F.P.S

FREE PARKING SPOT

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Date: 05/10/2019

CPEG-577-21 Internet of Things
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Abstract:

Students who own cars, sometimes have problems finding a free parking spot inside the campus, making them looking around from a parking lot to another. So, they end up wasting time and fuel while looking. If the Driver has the information about the parking spot, if it's occupied or not, he will know where to go directly, and by that, he will save time and fuel.

We propose as a solution to this problem, an IoT based system responsible for gathering data from distance sensors (Ultrasonic Sensors) to figure out if the parking spot is used or free to use. The information collected from the sensors will be sent to a cloud (Database) responsible for storing the data. Users will have an app allowing them to request the status of each spot and provide navigation to the parking lot.

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Introduction:

The Internet of Thing is an evolving modern type of communication that has as a vision, the integration of many technologies in one network, gathering data, larger connectivity using the clouds and mainly, simplifies users' daily life. Our project F.P.S (Free Parking Spot) is an IoT based system that falls within the same vision of the IoT. F.P.S uses different types of communication (Wireless and wired), collect data from distance sensors and store it in a database located in the cloud allowing access to the information from anywhere in the world.

Experimental details:

1. List of materials:

	Part Name	Quantity
	**Raspberry Pi 3B+**	**2**
	**Ultrasonic Sensors**	**6**
	**Android Device**	**1**
	**Bread Board**	**4**
	**TRI LED (Green & Red) + Resistors**	**1**

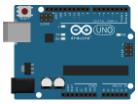
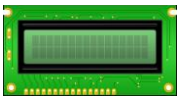
	**Jump Wire (Male to Male /Male to female)**	**2**
	**RFID Tags**	**3**
	**RFID Readers**	**1**
	**Servo Motor**	**1**
	**Prototype Cars**	**4**
	**Arduino Uno**	**2**
	**LCD Scree 16bits**	**1**
	**Keypad Mambran 4x4**	**1**

Table1- List of Materials

2. Project Diagram:

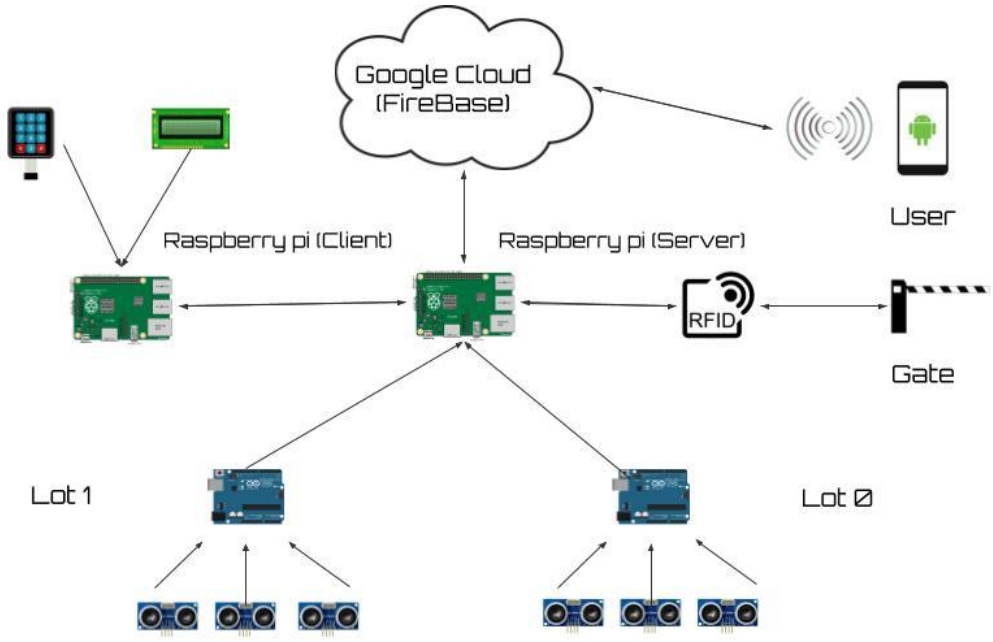


Figure 1- Project Diagram

3. Schemes of the project set up:

a. Raspberry pi (Server):

- **RFID Reader:**

Responsible for reading the RFID tags connected to the cars, and matching the IDs to the ones already stored in the database located in the Raspberry Pi(Server) to allow access to the parking lot or not.

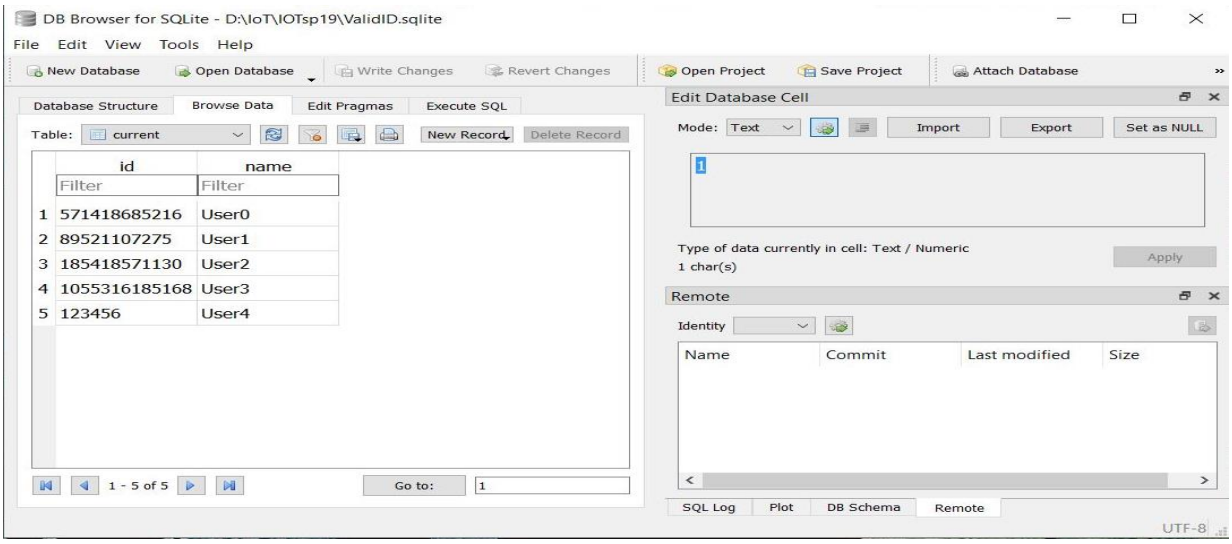


Figure2- RFID SQLite Database

- **Buzzer:**

Responsible about making a sound the time that the gate is open, and will stop after the gate is closed.

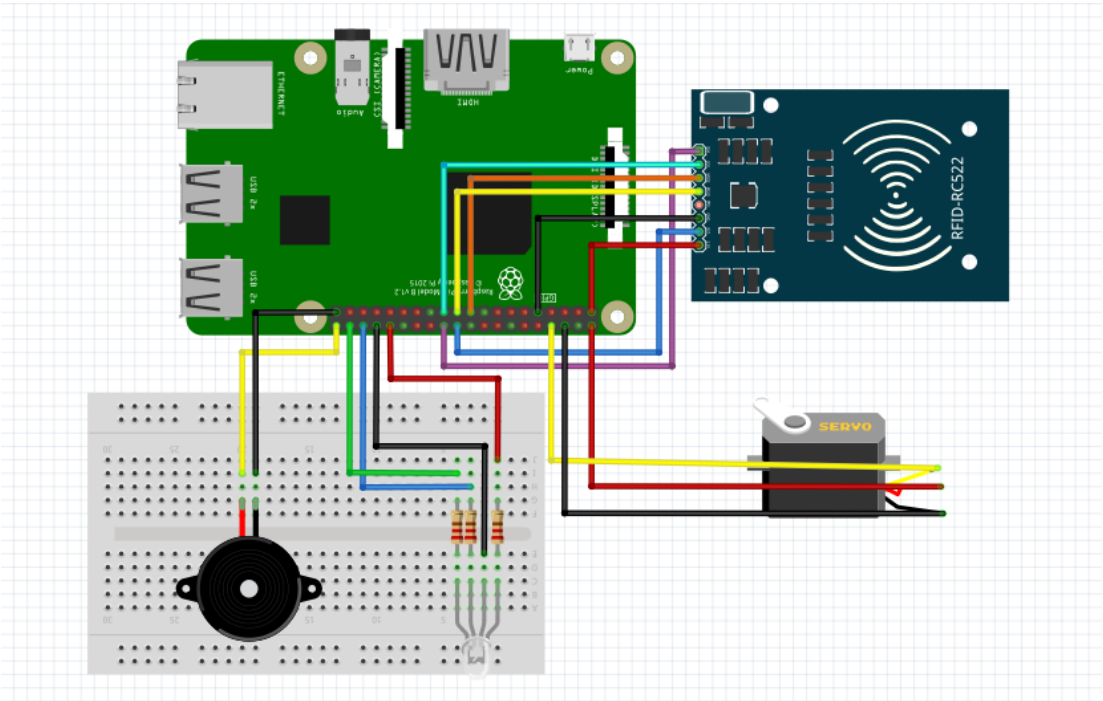


Figure 3- RFID reader, buzzer, Tri led and servo s90 set up on Raspberry Pi (Server)

- **Servo S90:**

Responsible for the movement of the gate. After allowing the access to the parking lot, the servo motor rotates 90° to open the gate and get back to 0° after a period of time.

- **TRI LED:**

Light up in RED when the gate is closed and light up in GREEN when the gate is open.

b. Raspberry Pi (Client):

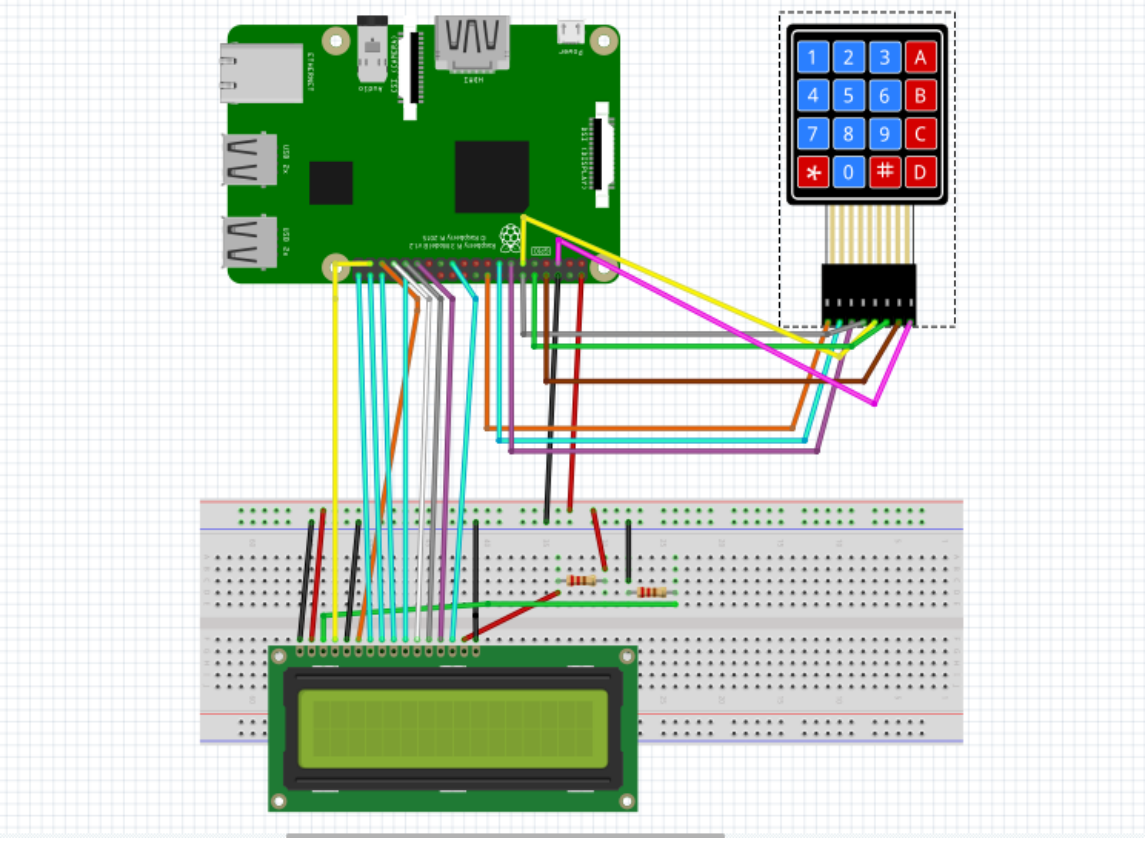


Figure4- Keypad 4x4 and LCD set up on Raspberry Pi (Client)

- **Keypad Membrane 4x4:**

Plays the role of a Back-up for the RFID Tag, users will have to type their ID through the keypad to get access to the parking lot.

- **LCD Screen:**

Responsible for displaying "Accepted" when the access is accepted, and "Denied" when the access is denied.

- **Raspberry Pi (Client):**

Due to the need for more pins, we opted to use another Raspberry Pi to add more features to our projects such as mentioned above. The connection between our main Raspberry Pi and the additional one is by using the web sockets (Server/Client).

C. Ultrasonic sensors set up on Arduino and connected to Raspberry Pi (Server):

- **Ultrasonic sensors:**

Responsible for sensing if there's a car in the range of the sensors, if so the status of the parking spot will be collected through Arduino as a binary data "0" if the parking spot is free, "1" if the parking spot is occupied. After this, Arduino will send the information to Raspberry Pi (Server) so it will feed the database in the Cloud.

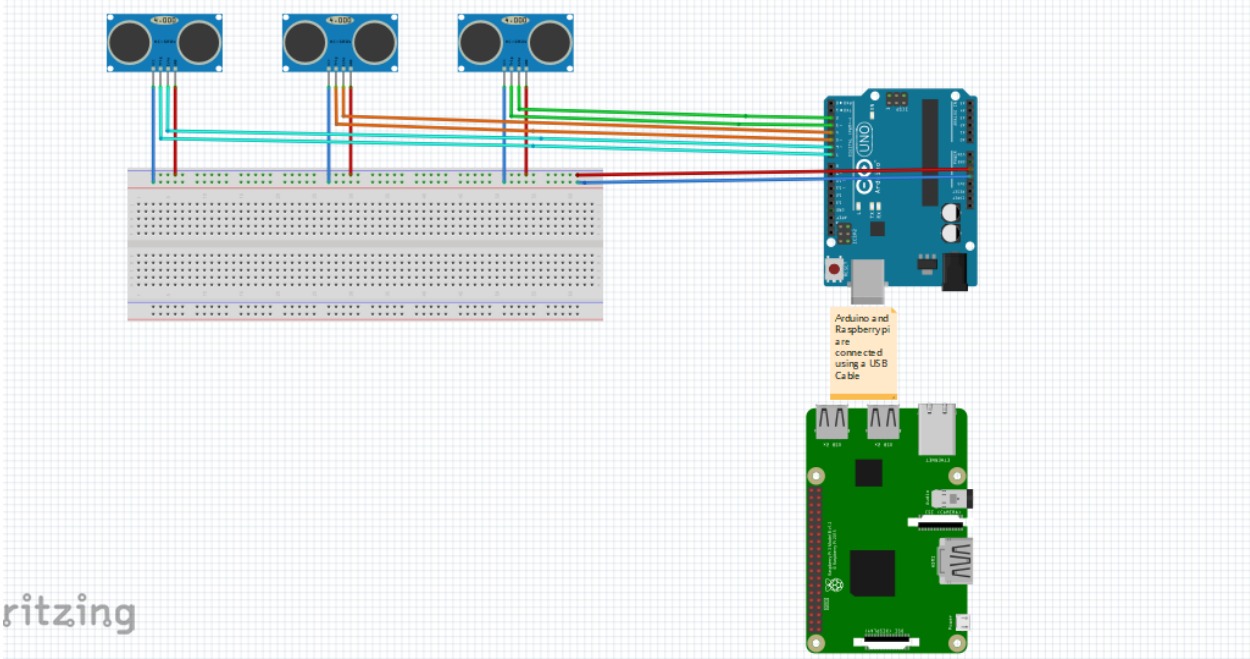


Figure 5-Ultrasonics Sensors set up on Arduino

- **Arduino Uno:**

Responsible for gathering the data from the Ultrasonic sensors and transmit them to the Raspberry Pi (Server). The connection between the Arduino and the Raspberry Pi (Server) is a serial connection using a USB cable.

4. App design (Android):

The app designed on Android studio is a simple app responsible about requesting the availability of the parking spot. Once the user is authenticated, the app will provide the number of free spots in each parking lot so the user can choose which one is convenient for where is heading to. After choosing the parking lot, the app will display the references for free spots and then the user will be able to choose one and get the navigation toward the parking lot including that spot.

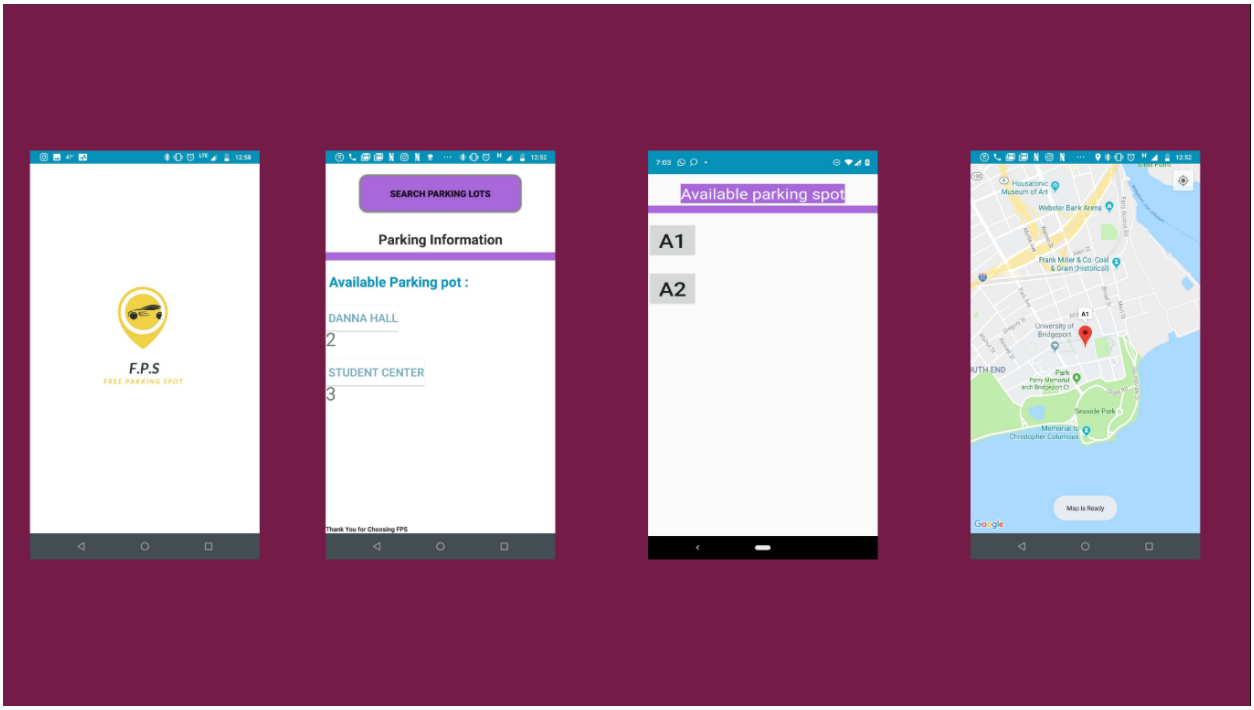


Figure 6- Screenshots of F.P.S App

5. Google Cloud "Firebase":

As the user will need access to the information about the availability of the parking spots from anywhere and anytime desired. We implemented Google cloud which has many storing option however we are using Firebase Database that will be responsible for saving the data captured from the sensors. By running simple codes (Java on the App, and Python on Raspberry Pi) the user will be connected to the Cloud and get the information about the parking spots.

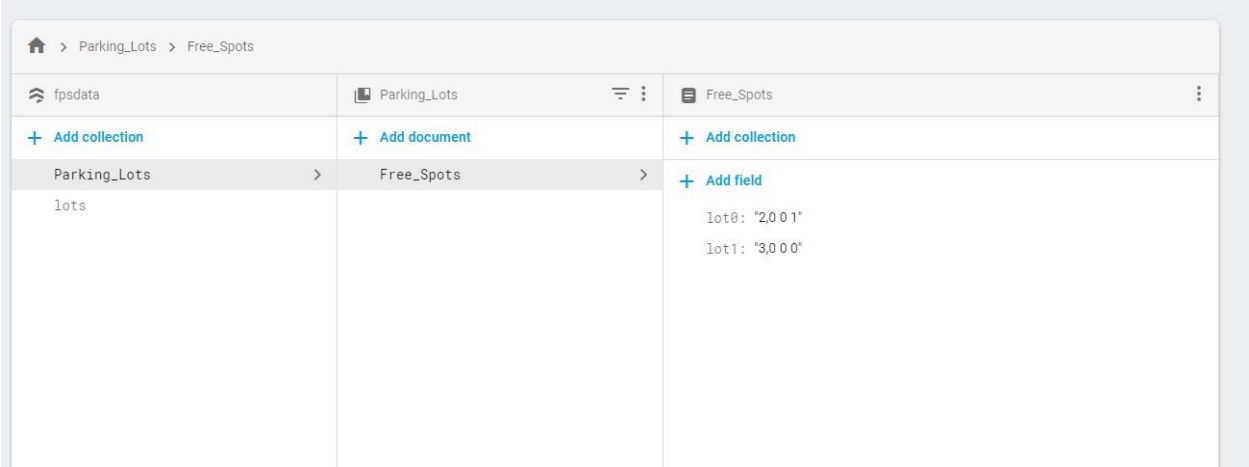


Figure 7- Screenshot of the Google Cloud (Firebase)

As marked in the figure 7, the cloud interface provides the information about the parking lot name (Lot 0, Lot1), Number of free spots (Lot0: 3, Lot1: 2) and also which spot is free (0: Empty Spot, 1: Occupied Spot).

6. Prototype Pictures:

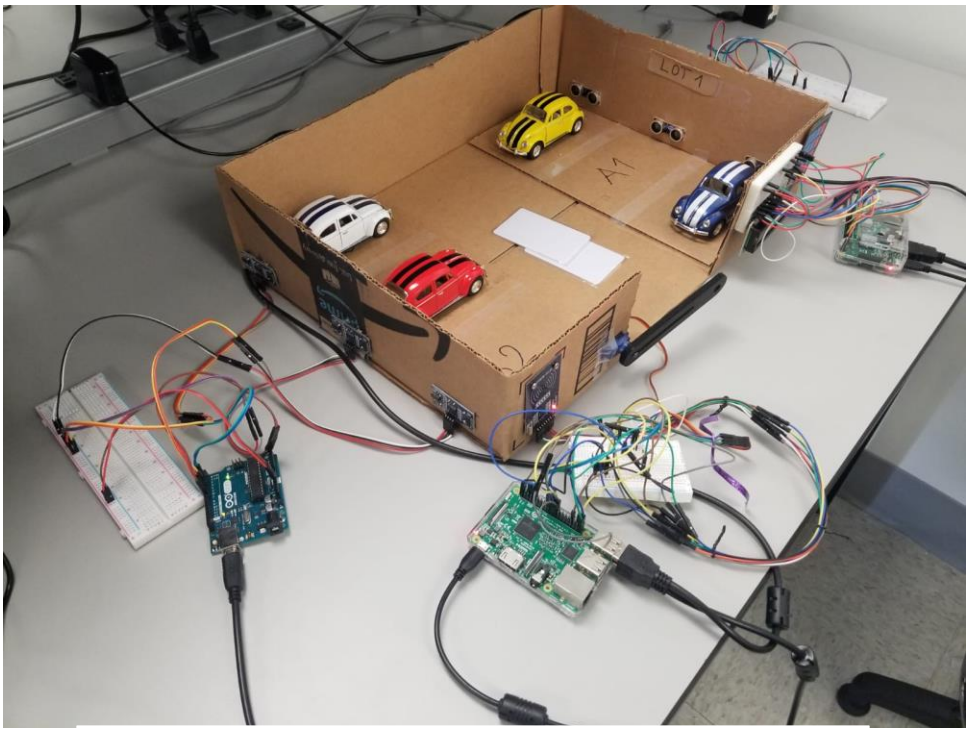


Image 1- General view of the prototype

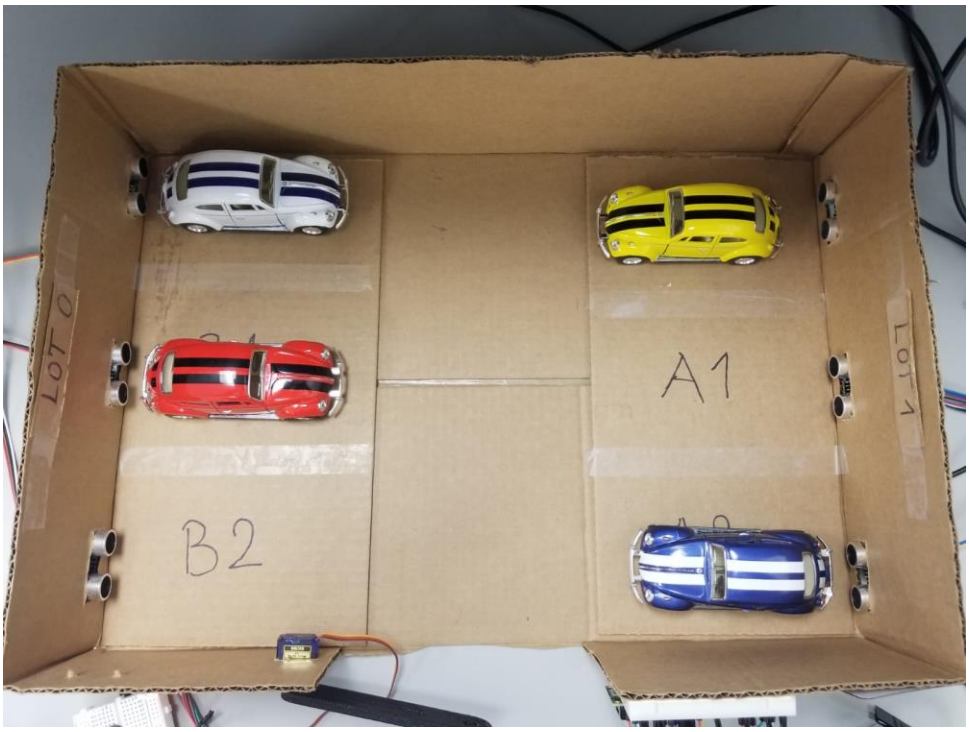


Image 2- Upper view of the prototype

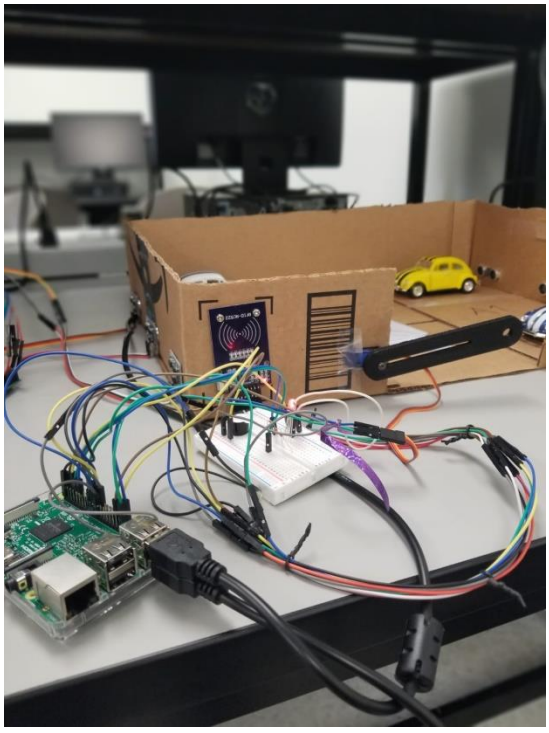


Image 3- Set up of the raspberry pi (server)

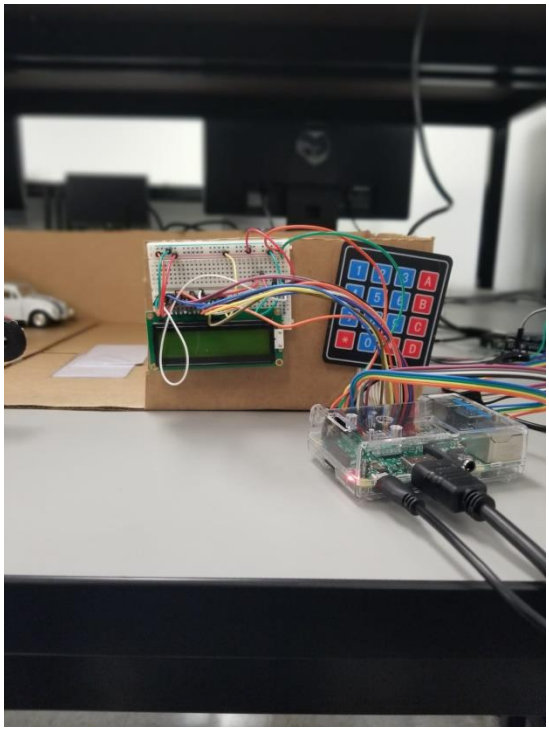


Image 4- Set up of the raspberry pi (client)

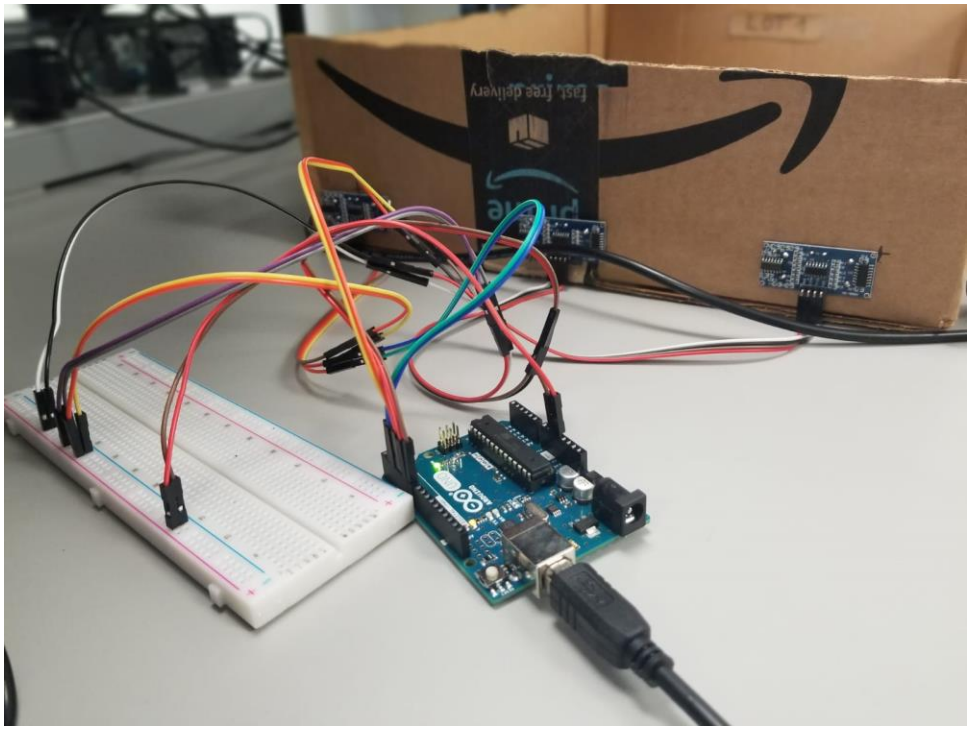


Image 5- Set up of the Arduino with the ultrasonic sensors

Conclusion:

As the F.P.S project will serve many users to skip the waste of time and gas and provide accurate information about the availability of each parking spot, F.P.S allowed us, as implementers of the prototype of this project, to benefit and use all what we learned from our Internet of Things class and other previous classes.

To fulfill the vision of the IoT taught in our IoT class, which is the convergence of many technologies in one network and the benefit from the data anywhere and anytime, we used in our project three different coding languages (Java, Python and C++) and different ways of communication (Wired, wireless and web sockets) grouped in one small network able to connect to the cloud and provide the service needed.