The Smart City Initiative

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Table of Contents

AN INTRODUCTION

Science and technology has drastically evolved over the last century, especially in the last three decades. It has influenced the lives of people on a very large scale by making it easy, simple and fast. In the new era, aspects of science and technology modernization has been implemented in almost every nation. Modern equipment has been explored to properly operate every field of life and to solve almost all the problems. It was not possible to get all the benefits without applying it in medical, education, infrastructure, energy generation, information technology and other areas. Whatever improvements we have seen in our daily lives are all attributed to the development of science and technology. Villages are now being developed as towns and cities, and this development has further led to ebbs in the economies of the nations. A notably critical role played in this transition has been because of the dawn of the Internet era. The internet had its birth in the 1960s with the Advanced Research Projects Agency Network (ARPANET), which slowly grew and developed through the 20th Century to become the World Wide Web in 1992. This network has now grown globally to what we know as the modern version of the internet.

With the advent of the internet and its widespread usage, the exploitation of this resource combined with the advancements in other technological fields, communication protocols, and standardisation mechanisms resulted in the introduction of the concept of **Internet of Things (IoT**). This has further evolved due to the convergence of multiple technologies, real-time analytics, machine learning, commodity sensors, and embedded systems. In the current day scenario, IoT has been successful in automating various processes across numerous small-scale, medium-scale, and large-scale industries.

What is a Smart City?

A smart city is an urban area which collects and organizes data acquired from electronic IoT sensors deployed across the city, and further interprets the data to generate insights that can be used to efficiently monitor and manage resources and services. This includes data collected from citizens, devices, and assets that is processed and analysed to monitor and manage traffic and transportation systems, power plants, utilities, water supply networks, waste management, crime detection, information systems, schools, libraries, hospitals, and other community services.

The technological and human branches involved in setting up such an environment amalgamate various digital, hybrid, wired, and artificial intelligence technologies with creative and innovative human thinking to produce seamless algorithms and means to solve problems using IoT.

OBJECTIVES

The objective of this project is to develop a smart solution for everyday problems faced by a commoner with integrating the concepts of the Internet of Things. This project addresses the problems faced in various facets of an urban city, and attempts to solve it. The problems chosen are in the following fields:

- Safety
- City roads and security
- Hospitality

Each of these form integral aspects in a metropolitan set up. Thus, we identified one major problem in each of these aspects that we should address through this project.

- ➔ Women's safety in city streets.
- ➔ Traffic congestion and difficulty in vehicle parking.
- ➔ Restaurant food delivery.

Each section ahead will describe our IoT based solution for each of these problem statements by explaining the working of the project solution, the code, and its applications.

Section- 1

1.1 Smart Safety Device

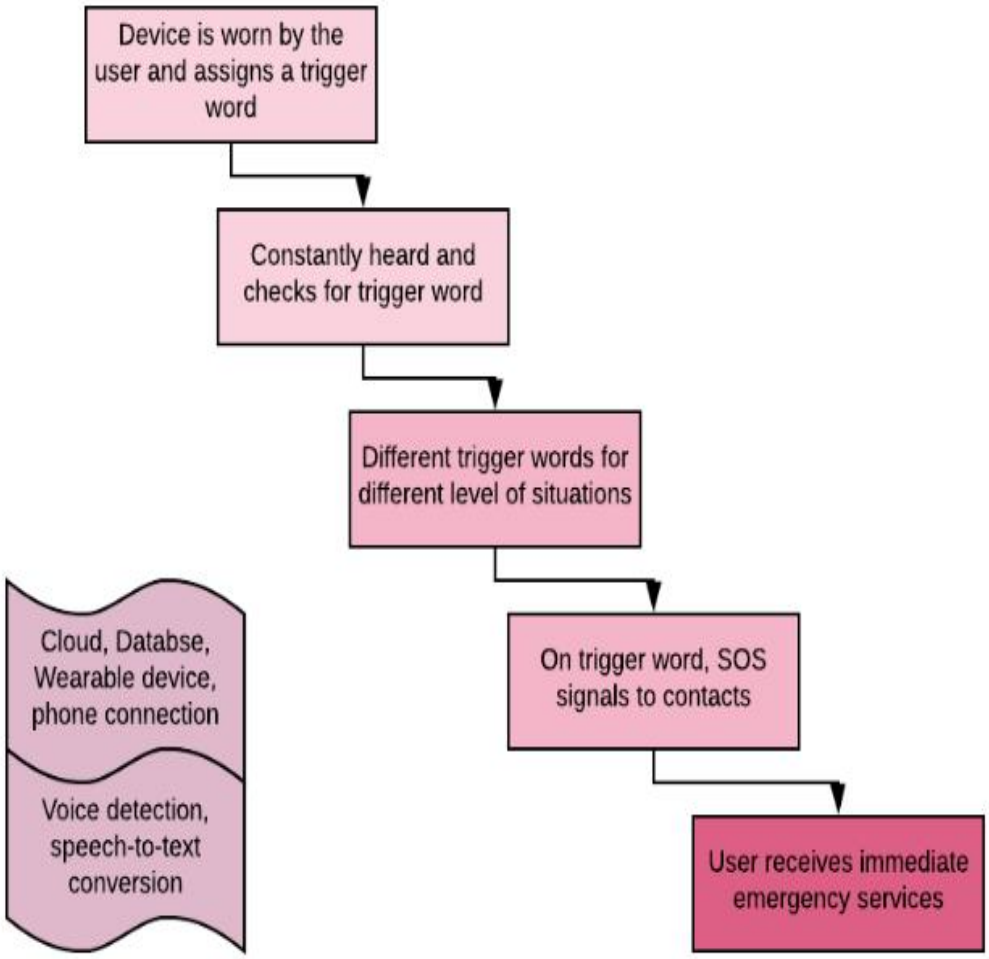
In today's world, we've been witnessing an increase in the crimes committed in our streets, especially against women. Eve-teasing, harassment, theft are few of the common crimes that are reported, and there are even more that do not get reported at all. In such a scenario, technology and IoT can play a critical role in creating a safe space.

The solution here is a voice recognition-based wearable device that can be used in times of perceived threat, in order to communicate said threat to close contacts, and alert the same to the concerned authority for assistance.

1.1.1 Working

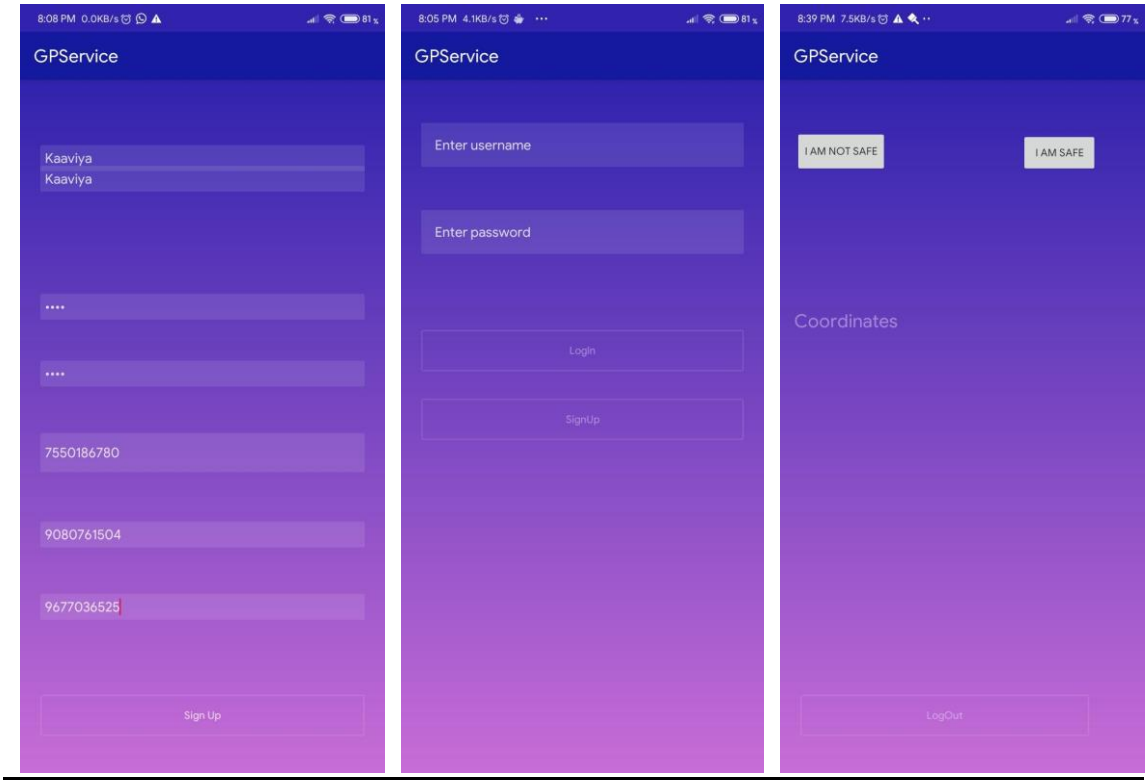
- The idea for this device is to be a distinctly wearable like a bracelet, or a pin. This structure will be embedded with a low-powered voice recognition device connected to the cloud. The device constantly records the voice of the user, and is being converted to text in the cloud simultaneously.
- Each user will have to assign a predefined trigger word, which would send an SOS signal to preassigned contacts and nearby emergency services. The cloud matches the recorded text with the trigger word, and if there is a match, it activates the trigger. There can be multiple trigger words for varying levels of threat.
- Whenever a trigger word pertaining to a particular threat level is sensed, the cloud sends an SOS message to the contacts and relevant emergency service authority pertaining to that threat level, thus allowing for any help to reach in difficult times of emergencies.

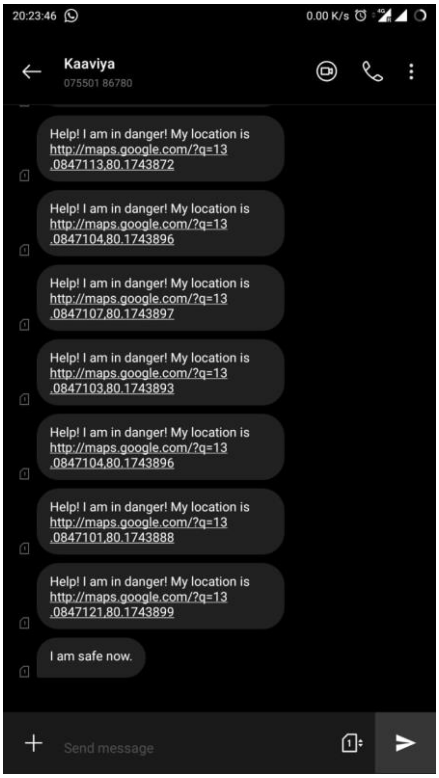
Flow Chart

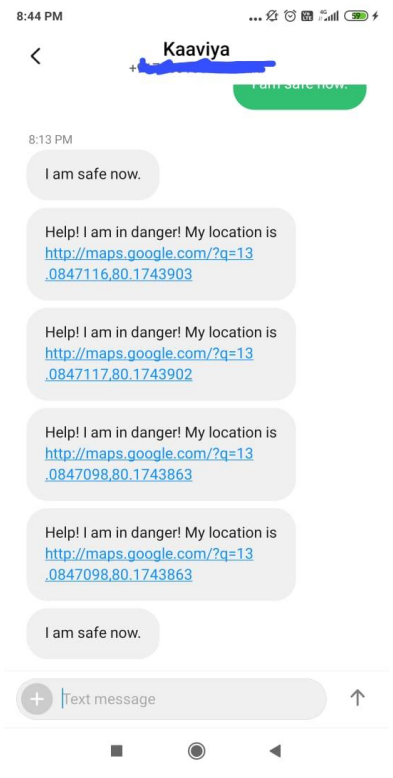


1.1.2 Relevant Pictures

The first two snapshots are the configuration of a user's account in the application and once logged in the user is provided with a simple interface with two buttons: 'I AM SAFE' and 'I AM NOT SAFE' which is depicted in the third snapshot.







In the last two snapshots, when 'I AM NOT SAFE' is pressed, one can see the message is being continuously sent to the emergency contacts specified with their inherent location, until the user presses 'I AM SAFE'.

Section- 2

2.1 Smart Restaurant Delivery System

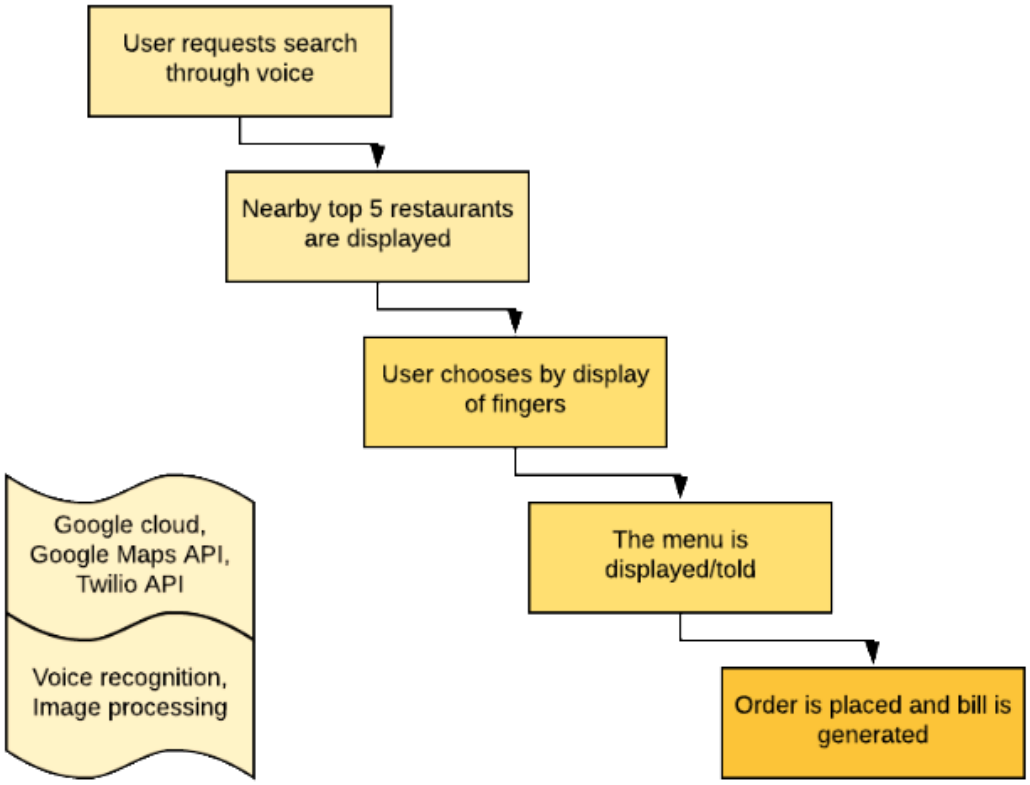
Time is of even more importance in today's busy world where people spend most of their time working and commuting, sometimes getting stuck in heavy traffic as a result. Instead, they can use this waiting time to search through restaurants based on time and place, and place an order and receive the bill - all through speaking.

Using IoT, image processing and voice recognition technologies, this is made possible to enable users to comfortably browse and place orders on the go.

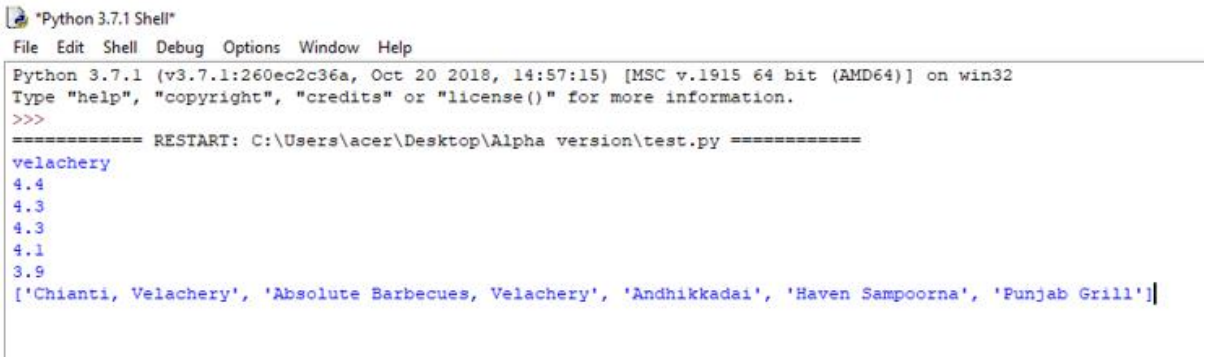
2.1.1 Working

- Using the application installed in the car's GPS screen, the users can search for hotels nearby them. It automatically takes the system time and suggests foods accordingly as morning, afternoon, evening and night.
- And using google maps API, we get the hotels nearby within an accessible distance. The top 5 hotels are then displayed and told to the user. The user can either manually press the button or show the no of fingers on their hand.
- Next, the user can select the items from the menu by voice and confirm the order. The bill is then generated to the user's mobile phone. We use Twilio APIto initiate outbound calls and send text messages.
- They can either pick the food instantly from the hotel without any waiting time or request a delivery to any address.

Flow Chart

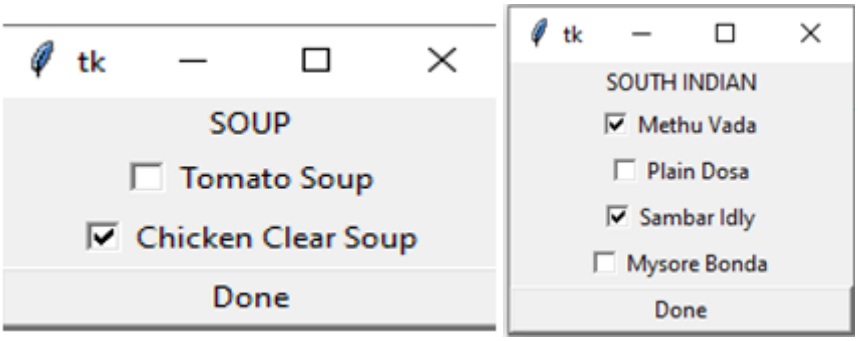


2.1.2 Relevant Pictures

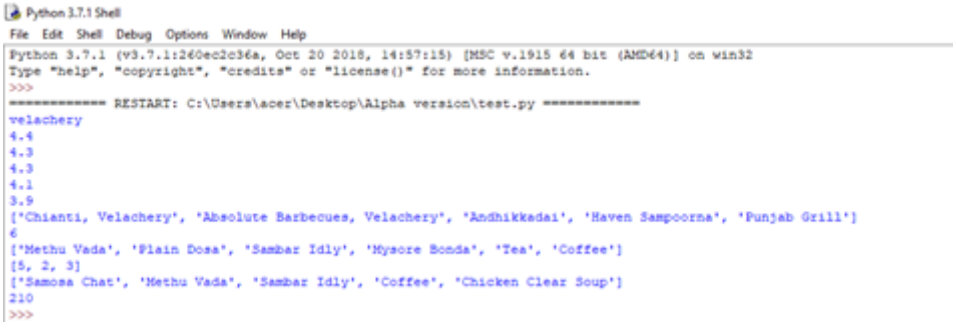


Customer ratings and list of restaurants based on location

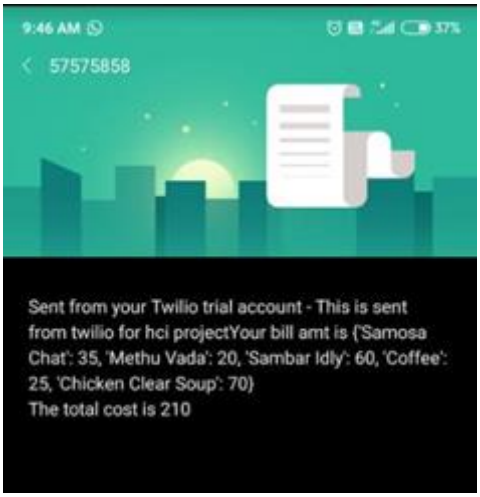
Choose the restaurant based on finger detection



Choosing the dishes from the menu option for each type of item



Display of items ordered along with the final bill price



Conformation of the order by SMS through Twilio API

The interface of the Bot

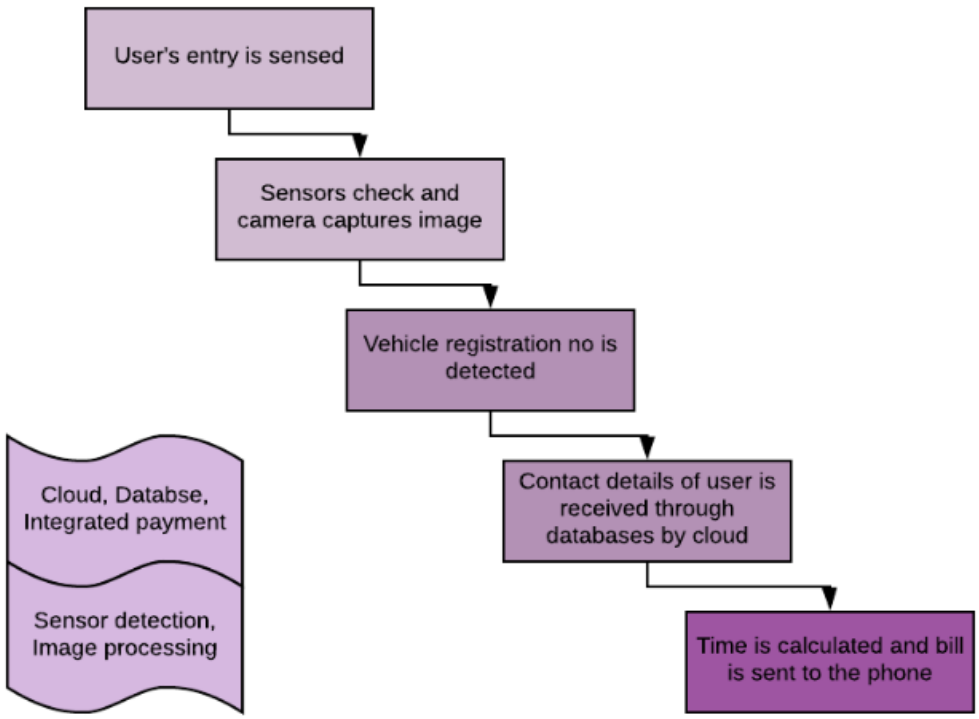
Section- 3

3.1 Smart Parking System

3.1.1 Working

- In front of a designated parking slot, ultrasonic sensors are placed which sense the entering of a vehicle into the slot. Once the vehicle reaches a particular distance from the sensor, (in this case 10cm), it understands that the vehicle is inside the slot fully.
- At this point, cameras placed in the front capture an image of the licence plate, and image processing algorithms run on it to extract the number plate of the vehicle. This information is uploaded to the cloud.
- Inside the cloud, information about the vehicle owner is extracted from databases of the vehicle registration number, from which the contact details of the owner is taken. The cloud also updates the dashboard and location of the users.
- The cloud also starts a timer to count the duration for which the vehicle is parked inside the slot. Once the vehicle is taken out of the slot, the cloud calculates the time the vehicle is parked for, and generates a bill for the parking charges using standard parking tariffs of that area.
- This bill is sent to the owner using the contact details, and the bill amount is deducted from the integrated payment method.

Flow Chart



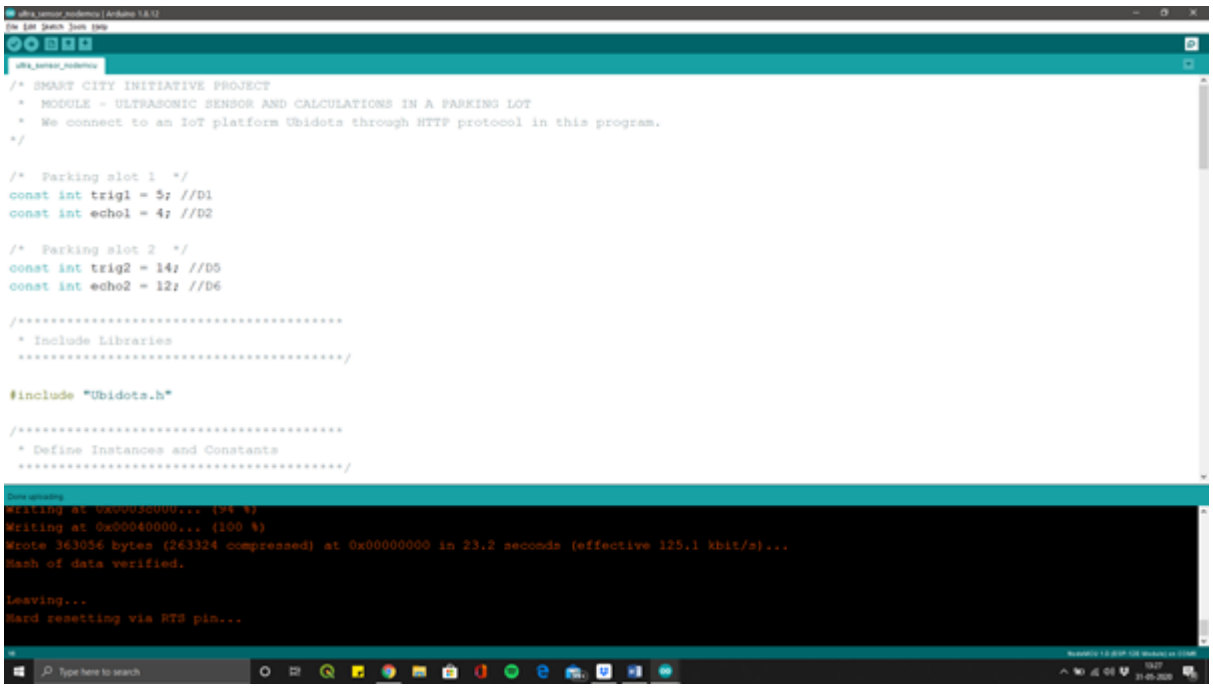
Components Used:

- ➔ NodeMCU-12E Development Board
- ➔ Camera
- ➔ Arduino Uno
- ➔ Ultrasonic Sensor * 2
- ➔ Jumper Wires
- ➔ USB cables
- ➔ Breadboard

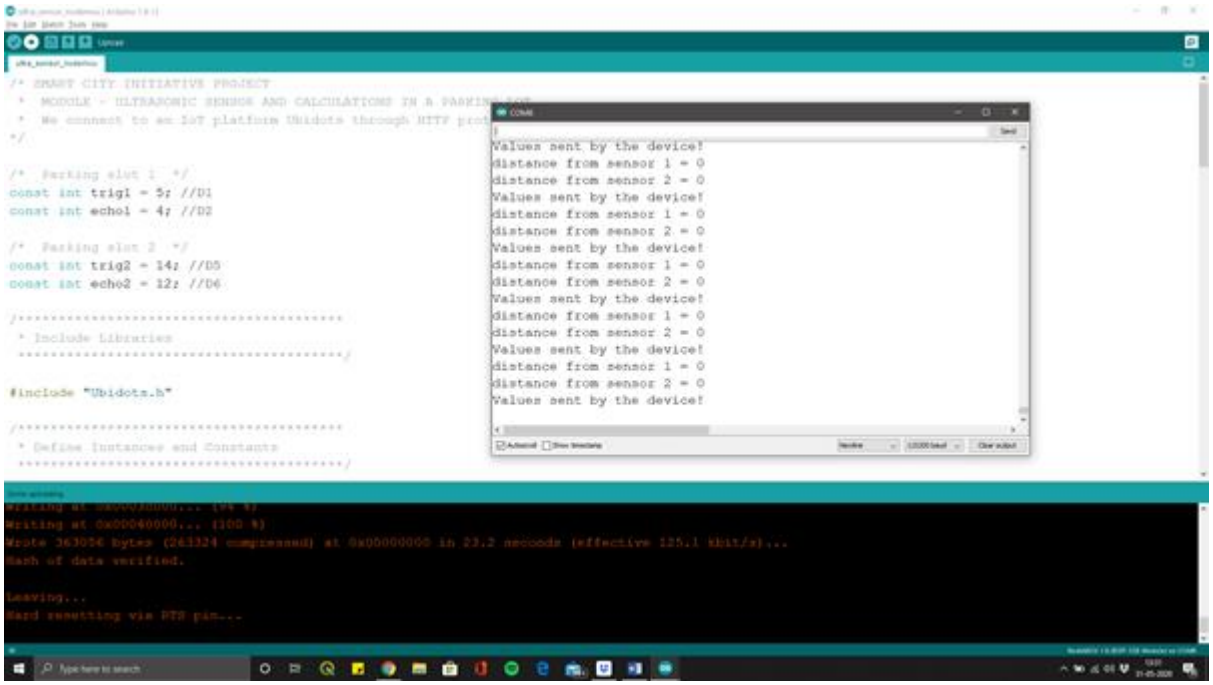
3.1.2 Relevant Pictures

Pictures related to Ultrasonic Sensor:

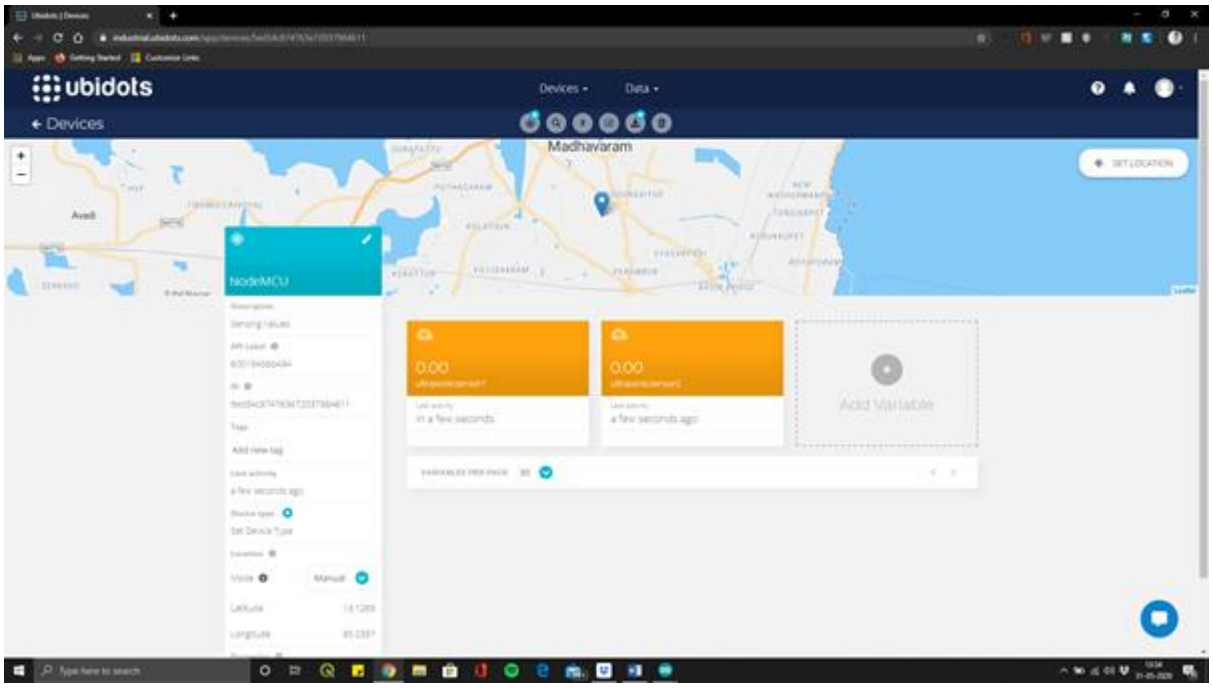
1. The code is compiled and uploaded onto the NodeMCU 12E development board using Arduino IDE.



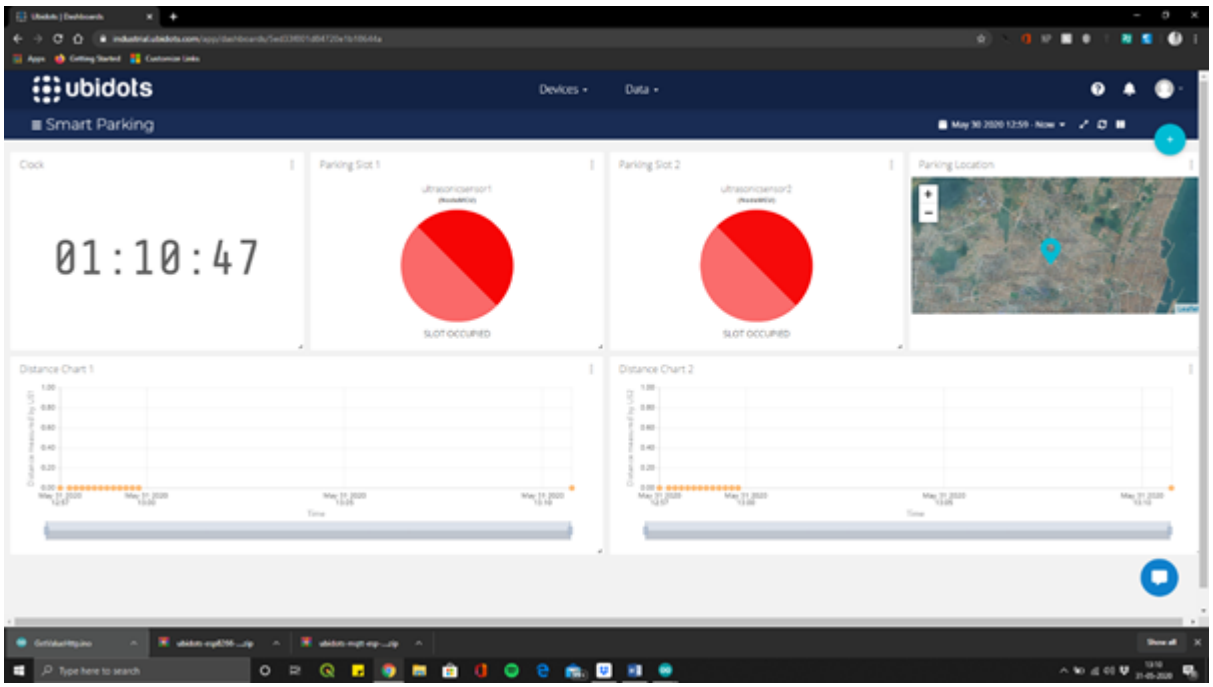
2. The serial monitor in Arduino IDE confirms the transmission of sensor data over to Ubidots personal dashboard.



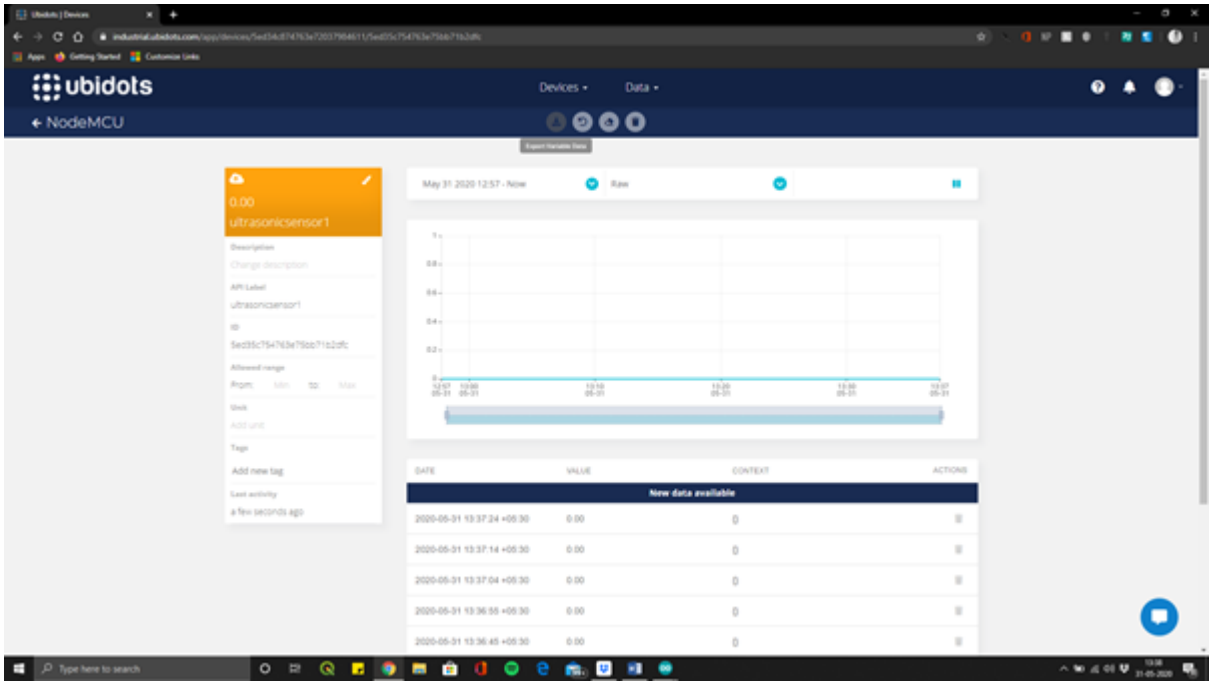
3. Under Devices in Ubidots Dashboard, we can see the parameters that we have created and need to be analysed for further decision making.



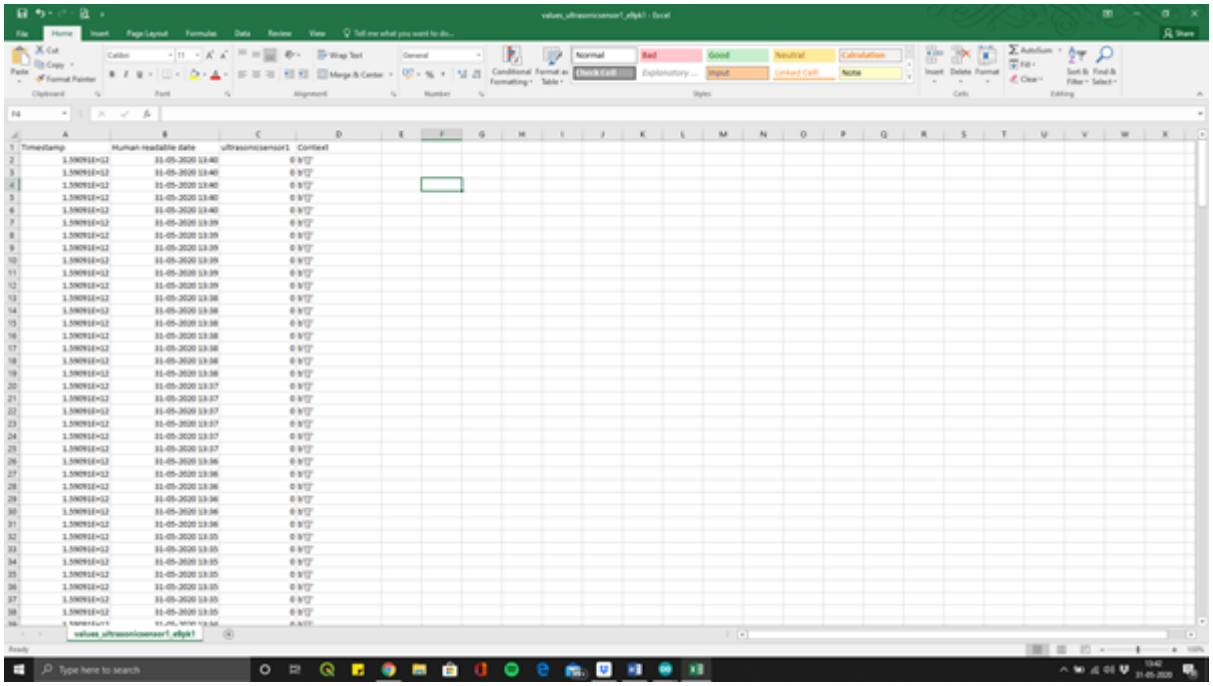
4. Appropriate visual parameters are added in the dashboard to make it convenient for the users to read their data.



5. We can export variables data to a readable CSV format for bill calculations.



6. Data is ready to be imported and to be used further.



Pictures related to License Detection:

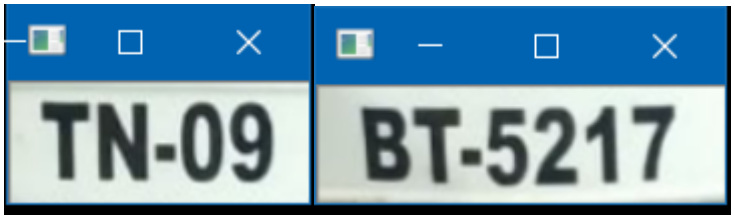
This is the pre-processing part. First, the image is converted into grey-scale and a threshold is applied to get a black-white image along with filtering methods to reduce noise.

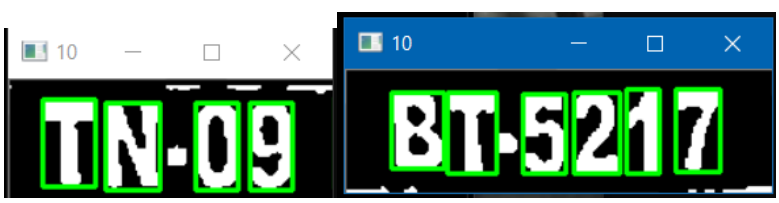
When the KNN model is run, similar areas are grouped together and are separated from the image by bordering it and then the vehicle registration number is identified as the largest such text combination.

The identified number is input into the database along with an image of the surrounding and removed upon exiting.

Example -

1)





```
F:\WIN SEM 2019-20\IOT\Licence_plate_original\Alpha_licence>py Main.py

step 2 - len(contours) = 989
step 2 - intCountOfPossibleChars = 66
step 2 - len(listOfPossibleCharsInScene) = 66
step 3 - listOfListsOfMatchingCharsInScene.Count = 2

2 possible plates found


possible plate 0, click on any image and press a key to continue . . .
possible plate 1, click on any image and press a key to continue . . .

plate detection complete, click on any image and press a key to begin char recognition . . .

chars found in plate number 0 = BT5217, click on any image and press a key to continue . . .
chars found in plate number 1 = TN09, click on any image and press a key to continue . . .

char detection complete, click on any image and press a key to continue . . .
```

2)

3)


AN BYOND


imgPlate
AN BYOND


imgThresh
AN BYOND


possible plates found
license plate read from image = ANBYOND
F:\Fall Sem 2019-20\ESD A1\Theory\Licence plate>

CONCLUSION

We have successfully completed our Smart City Initiative project by integrating several modules into a single infrastructure, hence proposing such a model to be incorporated in cities in future for the betterment of all netizens. Smart Cities following this model uses Internet of Things (IoT) devices such as connected sensors, lights, and meters to collect and analyse data. The cities then use this data to improve infrastructure, public utilities and services, and more. We've elaborately outlined how smart cities provide a more efficient and higher quality lifestyle for their residents, and the methods they use to reach these goals. Finally yet importantly, the size of a city is not an obstacle on the way to becoming "smart".

FUTURE WORK

The potential of smart cities is nearly limitless, and the growth of these cities should only accelerate in the coming years.

The deployment of the Internet of Things can also be extended to other sectors including manufacturing, fashion, restaurant, healthcare, and education etc. of a city. Smart cities can share a common smart city platform, which makes sense especially for small cities. The cloud-based nature of IoT solutions for Smart Cities is appropriate by sharing a platform based on open data. Small cities can form a common urban ecosystem. In this way, solutions of small and large smart cities are networked and controlled via a central cloud platform.

More measures can be taken to ensure that data is accurate and free from manipulation as the data collected and analysed includes sensitive details about consumers themselves. To achieve such security objectives, strict authentication and ID management solutions can be integrated into the Smart City ecosystem to ensure that data is shared only with authorized parties.

In addition to the above work, a more advanced smart traffic system can be built using the license plate detection algorithm to detect over speeding, stolen vehicles, etc. Since each node can represent a vehicle/user, tags can be attached to vehicles or people (in the form of, but not limited to an add-on for vehicles and key chains for people) and with the help of GPS services and their activity can be tracked.

In all of the above mentioned ideas, the data is important and finally points to the user. These data can be presented to the user as a freemium based application/service to further interconnect the network hence taking another step close to achieving an ultimate Smart City.

REFERENCES

The development of this project was based on various inputs from websites, research papers, etc. The following were valuable resources that helped us gain insights into the numerous nuances of this project:

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2. https://www.visualcapitalist.com/iot-building-smarter-cities/
3. “Smart City and IoT” Tai-hoon Kim, Carlos Ramos and Sabah Mohammed.
4. “Internet of Things (IoT) Technologies for Smart Cities” , Badis Hammi, Rida Khatoun, Sherali Zeadally,Achraf Fayad and Lyes Khoukhi.
5. Yunliang, Z., Lijun, Z., Xiaodong, Q., & Quan, Z. (2009). Flexible KNN Algorithm for Text Categorization by Authorship based on Features of Lingual Conceptual Expression
6. https://cloud.google.com/text-to-speech