PROJECT REPORT

INTELLIGENT POST-LOCK DOWN MANAGEMENT SYSTEM FOR PUBLIC TRANSPORTATION

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CHAPTER 1
INTRODUCTION

1.1 OVERVIEW

With nearly 2.48 million cases of coronavirus around the world, countries across the globe have been grappling with ways to stall the spread of the pandemic. The number of cases across the world have continued the exponential growth since last month. However, there are a few countries that have been able to limit the rate of growth and 'flatten the curve'. Flattening the curve involves reducing the number of new Covid-19 cases from one day to the next. This helps prevent healthcare systems from becoming overwhelmed. When a country has fewer new Covid-19 cases emerging today than it did on a previous day, that's a sign that the country is flattening the curve. To do so, we have created a user friendly application developed with the services provided by IBM with an interactive Node-Red UI.

1.2 PURPOSE

This is an application specially developed and customized for maintaining social norms and ensuring safety of people. A Chabot has been integrated to the app which takes user information and suggests the person whether he/she is fit for traveling or not. It mainly includes a service for passengers which would collect and store their body temperatures as well as the number of people being accommodated by the bus.

With this information, the user can take an informed decision of whether or not he/she should take the bus or not.

CHAPTER 2
LITERATURE SURVEY

2.1 EXISTING PROBLEM

As per social distancing advisory issued by MOHFW, the operators have to maximize social distancing in public transport besides ensuring regular and proper disinfection of surfaces. All front-line personnel are required to be equipped with protective materials such as masks and suits, and many have been trained to prevent cross infection between staff and vehicles. The operators are also encouraging people to use methods of digital transaction, instead of cash. These payment methods not only cut down on exposure risks, but also help authorities trace possible contacts and inform passengers and relevant communities if a passenger is diagnosed with coronavirus.

The Ministry of Railways has made it mandatory for passengers to download Aarogya Setu app in their mobile phones, before commencing their journey. While Aarogya Setu provides many ways to deal with the coronavirus crisis, there are still many challenges that can be expected post-lockdown.

2.2 PROPOSED SOLUTION

Our strategy is to design a smart transit platform that can analyse crowd distribution inside public transport and public spaces in near-real time and identify two metrics- space occupancy and space utilization. The analysis can be done by marking the available seats/spots by a visible marking and using it to determine how many spots are unoccupied in a space under consideration through visual recognition. The near-real time analysis can be visualized by the user to assess the space (like inside a public transport or a station platform). The application can also prompt the user whenever the space under consideration has an occupancy of, say, more than 35% and alert the user.

As a preventive measure, a non-contact infrared thermometer can be attached in a secure location at the entrance of public transport vehicle so that temperature of each passenger is measured before boarding and if body temperature of the person is detected to be higher than normal, it should trigger an alarm and he/she should not be allowed to board the vehicle. The passengers will also not be permitted to sit in the first row so as to maintain a safe distance from the driver. Further, a thermal camera can be installed inside every vehicle to keep a track on the heat signatures of the passengers during the journey and the data can be visualized on the platform so that the user may take immediate action. To protect the drivers from the risk of infection, there will only be one functional back door.

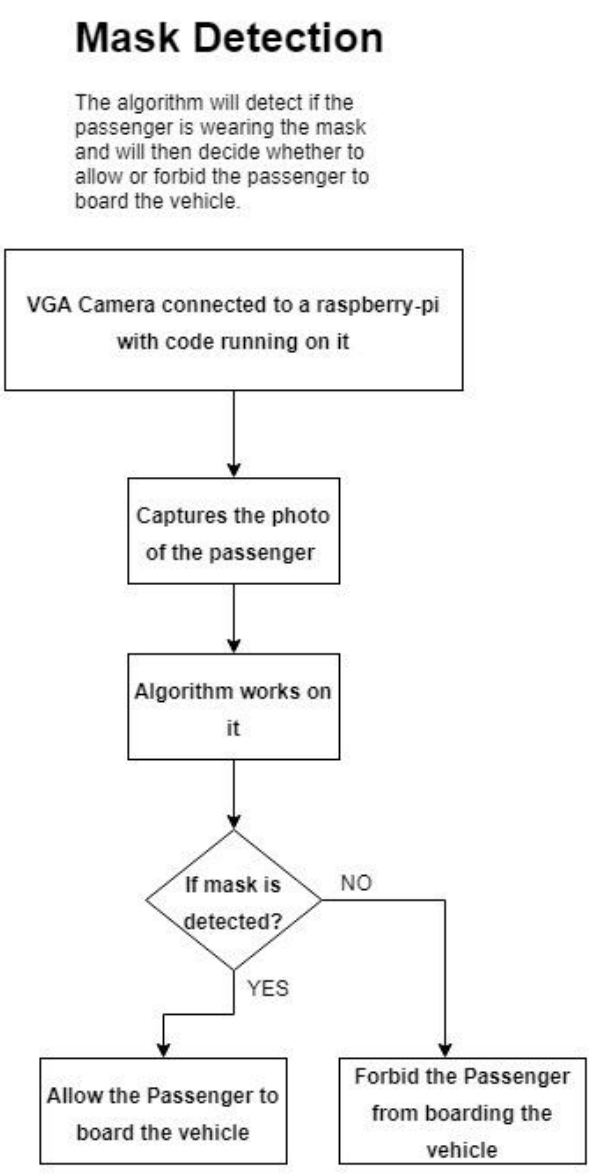
A Chabot can also be designed that can take user information and suggests the person whether he/she is fit for traveling or not.

After nearly two months of lockdown, the biggest challenge businesses will face will be restarting their operations. To get businesses back on track, we will have to ensure that we work within the constraints of what we are allowed to do. Our solution ensures that transportation businesses work within the hygiene and space constraints which will cause a new changed market dynamic that will be catered by the 'vehicle sanitation' business. Locally, the cost of sanitising a two-wheeler is Rs 20 and for disinfecting a four-wheeler is Rs 50; service centres and workshops (of Mahindra & Mahindra, Hyundai and Maruti Nexa) offer services from Rs 175 to Rs 1,500 for sanitation and disinfection. Our solution also gives rise to new employment opportunities for daily-wage labours like putting up visible markings in public transport and public spaces, etc. Once the transport operations kick-off, it is safe to say that people would be able to travel to their workplaces which means being a step closer to restoring the economy. As transportation becomes safer, more people would get comfortable to travel making our transportation business revenue-generating in no time.

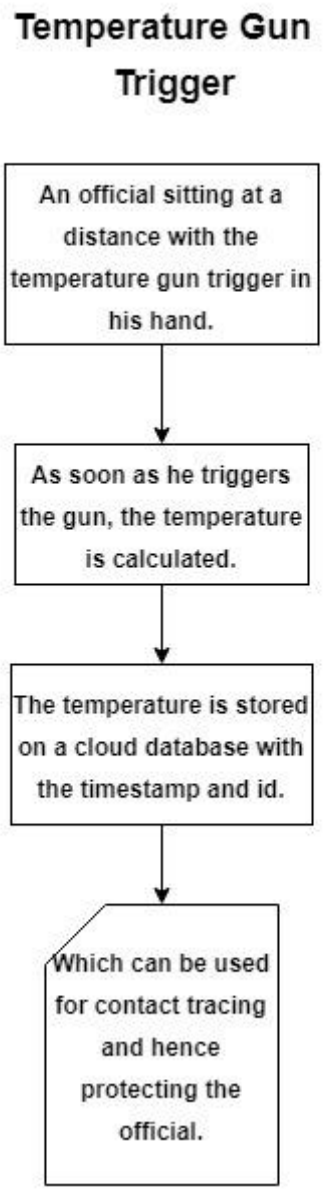
CHAPTER 3

THEORITICAL ANALYSIS

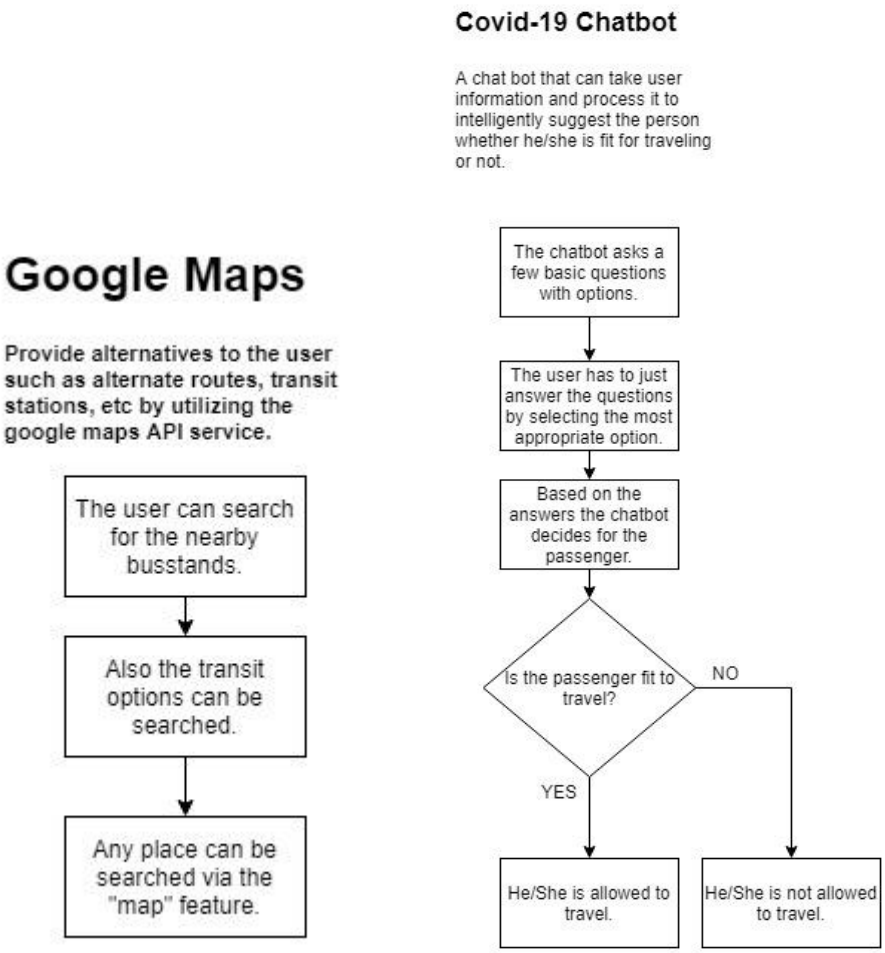
3.1 BLOCK DIAGRAM:



Flowchart 1



Flowchart 2



Flowchart 3 **Flowchart 4**

Fig 3.1 Flowcharts

3.2 HARDWARE/SOFTWARE DESIGNING

IBM cloud is used to build a web application. Using the IBM Watson platform, a device is created that sends the temperature readings to the application.

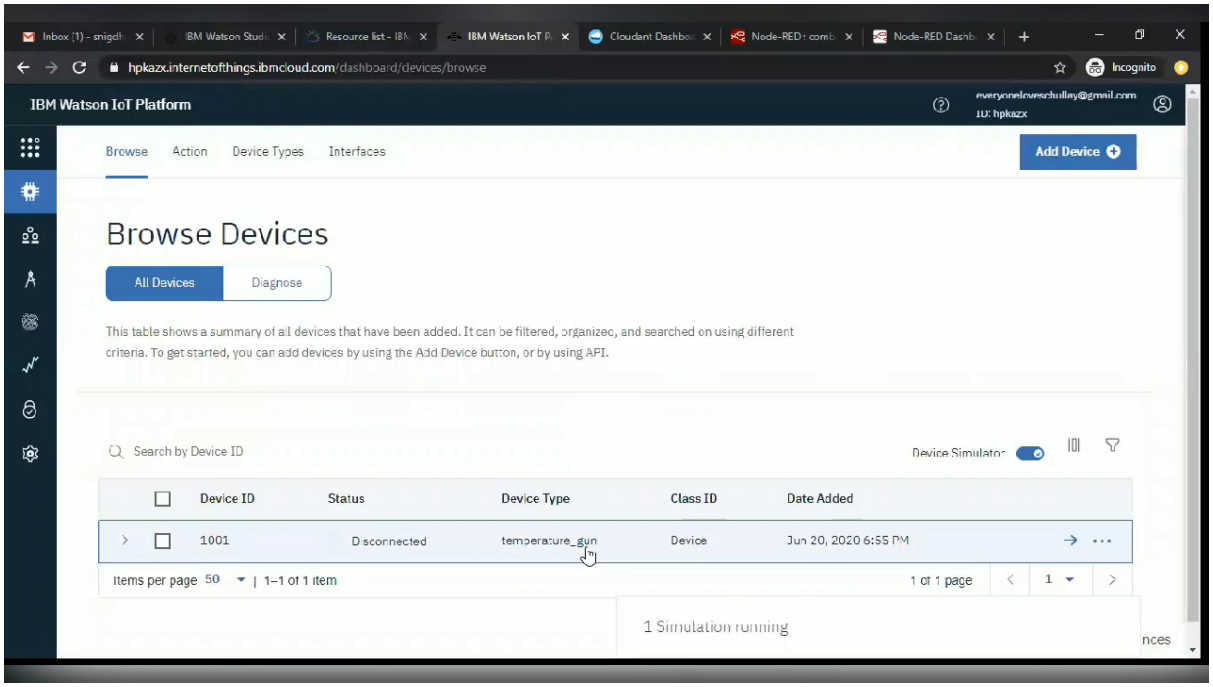


Fig 3.2 IBM Watson platform

A simulation event is created for getting the temperature value every 5 seconds. This simulator is connected to the device created on the IBM Watson platform.

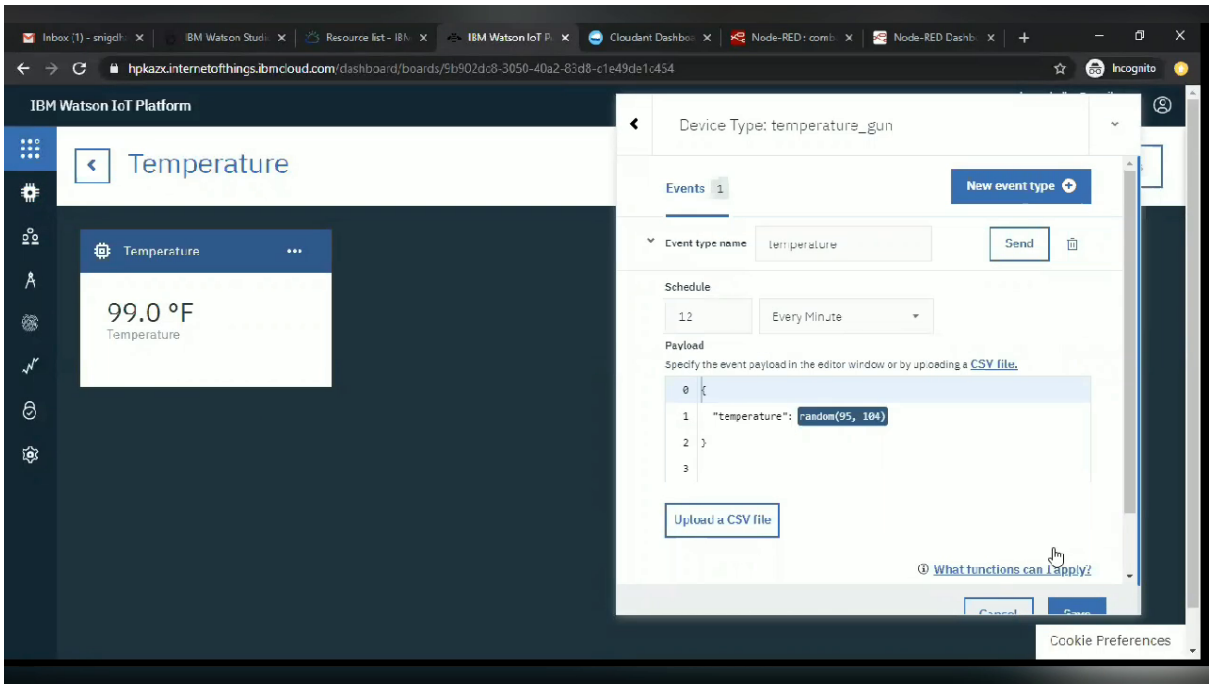


Fig 3.3 Event simulation

Node-RED is a programming tool for wiring together hardware devices, APIs and online services. It provides a browser-based editor that makes it easy to wire together flows using the wide range of nodes in the palette that can be deployed to its runtime in a single-click. To create a web application, node-RED is used.

A user friendly UI is designed using the node-RED dashboard. The mentioned flow is displayed in eight different tabs.

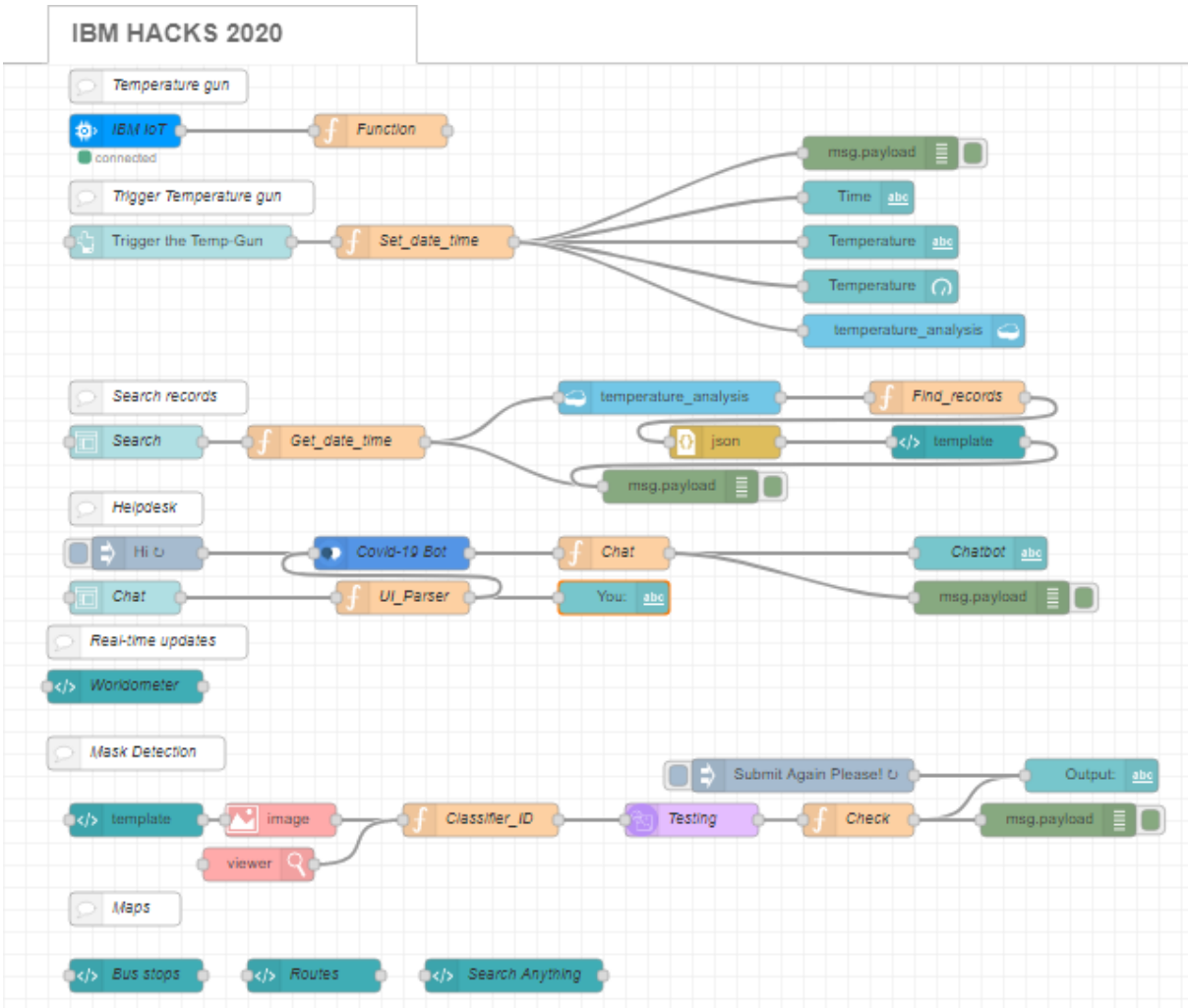


Fig 3.4 Node-RED flow

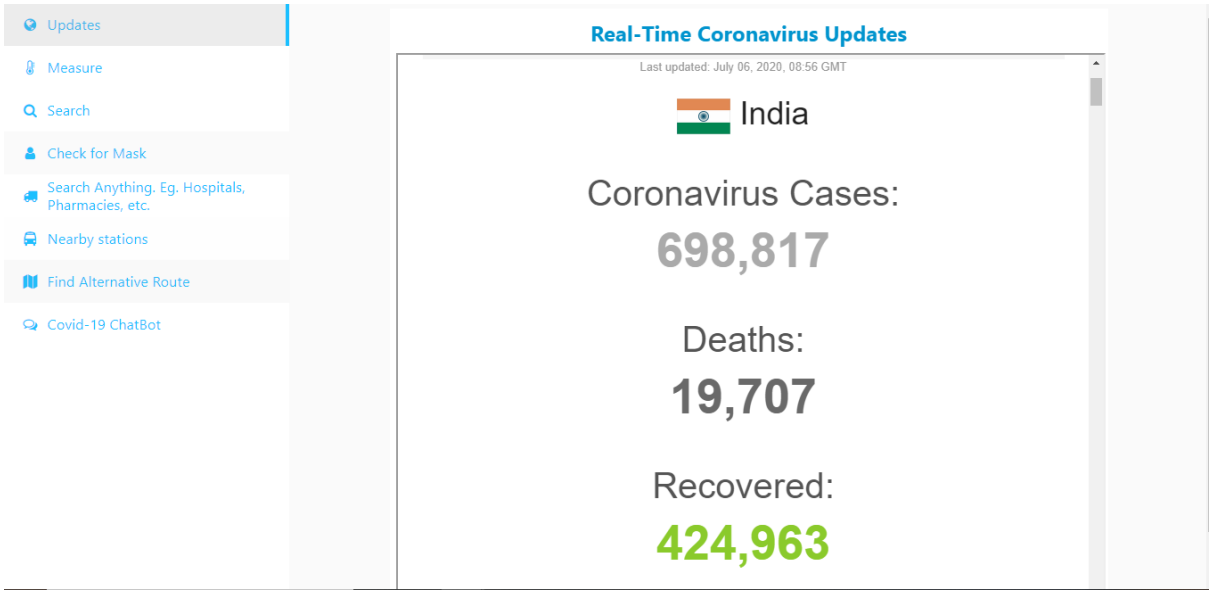


Fig 3.5 “Updates” Tab

This tab helps provide the user/traveller with all the real-time updates regarding the coronavirus throughout the world. The tab is set to show the data is India but the user can browse through any country/place/region. In this way the user can stay updated with the latest information hence the name “Stay Updated”.

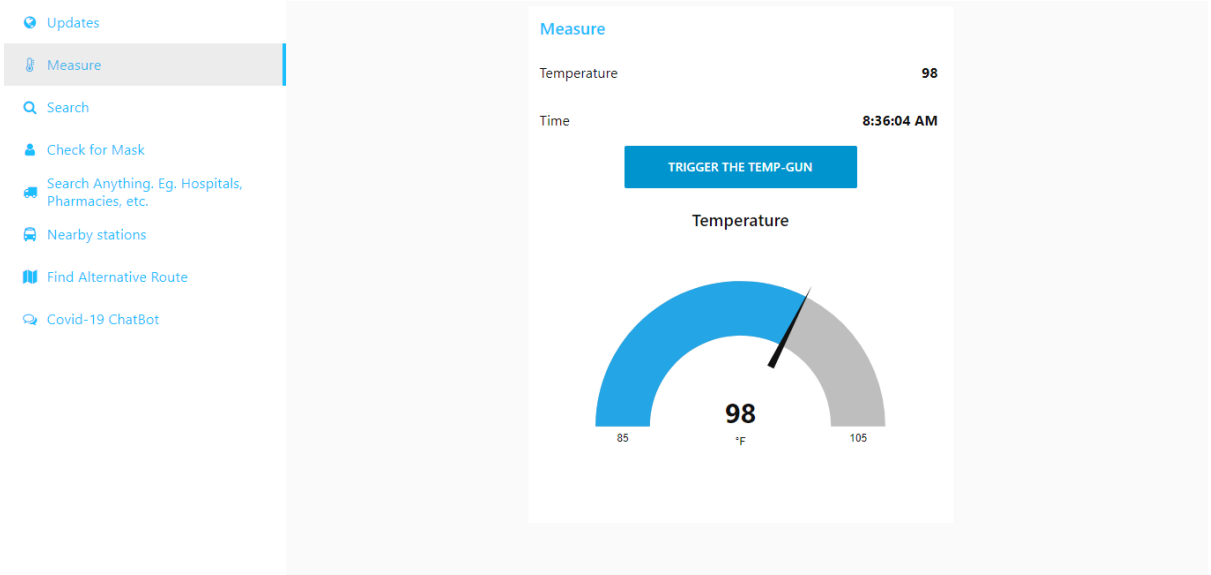


Fig 3.6 “Measure” tab

This is a simulation of a physical trigger button which is held by an official at the entrance of every station. The official will trigger it as the passenger enters the station. As soon as the button is triggered the temperature of the person is noted in the IBM Cloudant Database.

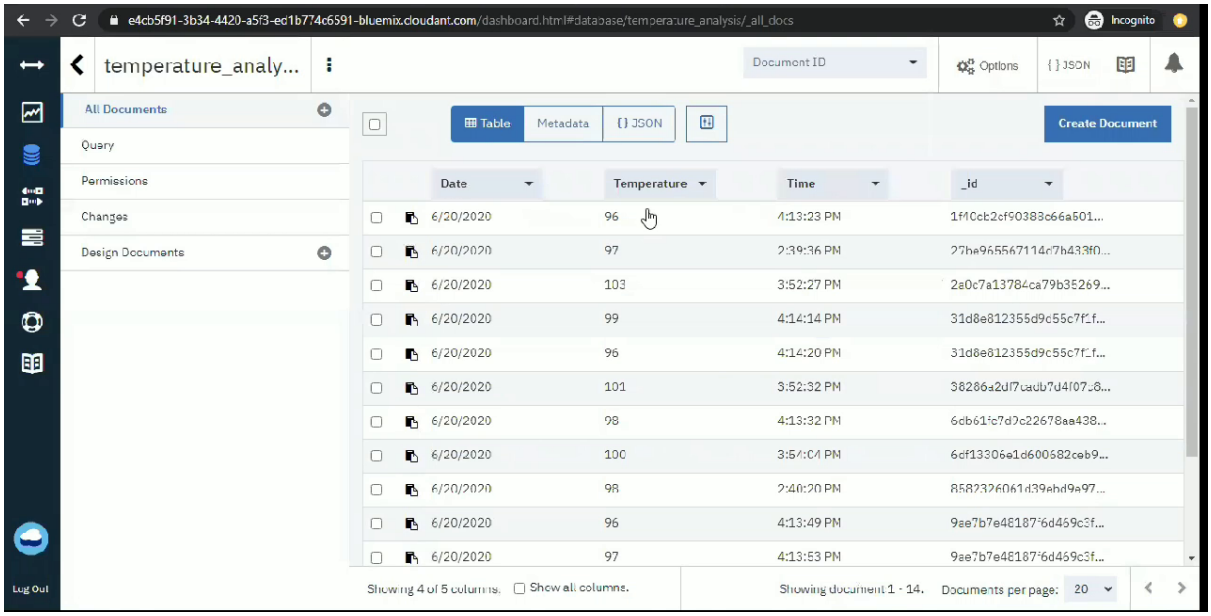


Fig 3.7 temperature analysis database

The temperature noted will be stored in this way with the time stamp as well an unique id to identify the passenger while contact tracing. This will help in efficient contact tracing and this information will only be accessed by government authorities at the time of need and with the permission of the passenger.

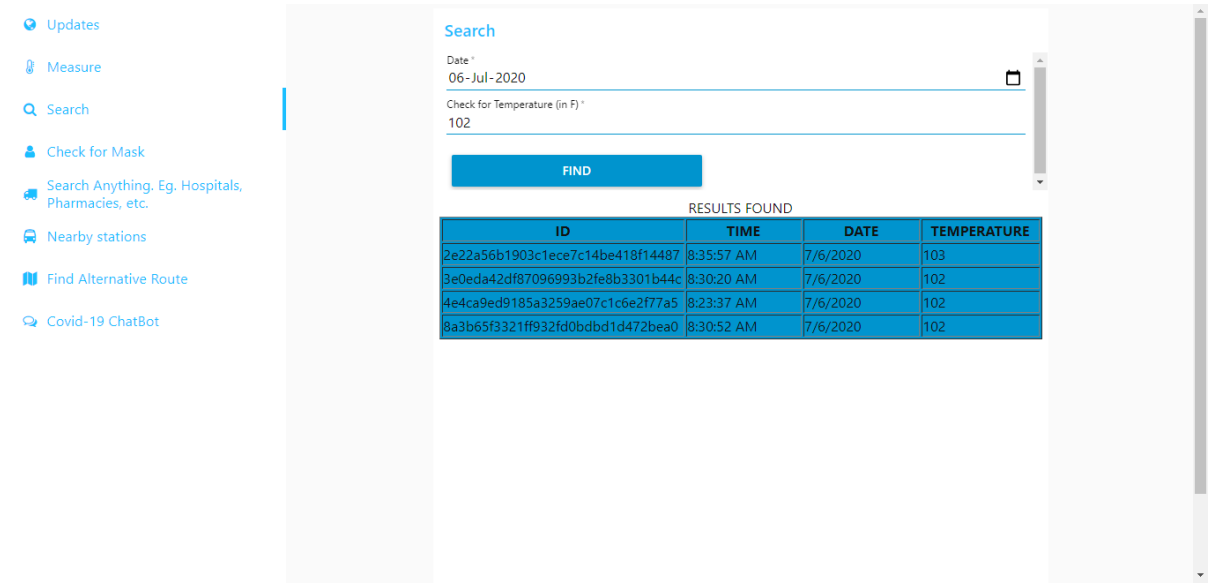


Fig 3.8 “Search” tab

The search tab will enable the authorities to access the temperature data of the passengers while contact tracing and the only input variables are the temperature and date. For example: If the authorities need to find the temperatures say 101°F

then that will be given as an input along with the date and the temperature will be shown in a list form.

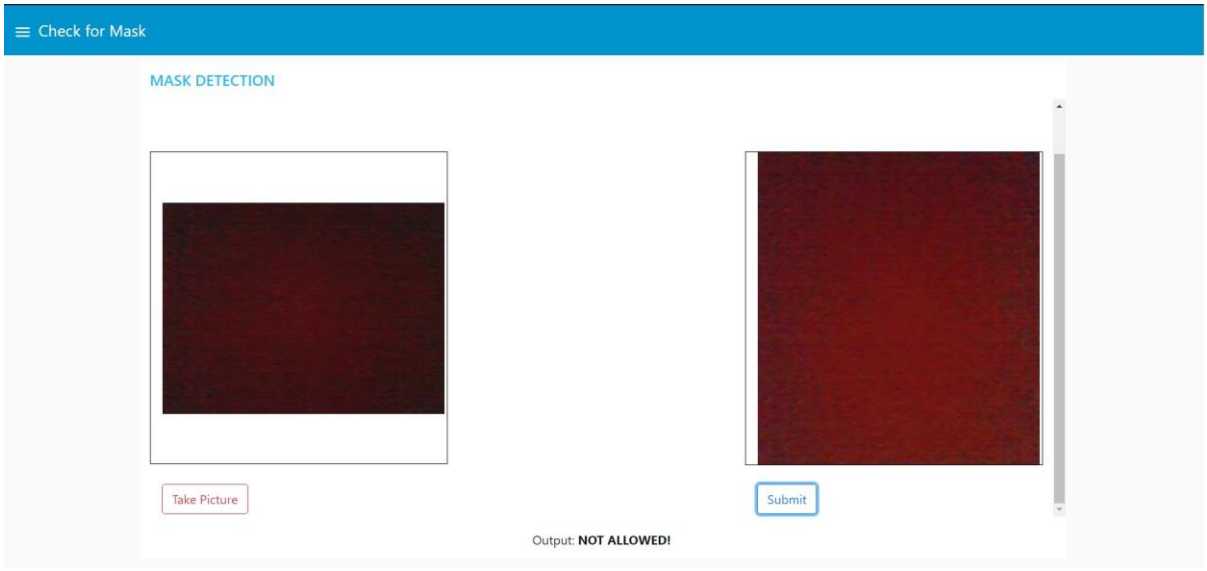


Fig 3.9 “Check for mask” tab

The browser just needs to access the camera and then it automatically clicks the picture and on clicking submit, the algorithm detects the mask and only allows the person to enter if the mask is on. So this system can be implemented at various check points which will reduce human labour for checking the masks and also this needs a VGA camera and a computer to work on at backend.

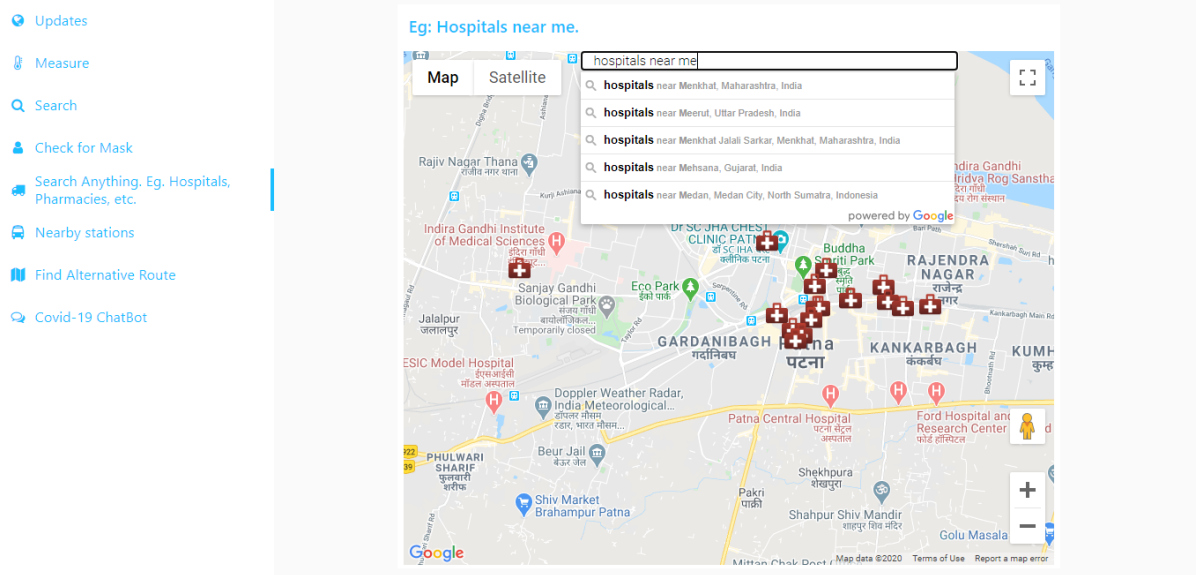


Fig 3.10 “Search anything” tab

If a passenger is a stranded in an unfamiliar place, instead of asking the people around, he/she can directly search for the place and it will be shown in the map and then the user can click on it to directly get the directions in the google maps.

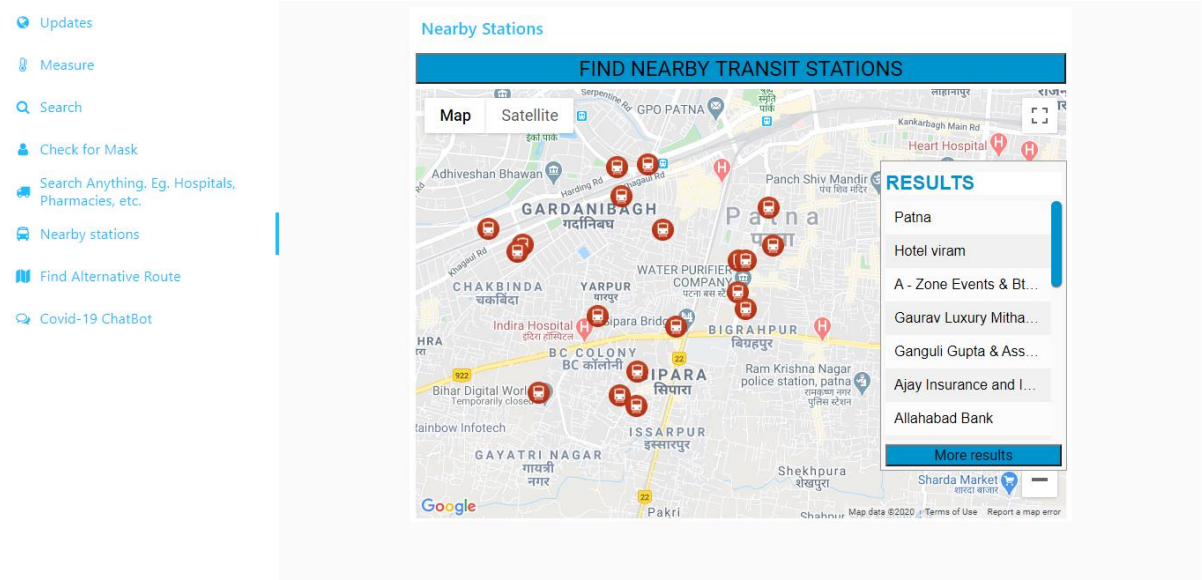


Fig 3.11 “Nearby stations” tab

Just by clicking on the “Find Nearby Transit Stations”, the user can get all the transit station like metro stations, bus stands, railway stations, etc. and then find the directions to the nearby one.

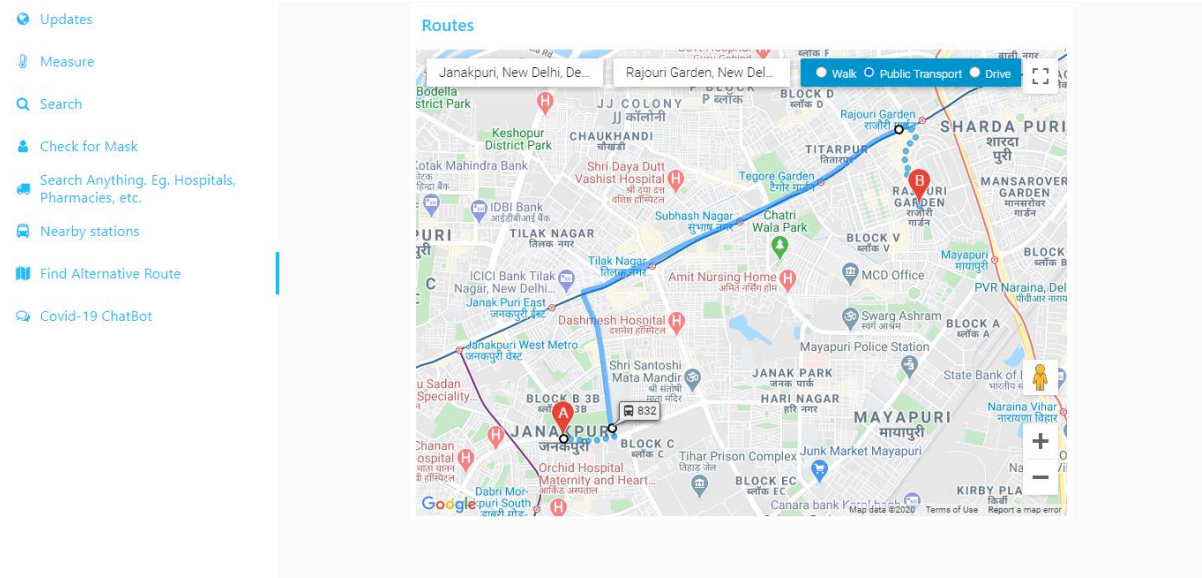


Fig 3.12 “Find alternative route” tab

If the user needs to find an alternative route to any destination, he/she just need to enter the origin and the destination and it will show the alternative route to reach there via public transport/walking/drive.

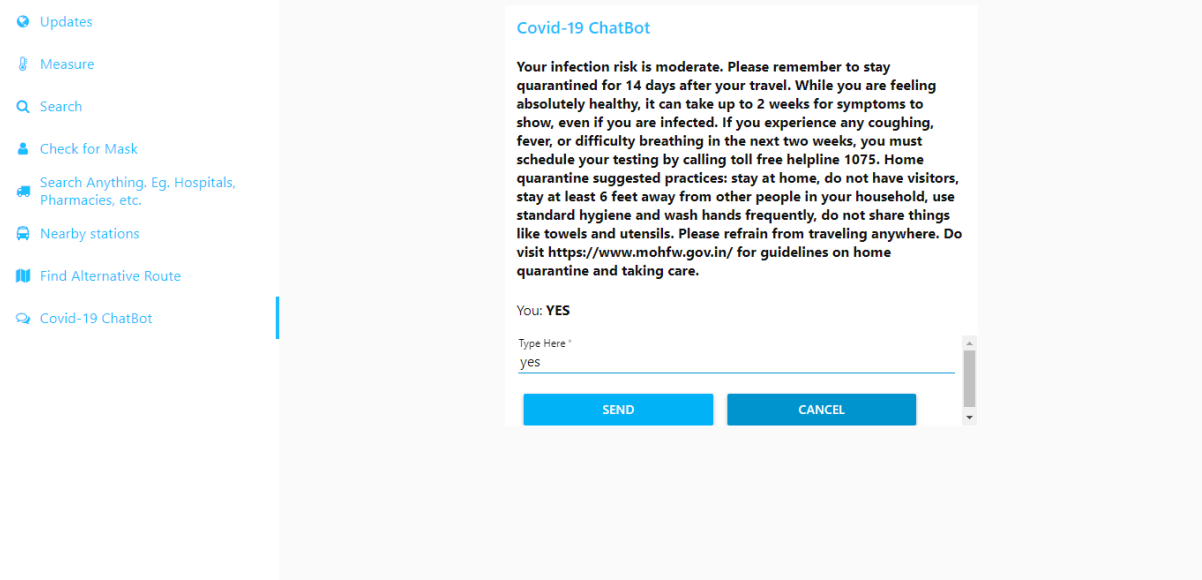


Fig 3.13 “Covid-19 Chatbot” tab

This Chatbot will ask basic questions to the user and then the user has to select the most appropriate option and then the Chatbot will advise the user whether it is safe to travel or not provided the user answers honestly.

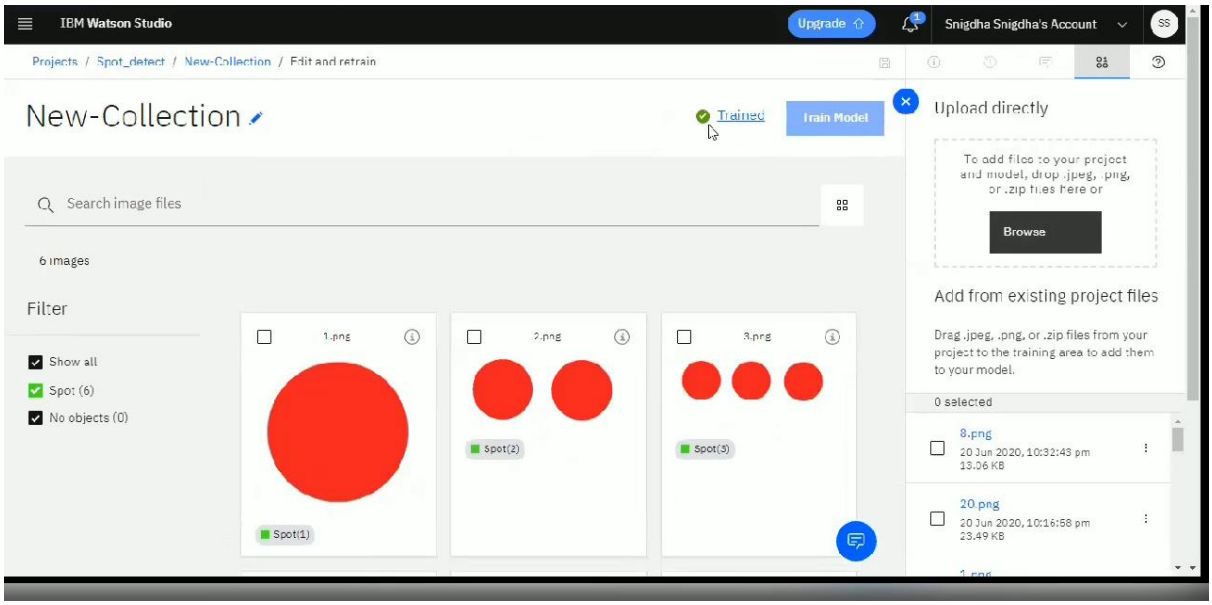


Fig 3.14 Spot detection model

The service of visual recognition is used to analyse the crowd distribution. An object detection model is trained to detect the red dots in an image. A camera is installed at the ceiling of every bus which will detect the red dots and keep a track of how filled the bus is by counting the remaining red dots. Then as soon as the bus is 33% full, it will notify the driver and the driver will not allow further passengers to board the bus.

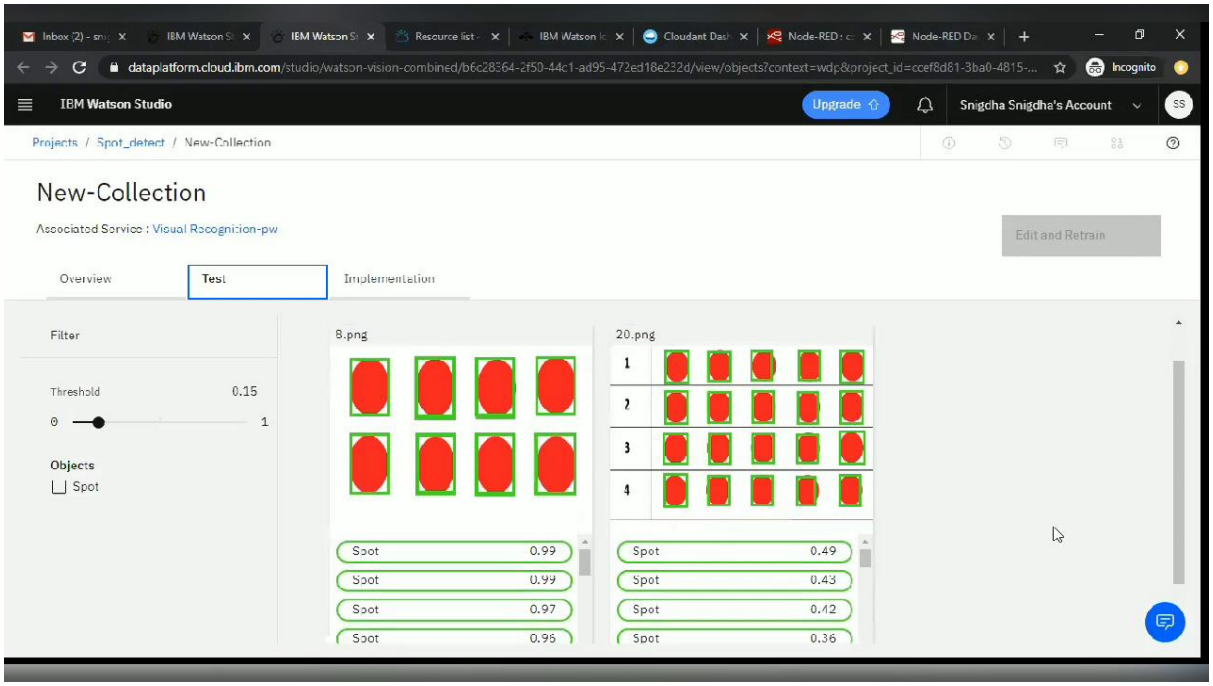


Fig 3.15 Testing spot detection model

To call the spot detetction model API in `Node.js` application, “spotdetect.js” (Appendix A) is written.

CHAPTER 4

EXPERIMENTAL INVESTIGATION

After creating an IBM cloud account, we use the IBM Watson IoT platform to create a device. An API key is also generated on the Watson platform which will later be used on Node-RED.

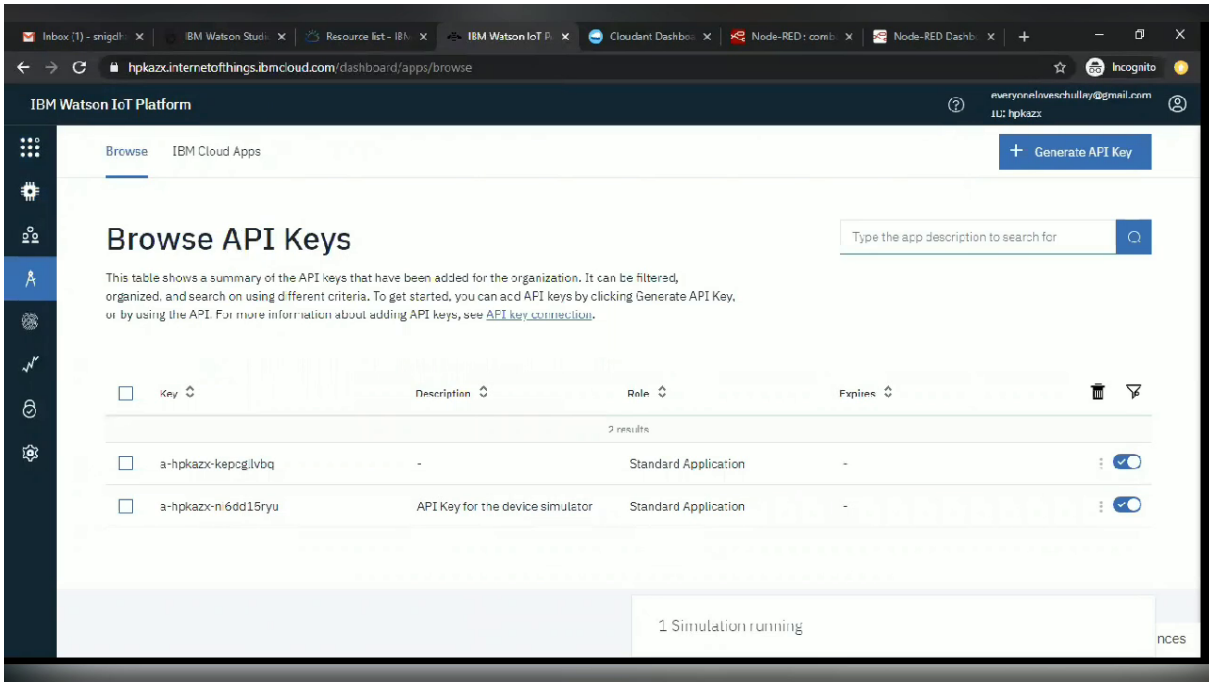


Fig 4.1 API keys on IBM Watson IoT Platform

NODE-RED is a programming tool that is installed for connecting API and the online simulator. Following are the additional required nodes that are installed on the Node-RED flow editor to create the flows:

1. node-red-contrib-scx-ibmiotapp
2. node-red-dashboard
3. node-red-watson
4. node-red-contrib-image-tools

Code for node js application “spotdetect”:

A code is written to call the spot detection API for the crowd distribution analysis. The source code is mentioned in Appendix A.

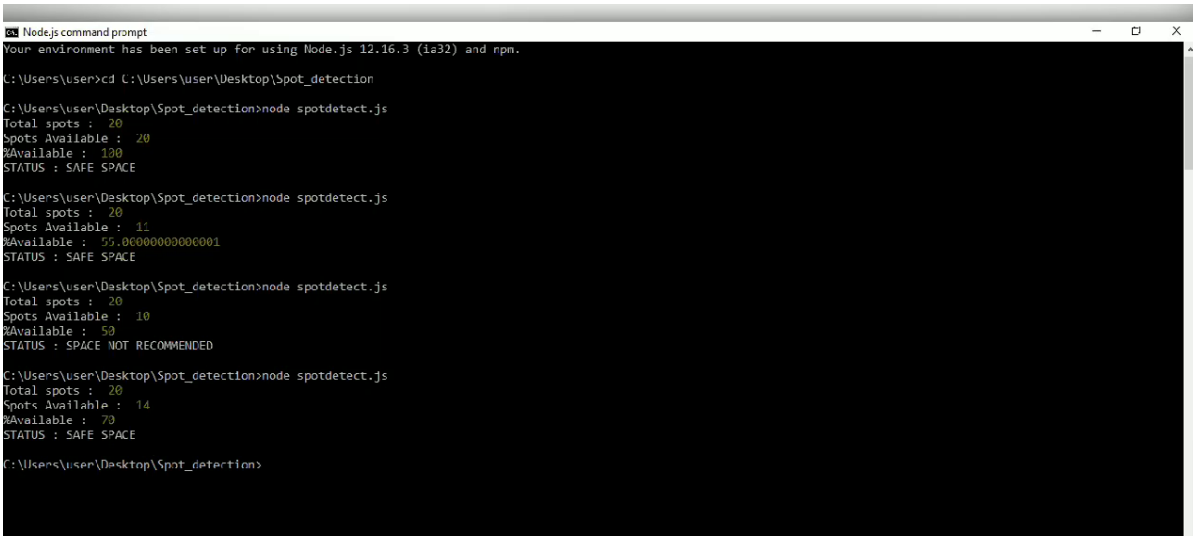


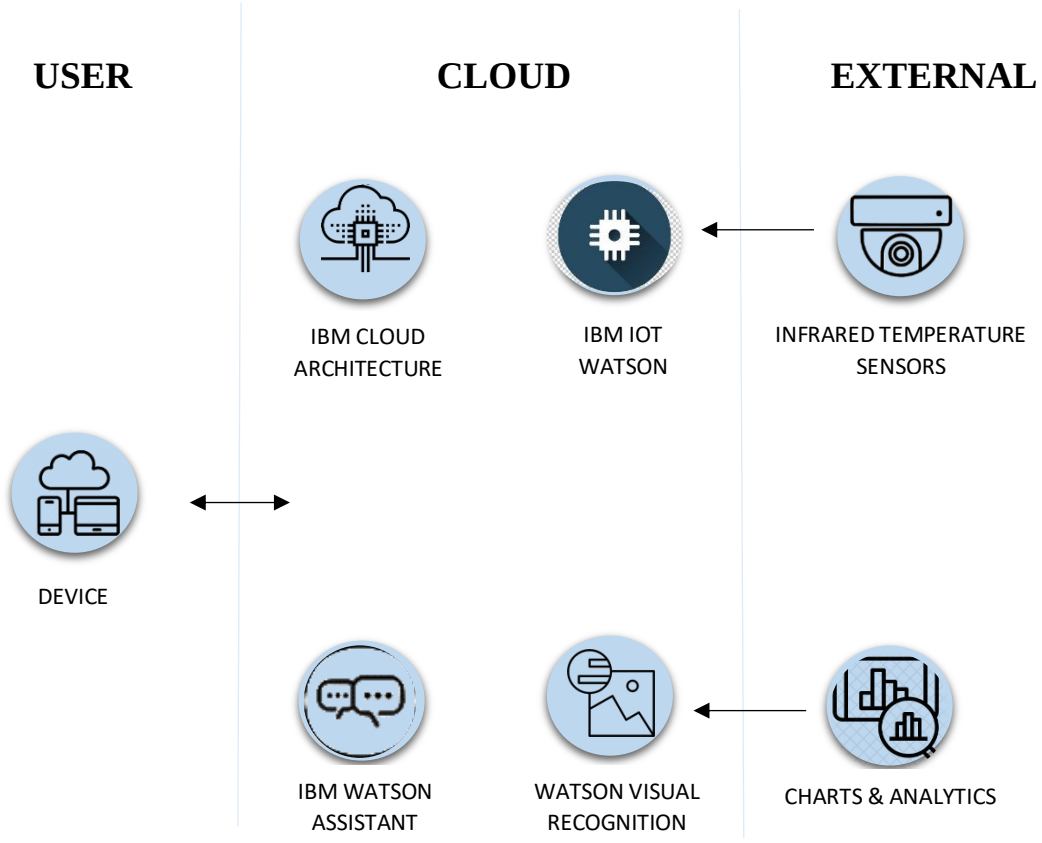
Fig 4.2 Result of node js application

CHAPTER 5

FLOW

Technologies used:

1. IBM cloud architecture
2. IBM Watson assistant
3. Watson visual recognition
4. IBM IoT platform



CHAPTER 6

ADVANTAGES & DISADVANTAGES

7.1 ADVANTAGES:

1. The major advantage of this system is that it ensures that people follow social distancing rules and their commute is made very efficient and smooth.
2. The mask detection system will not allow passengers without a mask on. This will ensure safety of not only the passenger but also the people around him/her.
3. It would also help the users to get information about the nearby hospitals, pharmacy, bus stands, hotels, etc.
4. The Chabot decides for the user whether or not the traveller is fit for travel or not.
5. The platform offers a real contactless way for measuring the temperature by providing an application to trigger the temperature sensor from a remote location.
6. Contact tracing is made easier and efficient.
7. Provides alternatives to the user such as alternate routes, transit stations, etc.
8. User-friendly interface makes it easy for the user to understand and navigate through the application.

7.2 DISADVANTAGES:

1. The IBM services are under free trial so this cannot be implemented without buying the services.
2. The object detection model on IBM visual recognition is still a beta-version. Hence, more development is required to obtain precise results
3. The cost of sensors and the software can be expensive for the transport providers.
4. Application failure when the network disconnects

CHAPTER 7
APPLICATION

The bus application is ready to use and can be implemented with a VGA camera and a raspberry-pi.

Also, it is an application to serve the users to get a number of facilities which makes their travelling easier and avoid them sticking into the hassle of searching for nearby transport centres and paramedical centres.

CHAPTER 8
CONCLUSION

The project provides an extensive platform to maintain social norms and ensure safety of people. The application suggests safe alternatives that can be opted to promote social distancing. The novelty that comes with our solution is that all the necessary aspects are confided at one place and it is very user friendly and easy to understand. Following are the project deliverables:

- **For the passenger**

1. A smart transit platform that can analyse crowd distribution inside public transport and public spaces in near-real time. The analysis can be done by marking the available seats/spots by a visible marking and using it to determine how many spots are unoccupied in a space under consideration through visual recognition. The application can also prompt the user whenever the space under consideration has an occupancy of, say, more than 55% and alert the user.
2. Provide alternatives to the user such as alternate routes, transit stations, etc by utilizing the google maps API service.
3. Access to useful information like current statistics related to coronavirus situation in the country, hospitals or pharmacies nearby, etc.
4. A chat bot that can take user information and process it to intelligently suggest the person whether he/she is fit for traveling or not.

- **For the transport provider**

1. A mask detection model that can detect if the person is wearing a mask or not, and allow only those to enter a vehicle, or any premise, if they are found to be wearing a mask.
2. As a preventive measure, a non-contact infrared thermometer can be attached in a secure location at the entrance of public transport vehicle so that temperature of each passenger is measured before boarding and if body

temperature of the person is detected to be higher than normal, it should trigger an alarm and he/she should not be allowed to board the vehicle.

3. The data from contactless thermometer to be stored in a database along with the date and timestamp, so that it can be utilized later during contact tracing.

CHAPTER 9
FUTURE SCOPE

The future scope of this project has numerous applications.

1. The face detection system can be redesigned and can be used at airports and places of high security.
2. The other features supported by this system can be taken into use always as the users are always in need of such facilities that provide them information about the nearby paramedical centres and transport services.
3. A Chabot can serve the user with the information whenever and wherever.
4. The crowd distribution analysis model can be trained for real life scenarios and used in public spaces like bus stations, train stations, malls, offices, etc.
5. The costs associated can be reduced when the system is fully implemented.

REFERENCES

1. https://flows.nodered.org/
2. https://cloud.ibm.com/
3. https://internetofthings.ibmcloud.com/
4. https://developer.ibm.com/
5. https://cloud.ibm.com/docs

APPENDIX (A): SOURCE CODE

```
const fs = require('fs');
const VisualRecognitionV4 = require('ibm-watson/visual-recognition/v4');
const { IamAuthenticator } = require('ibm-watson/auth');
//Call object detection model API
const visualRecognition = new VisualRecognitionV4({
  version: '2019-02-11',
  authenticator: new IamAuthenticator({
    apikey: '7fuJ_AZ6A5lb-YbE-j7SH72sai438oQvC5acZ9Cn9LDD'
  }),
  url: 'https://api.us-south.visual-
recognition.watson.cloud.ibm.com/instances/b09a5c92-c2b7-4815-b680-
09170d72aeb4',
});
//Test
const params = {
  imagesFile: [
    {
                data: fs.createReadStream('./data/14.png'),
                contentType: 'image/png',
          },


        ],
  collectionIds: ['b6c28364-2f50-44c1-ad95-472ed18e232d'],
  features: ['objects'],
  threshold: 0.15,
};
//Result
```

```
total_spots=20
visualRecognition.analyze(params)
  .then(response => {

available_spots=response.result.images[0].objects.collections[0].objects.length
    percent_available=available_spots/total_spots*100
    console.log('Total spots : ',total_spots);
    console.log('Spots Available : ',available_spots);
    console.log('%Available : ',percent_available);
    if(percent_available>=55)
        console.log('STATUS : SAFE SPACE');
    else
        console.log('STATUS : SPACE NOT RECOMMENDED');
  })
  .catch(err => {
    console.log('error: ', err);
  });
```