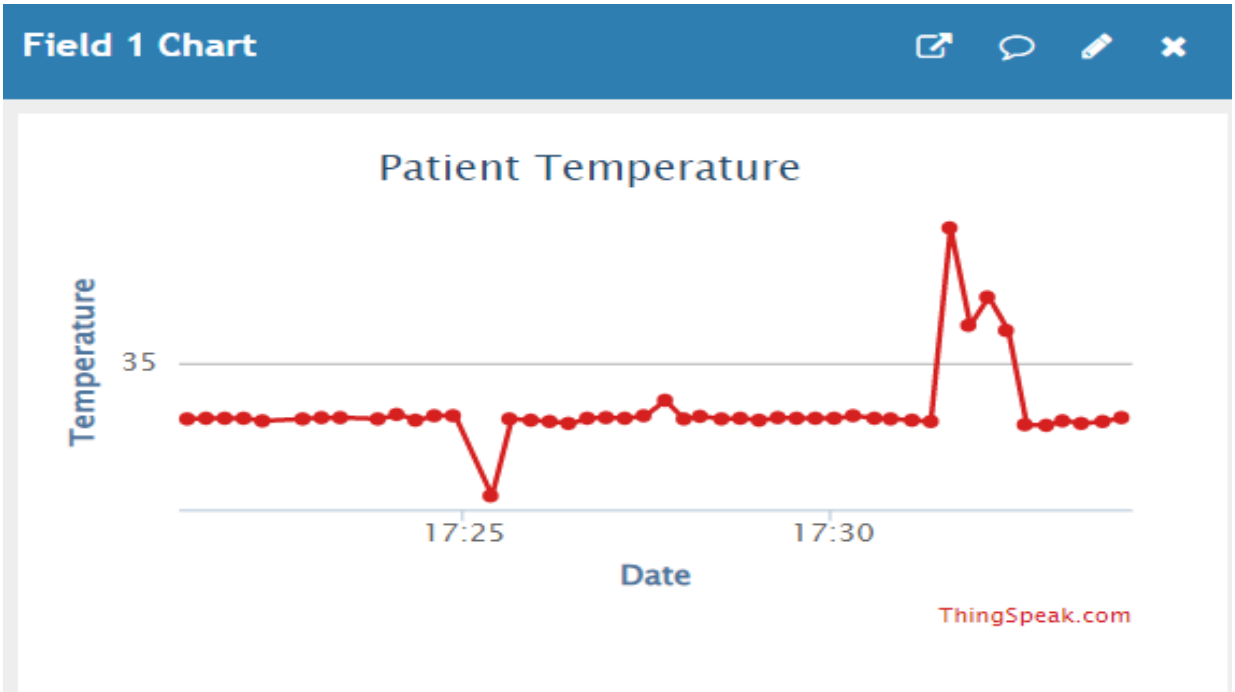
2.) Temperature (Ambient and Object)



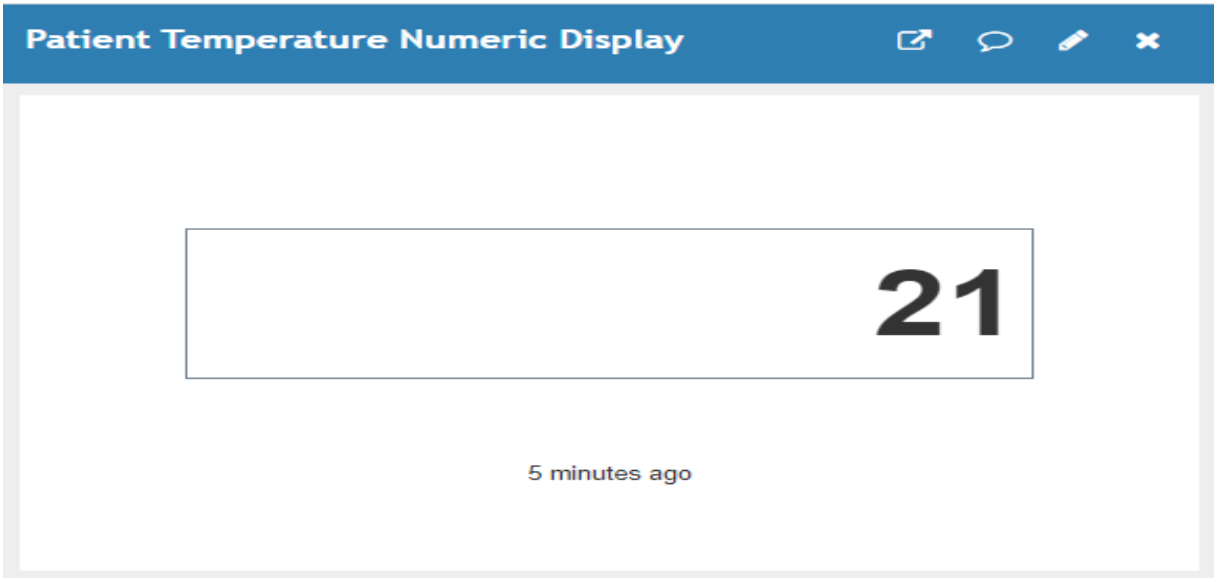


Patient monitoring system with integrated sensors.None of the sensors used are invasive in nature, hence being very patient friendly. The entire project costs less than Rs.5000 hence making it very cost effective.

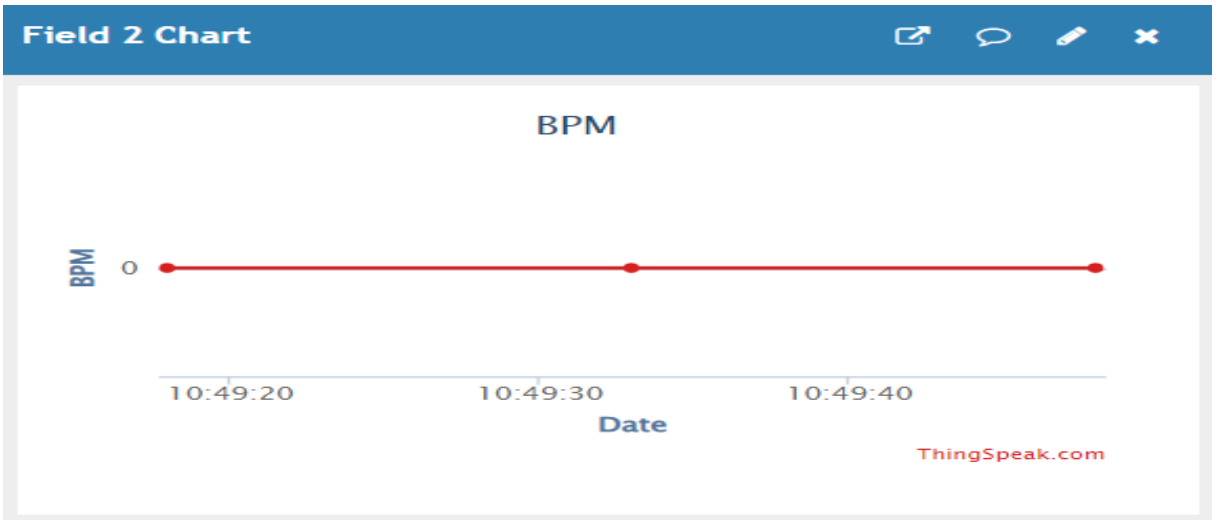
Thingspeak



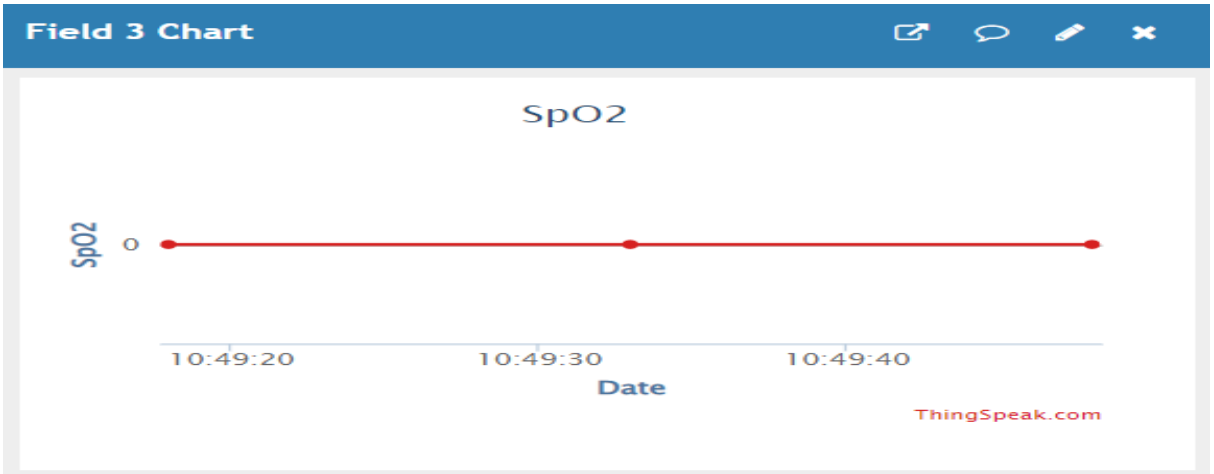
Graphical presentation of Patient's Temperature



Numerical value presentation of Patient's Temperature

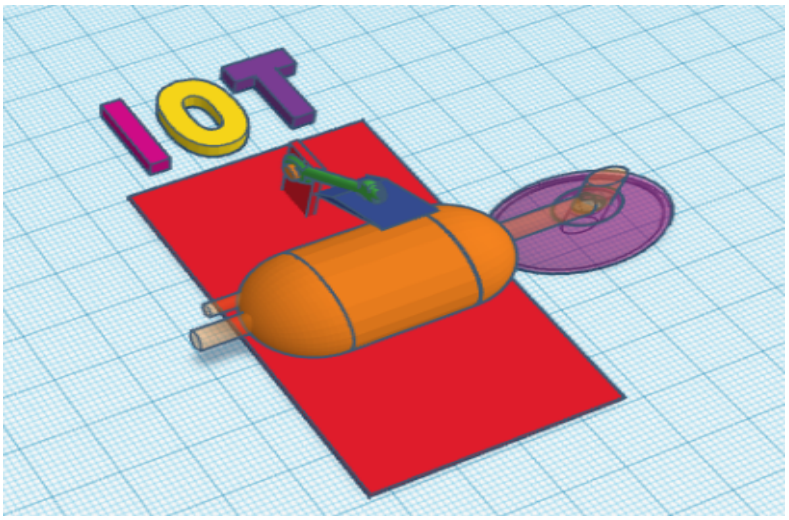


Graphical presentation of Patient's Heartbeat



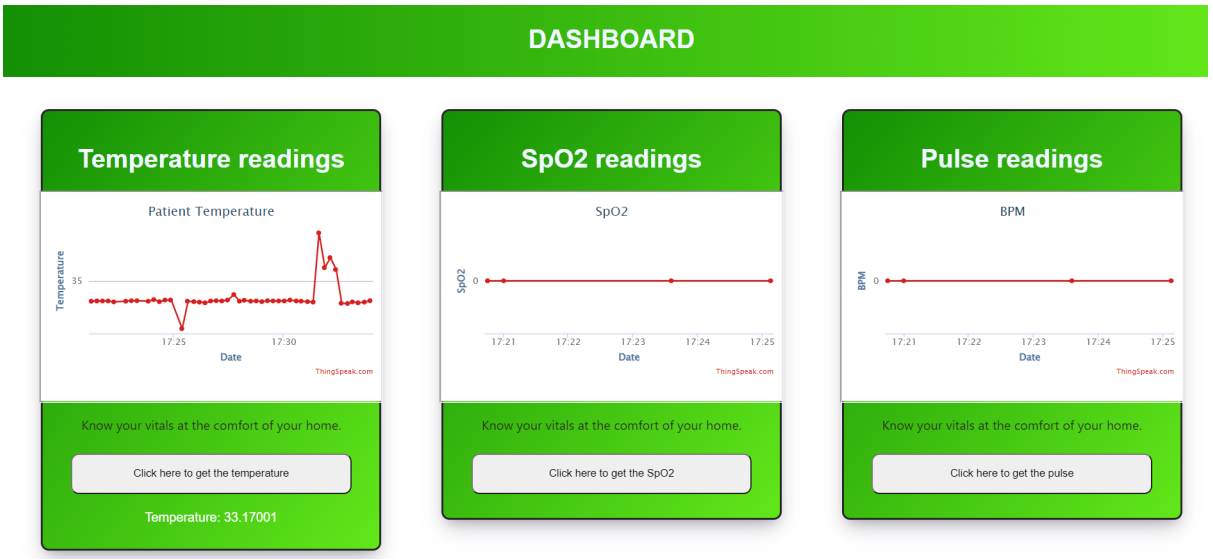
Graphical presentation of Patient's Oxygen level

Tinkercad



Ventilator model for Patient's emergency situation

Custom Dashboard



All the sensors have been proved to be sensitive and accurate, when checked for accuracy and good precision by assessing the parameters multiple times.

V. CONCLUSION

The vital parameters were picked up using the system developed. The sensor data collected from the sensors were sent and recieved to a WiFi module called NodeMCU ESP8266, through which the data is uploaded on cloud, which will allow the healthcare provider to view it. We also verified the results obtained from the project's sensors to mercury thermometer, pressure measuring system, pulse oximetry system. We found that the values varied only by a ± 3 factor. Hence will allow the health-care providers to get an estimate of the patient's vital signal measurements. If our patient monitoring system is integrated with the ambulatory-monitoring system, it will help the healthcare-providers prepare in advance for the arriving trauma.

VI. REFERENCE

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