Second Review Document

Intelligent Healthcare Monitoring System with Pulse Oximetry Analysis

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Abstract

In light of recent events that have exhausted the medicals facilities of developed countries, the SARS-CoV-2 patients find difficulties in breathing after an increase in the concentration of carbon dioxide in the lungs and a decrease in blood oxygen level, which causes loss of patient's life. Various researchers have found that blood oxygen level and body temperature are significant factors used to monitoring covid or chronic obstructive diseases patients. The most standardized test for these kinds of conditions is the spirometry test. Similar to this, PCR and RT are also considered standardized tests for covid suggested by WHO. Real-time monitoring of these chronic obstructive diseases to heal with proper medications and treatment.

The proposed architecture helps monitor the activity, body temperature, the oxygen saturation level(spo2) parameters of disease caused by a coronavirus. Preliminary covid symptoms can be detected using this proposed system. The developed architecture includes a hardware module to monitor the patient's body temperature and oxygen saturation level. As previously shown that measurements of body temperature, oxygen saturation can be performed with reliable accuracy under laboratory conditions. The observed data from the hardware are sent to the patient's doctor by WIFI module. The monitoring application and doctor examining the sensed values can take necessary action on the medication and treatment of the covid patient. The developed architecture is a practical, authentic, and easy-to-use device to determine the symptoms of covid or chronic obstructive diseases.

Keywords:

PCR (Polymerase chain reaction), IoT based healthcare monitoring, RT (rapid testing), Spo2, microcontroller, oxygen saturation, Arduino

1. Introduction

1.1.Theoretical Background

Communicable diseases through airborne is a transmission that delivers very minute water droplets. Those droplets are also known as microdroplets. The size is less than 5 micrometers. In comparison, water droplets are usually larger than 5 micrometers. Because it is minute and feathery, the aerosol carrying the SARS-CoV-2 coronavirus can survive levitating in the air for many hours. Besides, these particles can also drift quite far. Studies in the U.S. call the SARS-CoV-2 coronavirus can live on particles for up to four hours. While other reviews say, it can last 16 hours. The recent research shows coronaviruses that showered in the air can stay alive for at least three hours. However, the scientists stressed that the experiment conducted in a laboratory is different from real-life conditions where the results can vary. Cases of coronavirus, called 'super spreading,' have strengthened the suspicion that airborne contamination is possible. In the city of Mount Vernon in Washington, USA, one person is infecting at least 45 other people who have sung with him in the same choir. As people are getting so much infected, it would be straightforward if any device could simulate and find a relation between blood oxygen level and breathing also, with other health parameters. We could also detect the symptoms of disease caused by the coronavirus and save lives. There are devices like ventilators that aids patients while they are suffering from breathing problems.

The World Health Organization suggests finding out and monitoring Chronic obstructive disease or covid at an earlier stage is the best way to deal with this virus. As per WHO instruction, doctors diagnose and monitor the seriousness of symptoms through PCR and spirometry tests.

This paper aims to analyze diseases and studies aiming to automated diagnosis or monitoring of infectious diseases whose symptoms are detected with body temperature, blood pressure, and oxygen saturation level. In this work, we propose a system that monitors the patients' body parameters; if there is any unusual behavior, they will be symptoms. The monitoring system will help the area where the expert in respiratory diseases analysis may not be available. This project curbs human error while detecting these viruses or diseases by using intelligent monitoring and analysis systems. Evaluation of the percentage of detection and efficiency shows which

monitoring, i.e., body temperature, blood pressure, and oxygen saturation level, has a higher predictive rate, a comparative study tested on the same input slide.

1.2. Motivation

There thousands of deaths that has happened because of corona virus and other chronic obstructive diseases still there are no proper system that monitor patients with these diseases. With the help of this system, we going to promote the concept of homecare is becoming increasingly vital role in medical technology and will play important role in future.

Covid is a Chronic obstructive disease, which causes shortness of breathing, gasping, irritation in the respiratory tract, etc. The recurrence and grimness of the conditions vary from different age ground people, but it primarily affects old age people. Early morning cold effects, stress, common cold, pneumonia, etc., leads to aggravating of the disease. Apart from its allergies indulged, such as loss in taste and smell, a patient may rise from covid disease problems.

1.3. Aim of the proposed Work

A regular blood oxygen reading would be between 95 and 100 percent, anything under 90 is considered unhealthy. While indicated coronavirus patients with measurements as low as 50 percent. When oxygen levels sink this far, patients have much more apparent trouble breathing. The data could be set, as well as the monitoring results are also directly connected and actually stored on IoT Gateway. From IoT gateway, the IoT system is used to send data of heart rate, oxygen level, carbon dioxide, and volatile organic compounds to the cloud for analytics in real-time.

There are lots of existing monitoring system but new concept of home isolation was brought in after coronavirus pandemic happened. This architecture basically help government, healthcare department and patients to promote home isolation and control the spread of virus.

1.4. Objectives of the proposed work

In this project plan to write a server application so that we can interface using our Arduino program with other clients in the network. Finally, we plan on making froward a frontend application in any language that will fetch data from sensors and log in server to display it in user friendly way. This will be an excellent way to setup a home health care monitoring system.

2. Literature Survey

2.1. Survey of the Existing Models/Work

This article reviews about asthma disease and how can we monitor this disease with the help of Arduino [1]. As mentioned, this disease can be easily treated when medicine and treatment are given in time. The proposed architecture tests different activities and environmental parameters of asthma. The basic parameters that are going to be examined are temperature, humidity, air pressure, activity, and volatile gases are collected and then send to the patient's doctors via the GSM module. The doctor then examines the data and then gives suitable treatment and medicines for asthma.

Another paper reviews about e-health monitoring system which the device designed monitors the difficulties experienced by the users in flight [2]. The main goal of this system comes after knowing of the condition inside cab travelers in cab conditions, such as low pressure, lack of oxygen, and low humidity risk factors in patients suffering from cardiovascular diseases etc. Monitoring the oxygen level of the patient during takeoff/landing and during flight hours provides valuable information on the health status of passengers. This information later could be used to travelers of similar alignment of health difficulties.

2.2. Summary/Gaps identified in the Survey

There has been a lot of systems proposed to control the spread of these chronic obstructive diseases. There are different proposed architecture tests, different activities, and environmental parameters of asthma. The basic parameters that are going to be examined are temperature, humidity, air pressure, movement, and volatile gases are collected and then send to the patient's doctors via the GSM module [1].

Given all the research projects conducted, we can say that the real-time monitoring of chronic obstructive diseases like covid-19, asthma is of enormous significance in patient's health and recovery. Recently we have also come to know that spo2 plays a vital role in monitoring the patient's health, which has been missing in all these architectures. This project solves these problems by monitoring the patient's location, body temperature, and spo2 level. The health official can quickly know the health of the patient in real-time.

Basically, with the help of the architecture proposed, we will solve the major problem that we are facing in this pandemic. Firstly, the device helps to monitor the patient's primary health condition like spo2 level, which thresholds to be more than 92% of body temperature etc. from home itself, which reduces the risk of health workers and other frontline workers to get infected. Then after that, the doctor analyses the data received from the sensors and validates whether the patients are in safe conditions. If not, then changes in medication and treatment can be easily made through phone or necessary steps that can be taken.

3. Overview of the Proposed System

3.1. Introduction to Related Concepts

The base architecture is divided into two parts Arduino architecture and server architecture. The Arduino will receive data from the data sensors and then sends it to the server, which will use that data to analyze whether the patient has got any chronic obstructive diseases or not. The server-side contains mainly two parts, i.e., Thing Speak IoT and chat application. Thing Speak IoT is a cloud architecture that takes the data, helps to visualize it and store into .csv file or even send to other application using API.

3.2. Framework, Architecture or Module for the Proposed System

The following diagram gives an overview for the design we are going for:

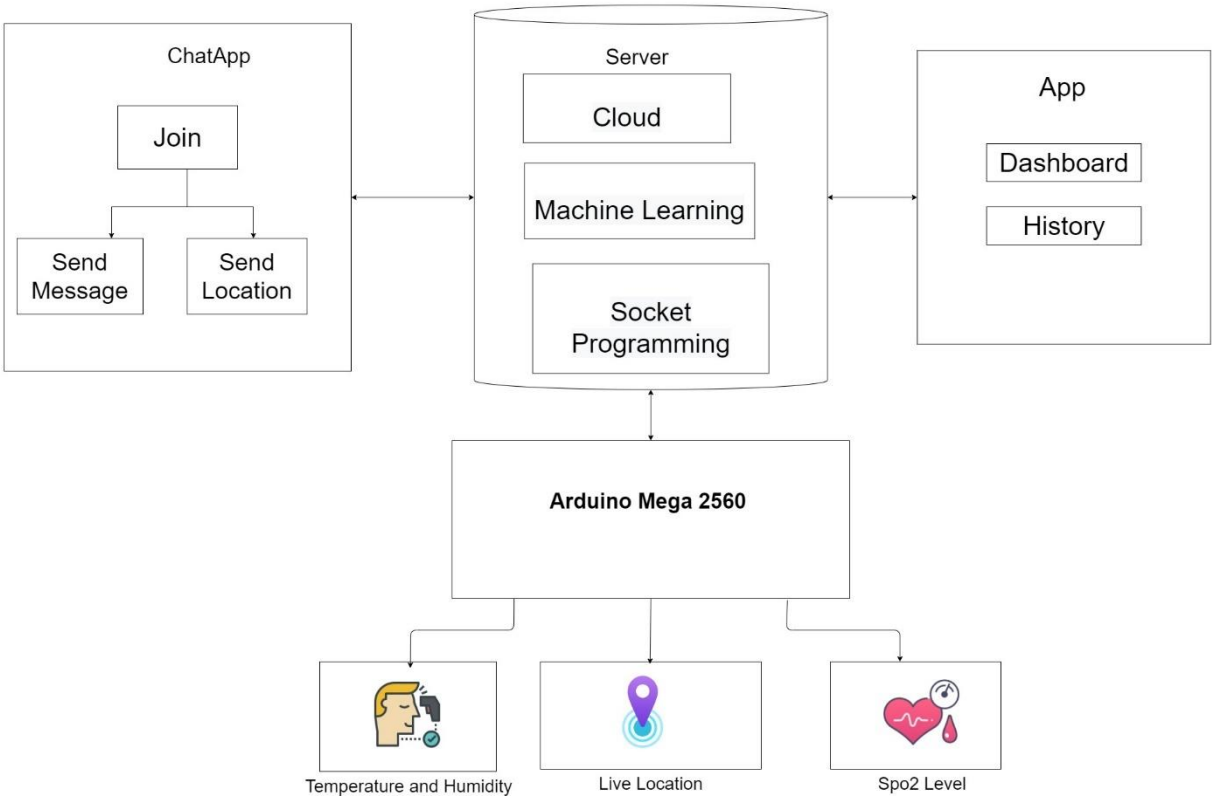


Fig 1. System Design Overview

The basic system architecture would consist of spo2 sensor module, body temperature sensor module, GPS sensor module. The main purpose of this project is to integrate these modules to gather data from the user. All the modules would be connected using Arduino board that contains wi-fi module which is going to send data onto the cloud. Now the data collected can be processed and analyzed using ML. This would be really helpful in predicting the how likely a person is going to affected by the virus or diseases and thus encouraging steps to create more health posts for the betterment.

The system is also integrated with a chat application in which the patient and the doctor can chat simultaneously by sending messages and live location from the browser.

3.3. Proposed System Model

Use Case Diagram

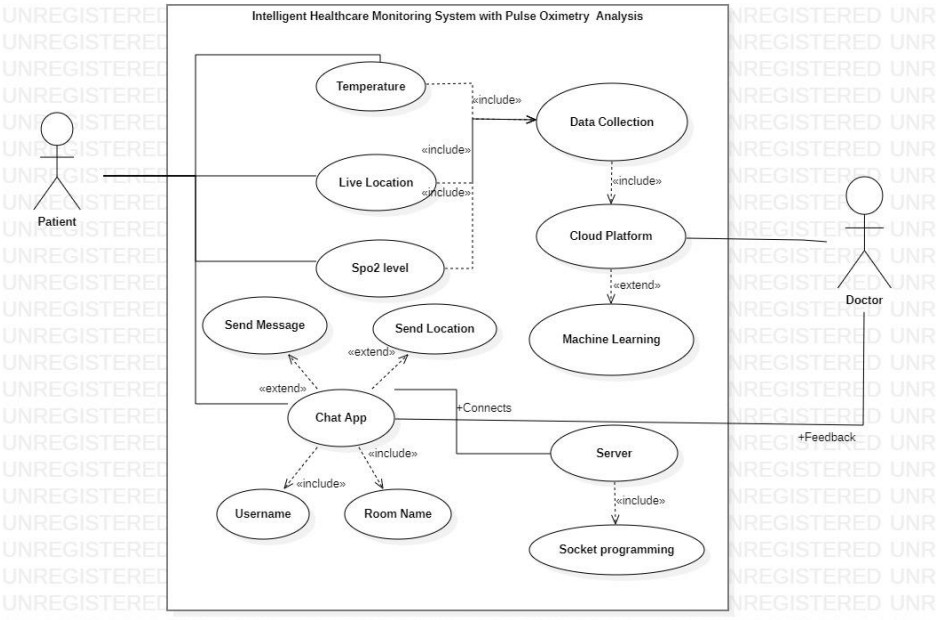


Fig 2. Use case Diagram

This use case model explains clearly how a user interacts with the system. First, the patient interacts with Arduino sensors and provides data on body temperature, humidity, blood saturation level, and live location coordinates. Then the information is collected through the IoT system and

sent over to cloud storage. The data is then assessed through a Machine learning algorithm, and a detailed report is sent to the doctor. The patient can also chat with the doctor using a chat application by specifying a username and room name.

4. Proposed System Analysis and Design

4.1.Introduction

The microprocessor we are using is Arduino Mega, and we collect it with the sensor (GPS, Temperature, and pulse oximeter). The Arduino will now send data to the server using a Wi-Fi module that is attached externally. After that, we can visualize that data from the server or download it into CSV format, and data for ML algorithm is used using .csv form. The algorithm then predicts the results, which are then reported to the doctor. The patient can chat with the doctor in real-time and send messages or locations to get the necessary feedback.

The microcontroller we will be using Arduino mega which can run at default 490 Hz except pin 4 and 13 whose default frequency is 980 Hz and can give quick responses to temperature changes which makes it suitable for this purpose.

4.2.Requirement Analysis

This system helps user to provide body health conditions using the sensors which can be used to monitor his health condition so that the patient suffering from chronic obstructive diseases recover from it easily.

4.2.1. Functional Requirements

4.2.1.1. Product Perspective

The product is used for collecting data from the patient and sending it onto the cloud for information and analysis.

4.2.1.2. Product Features

The product implements different sensors to collect data and then uses Wi-fi module to upload it to the cloud.

4.2.1.3. User characteristics

The user has to give input to the sensors. Then rest is automated by the system. The user can also chat with the doctor for feedback on the reports.

4.2.1.4. Assumption and Dependencies

The assumption is that the users have a good knowledge about using the device and a basic knowledge of keeping the device connected to the internet at all times.

4.2.1.5. Domain Characteristics

The proposed system would require an established internet connection on both the senders end as well as the receivers end for real-time data transfer.

4.2.1.6. User Requirements

The proposed system would require an established internet connection on both the senders end as well as the receivers end for real-time data transfer.

4.2.2 Non-Functional Requirements

4.2.2.1. Product Requirements

4.2.2.1.1. Efficiency

The product is more efficient than the tradition system in which user has to input all the data manually and depends upon maintenance of sensors and strength of internet services

4.2.2.1.2. Reliability

The reliability of the system depends on proper use of the sensor while providing the readings.

4.2.2.1.3. Portability:

The architecture is portable if certain cautions is taken while handling the microprocessor and the sensors.

4.2.2.1.4. Usability

The system can be used anytime at any place just have to take care while providing readings.

4.2.3. System Requirements

For system requirements there are two major categories i.e., hardware that has been used and software that helps to hold it all together. The hardware and software integrated for proposed system are:

4.2.3.1. H/W Requirements

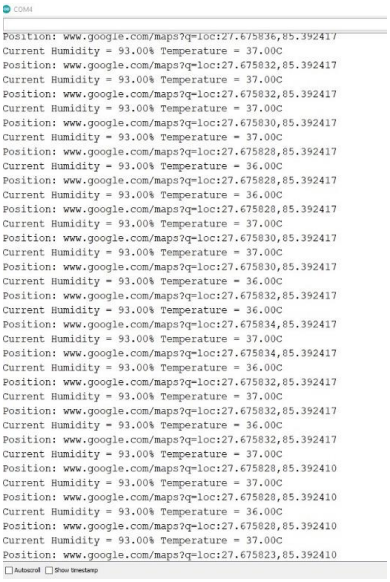
- Arduino Mega
- Neo-GM GPS module
- ESP8266 Wi-Fi module
- DH11 Temperature and Humidity sensor
- MAX30100 Pulse Oximeter

4.2.3.2. S/W Requirements

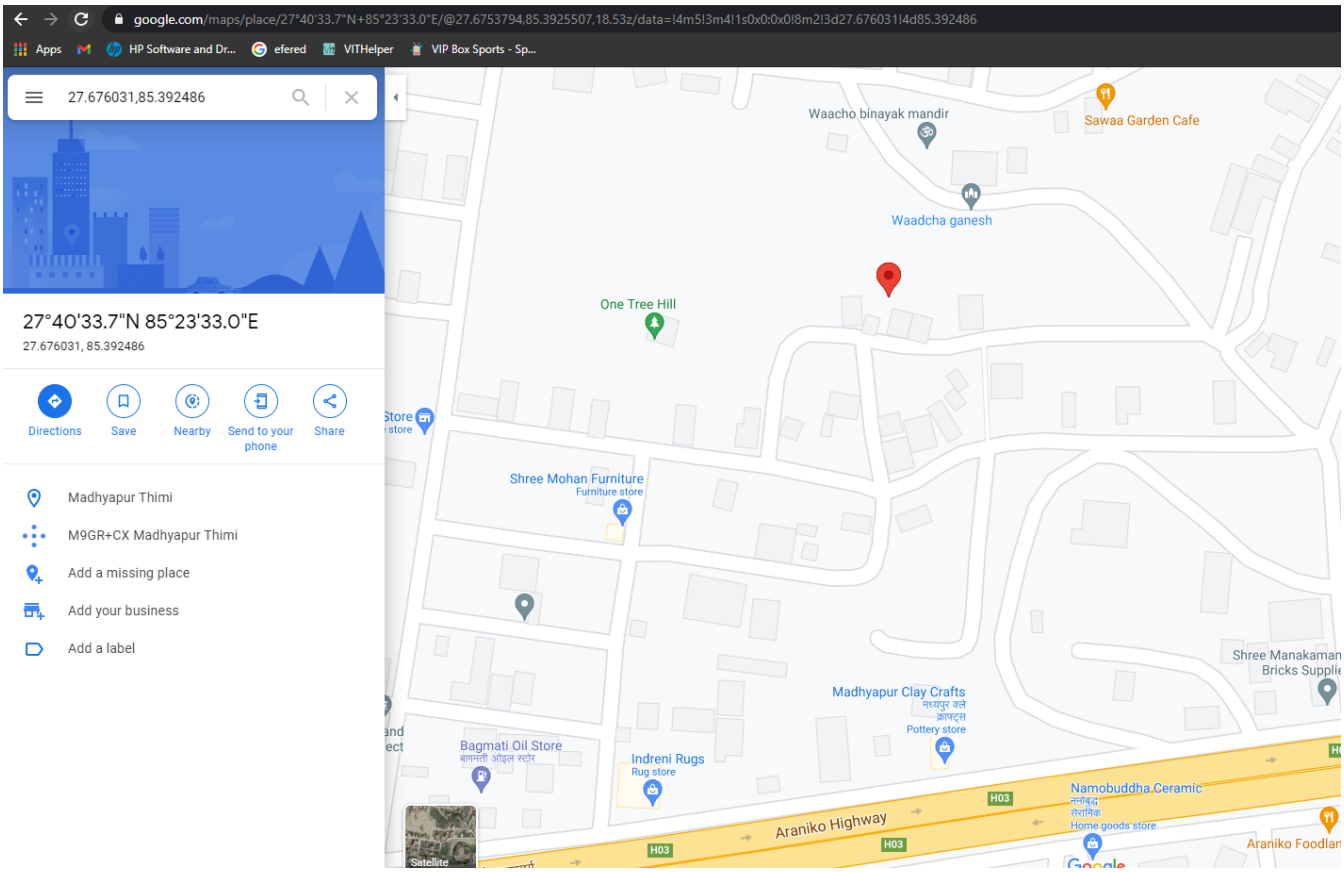
- Arduino IDE
- Jupyter Notebook
- Browser Version (Internet Explorer 5.5+, Safari 3+, Google Chrome 4+, Firefox 3+, Opera 10.61+)

5. Results

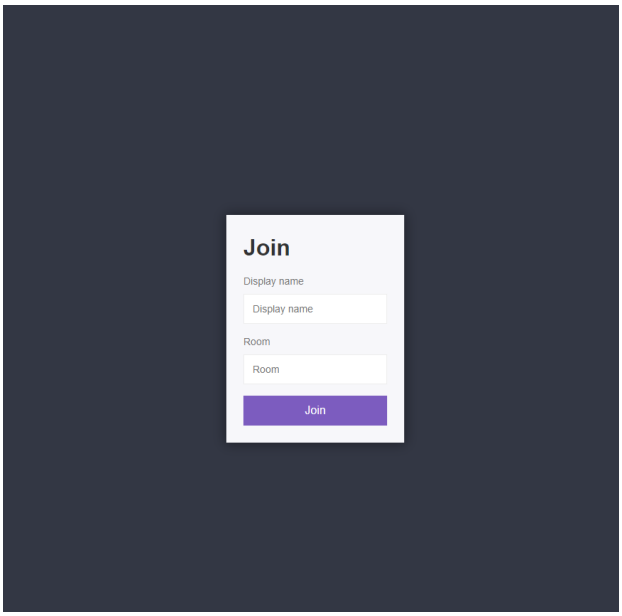
Data from microprocessor:

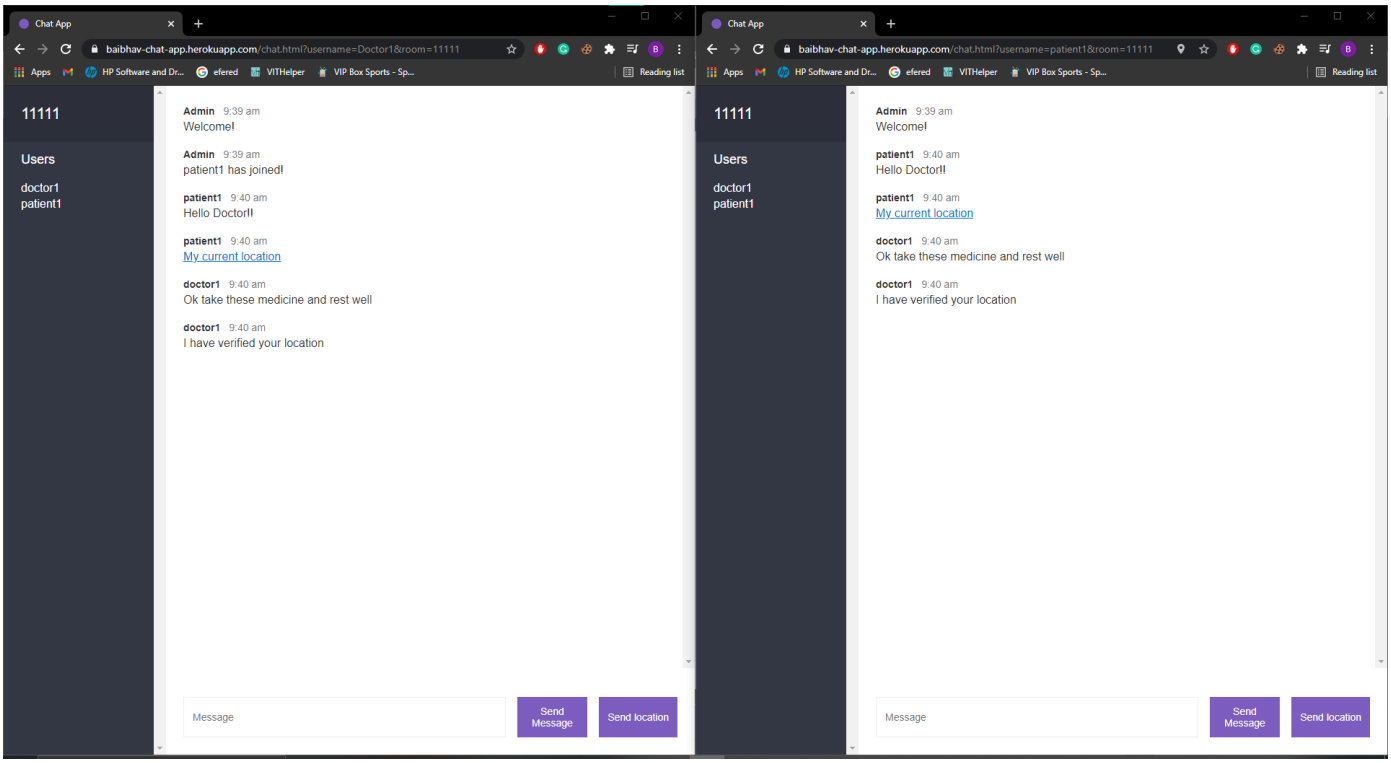


Verification of live location:



Chat Application:





6. Discussion

We can get the position of patients easily and will stop other people from getting affected. We also can get his body's temperature & blood oxygen level which is basic criteria. In future this project could be further develop as product. The product in form of watch could help people to be monitored remotely than physically. We could use better sensors than we have used in this project to increase the accuracy of this project. The project could be further developed as product by developing it into watch by designing a PCB which could make it portable like a fitness band. The fitness band could easier for the patient to wear it.

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