IOT Based Cloud Integrated Parking, Trolley Identification and Outdoor Mapping System at Airport

D. Narendar Singh, B. Pavitra, M. Anusha

Abstract*: In every airport, it is mandatory to maintain the security system like parking area, left over trolley's, outdoor mapping, etc., The proposed parking system consists of an deployment of an IOT module that is used to monitor the state of availability of each single parking space a mobile application is also provided that allows an user to check the availability of parking space and book a parking slot accordingly. And few passengers will left trolleys in parking area if they find of no use, in order to track leftover trolleys we integrate devices to trolleys and check the status in mobile app. And also new passengers can checking nearby places at airport, with the help of mobile app passengers can view airport outdoor mapping.

Keywords: ESP8266, ESP32, OLED, Keypad, Servo Motor, Mobile App, Cloud storage.

I. INTRODUCTION

The internet of things (IOT) is the network of physical devices, vehicles, home appliances and other items embedded with electronics, software, sensors actuators and connectivity which enable these objects to connect and exchange data it is the interconnection of uniquely identifiable embedded computing devices within the existing internet infrastructure. [1] Few applications are smart home/ home automation, agriculture, energy management, environmental monitoring, medical and healthcare, and transport.

II. SYSTEM ARCHITECTURE

As we all knew about the traffic at airport parking area and users who find the things unwanted leave there belongings at parking space and in other places, and also who are new to the city they can find nearby places at airport as per they want in mobile app. To prevent all this problems here are the techniques which are used in my project are explained below in detail.

The ESP8266 and ESP32 are used as an embedded controllers to interact with the other devices to connect with cloud (fire base) and mobile app.

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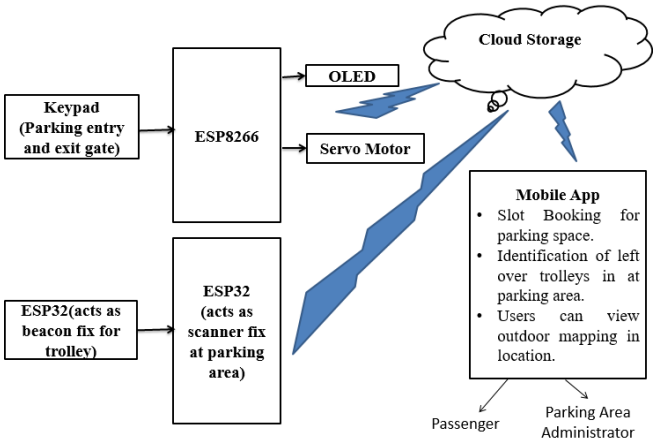

Fig1: Block Diagram of Proposed System

III. HARDWARE DESCRIPTION

- ESP8266: Esp8266 (Espress if) is an controller and has 32pins inbuilt Wi-Fi module with 32-bit processor, one core, CPU frequency of 80mhz, RAM of 160kb, flash of 16mb, one ADC pin, 4 busses (SPI, I2C, UART, I2S), GPIO pins of 17. In our project D0, D3, D4, D5, D6, D7, 9 (SD2) pins are used to connect keypad. D1, D2, GND, VCC are connected to OLED. GND, VCC, 10 (SD3) are used for servo motor. Esp8266 setup is placed at the entry and exit gate at parking area were keypad, OLED, servo motor are integrated with Esp8266 and connected to cloud (firebase).
- ESP32: It is an extended version of esp8266 has 40pins inbuilt Wi-Fi and BLE module with 32-bit processer, two cores, CPU frequency of 160mhz, RAM of 512kb, flash of 16mb, GPIO pins of 36, 18 ADC pins, 2 DAC pins,5 busses (SPI, I2C,UART,I2S, CAN). Esp32 setup is used to identify the left over trolleys at parking area here beacon concept is used where few esp32 (which acts as beacon scanner are fixed at parking area) and esp32 (which acts as beacon [2] are fixed to passengers trolleys) and to track them esp32 (beacon) unique id the nRF connect app is used.
- Keypad: The keypad matrix which we are using has 4x3 (4 columns and 3 rows) i.e. 7 buttons and they are flexible. All 7 buttons are connected to esp8266. In that 4 columns 1st button has connected to D0, 2nd button to D3, 3rd button to D4, 4th button to 9th pin i.e. SD2, whereas 3 rows 1st button connected to D5, 2nd button to D6, 3rd button to D7.

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- OLED: OLED [3] is define as organic light-emitting diode the purpose of OLED is to display information. It has 4 pins all are connected to esp8266. 1st pin (clock) connected to D1, 2nd pin (data) to D2, GND to GND and VCC to VCC of esp8266 (3.3v).
- Servo Motor: Servo [4] motor is used to control the motion of position. In my project servo is used to act as gate for entry n exit of parking area. It has 3 pins which are connected to esp8266. 1st pin (red) connected to VCC, 2nd pin (brown) to GND, 3rd pin (orange) output pin to 10th pin (SD3).

IV. SOFTWARE DESCRIPTION

- Arduino IDE: The Arduino IDE is an open source software where we can write, execute and upload to the board it can install for windows, Linux, etc., here different languages like C, C++, embedded C are used. I have written the program in embedded C and uploaded to hardware board by connecting USB. The functions of IDE are setup () are used to execute or reset the program, loop () are used to repeat a specific block of code in the program.
- Embedded C: It is a extension of C language but the main difference between both language is C is used only for desktop computers, [5] while embedded C is used for microcontroller based applications.
- Android Studio: The Android studio is an software development tool to create a mobile app, were there are many other mobile app development tools I prefer android studio because it has inbuilt firebase cloud which is useful for my project. Here the code is written in Java and xml language. This studio can install for windows, Linux, etc., The text page is to write the code and design page is to design the app as per our convenient.
- Java: Java code is used for backend functionality. The java code can run (compile) in any platform once we write it. It is used for client-server in a network application purpose.
- Cloud Storage (firebase): The firebase it is a real time data and a backend as a service. The service provide application developers an API that allows application data to be synchronized across clients and stored on firebase cloud [6] also it is an mobile platform that helps quickly develop high-quality apps. The main products/ develop/ services are Analytics, cloud messaging, authentication, real time data base, cloud storage, hosting, remote configuration, notification, app indexing, dynamic links, invites, AD mobs, etc.,

V.SYSTEM IMPLEMENTATION

The proposed parking system consists of an deployment of an IOT module that is used to monitor the state of availability of each single parking space. A mobile application is also provided that allows an user to check the availability of parking space and can pre book a parking slot accordingly while reserving the slot user should mention aadhar card number (this number will store in cloud i.e. firebase) for security purpose and select the amount of time (in hours/days) for which they would like to park vehicle. When the passenger comes to park the vehicle they should enter details in keypad which will display on OLED at the entry gate then this card details are compared with stored details presented in cloud link then only gate will open automatically using servo motor for that ESP8266 has used as controller. While exiting the parking area also user should enter details and this status is also updated to mobile app via cloud server. We can also send notification to the user if he/she want to rebook the slot if the entry time out is finished.

About left over trolleys, Few passengers will left trolleys in parking area if they find of no use, in order to track these leftover trolleys we integrate devices (ESP32 which acts as beacons) to trolleys each beacons has an unique ID, with the help of nRF connect mobile app we can identify the ID, and that ID details are stored in cloud server so whenever the trolleys are found in the range of esp32 (acts as beacon scanner) which are fixed in the parking area, then we can notify the authorities by sending alerts in mobile app.

The outdoor mapping is to checking nearby places for users who are especially new to the city with the help of mobile app passengers can view airport outdoor mapping (showing the particular location of schools, hospitals, restaurants ,hotels, etc.) so that this will be helpful in finding the places at airport.

VI. RESULTS AND DISCUSSIONS

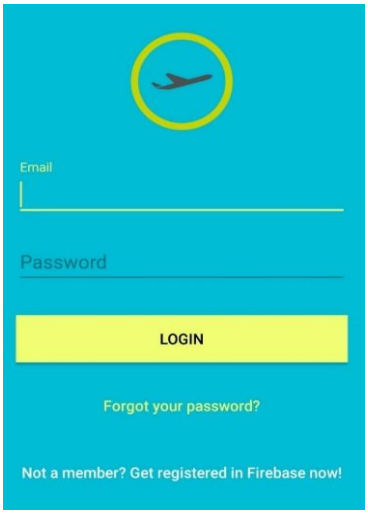

Fig2: Mobile app login page.

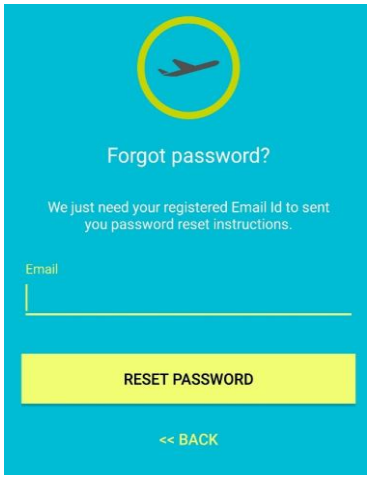

Fig3: Mobile app forgot password page.

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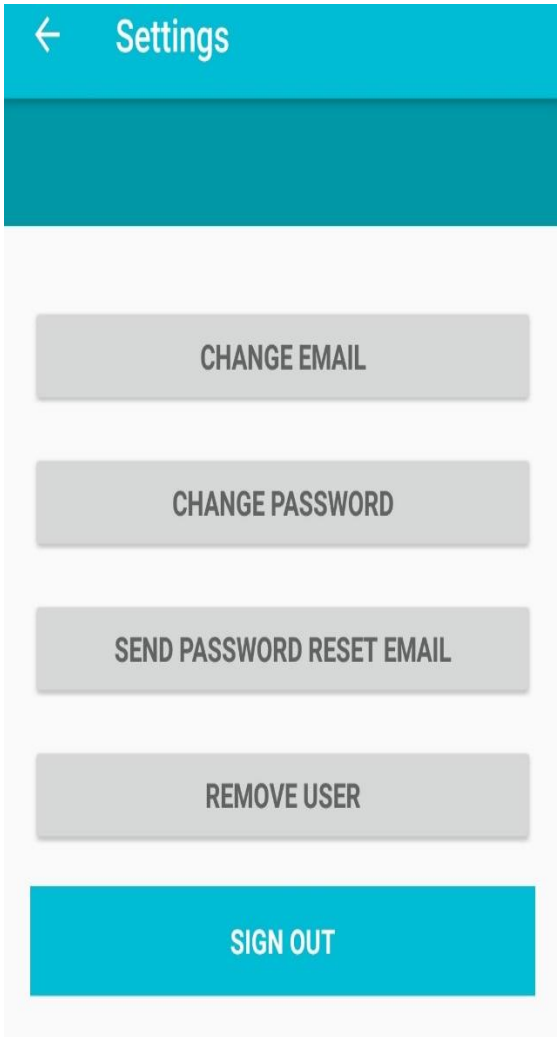

Fig4: Mobile App Setting Page.

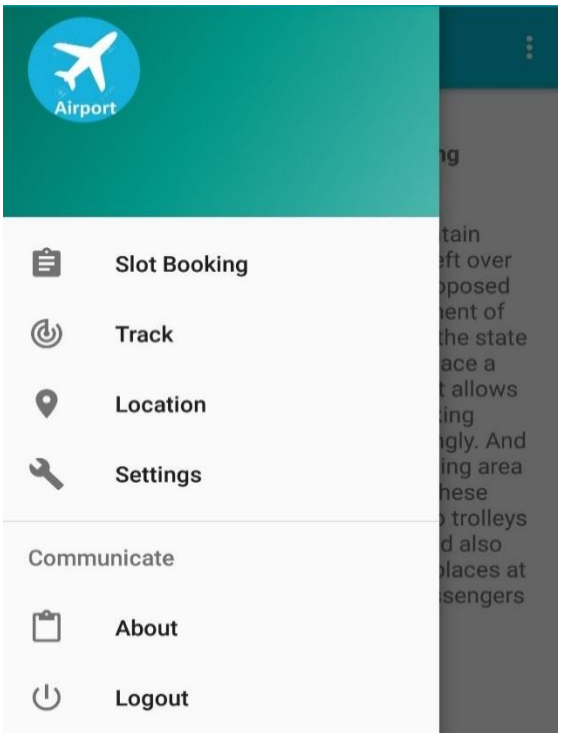

Fig5: Main page were user can book the parking slot and check the direction of outdoor mapping in location at airport and authorities can find the state of left over trolleys in track field.

A. Parking Area Outputs (Entry)

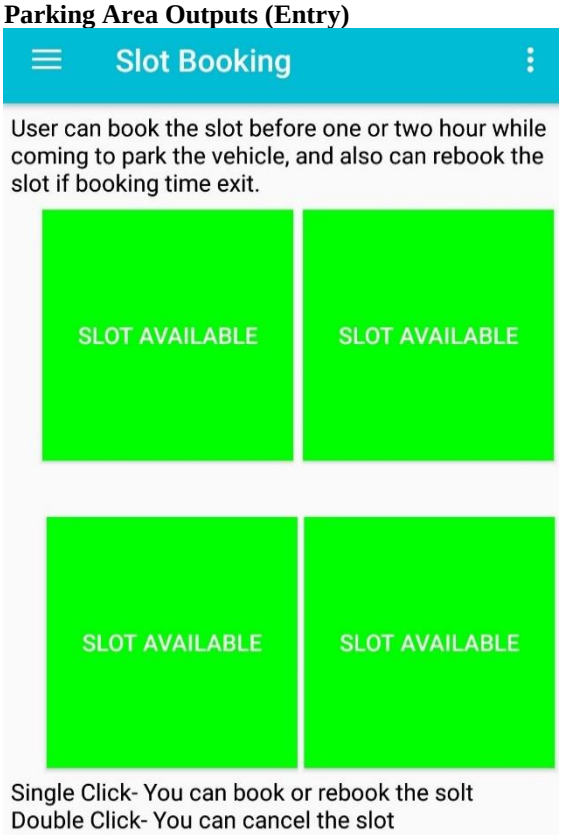

Fig6: User after getting login to mobile app they should select the slot booking field and check the availability of free space.

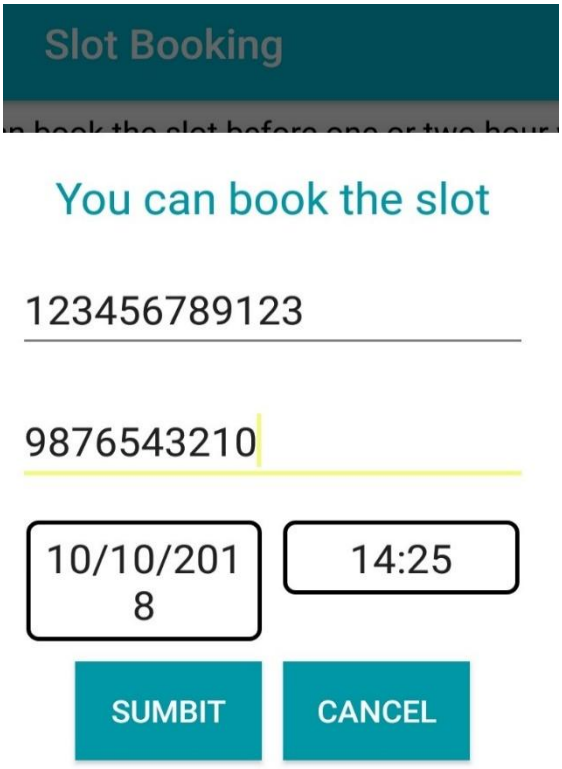

Fig7: After finding free space user can book the parking slot by providing details and book the slot accordingly as per there convenient.

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Fig8: After user booking the slot, the slot vacant time and date are displayed (all this details are stored in cloud) and other users so, that they can find at what time parking space are available.

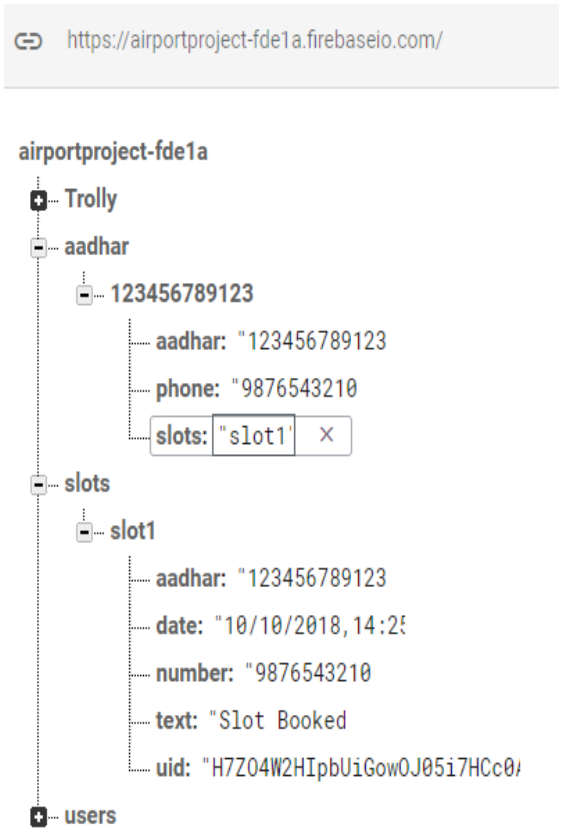

Fig9: Cloud page were the real-time data is stored.

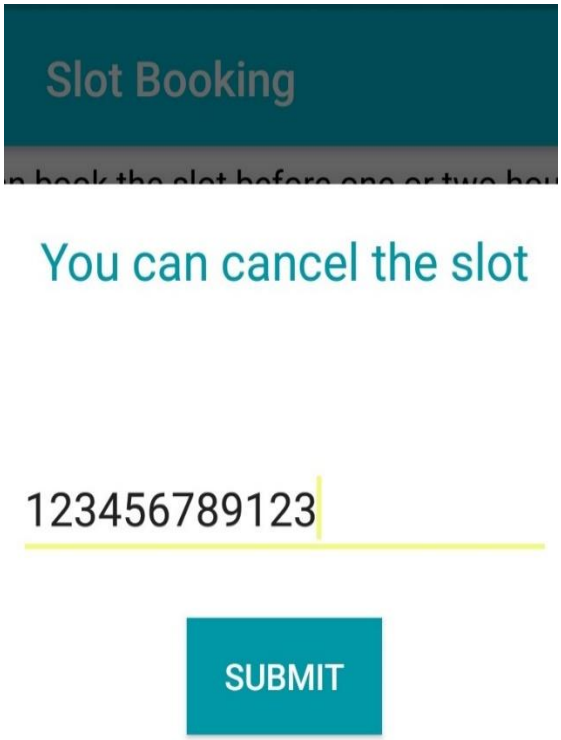

Fig10: If user want to cancel the slot they should long press the slot and enter the id number.

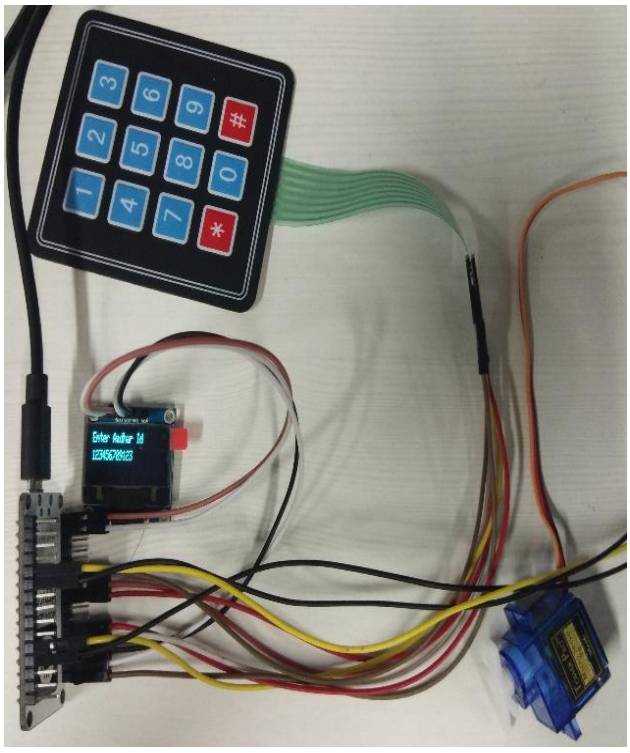

Fig11: Entry gate setup at parking area whenever user come to park the vehicle the login details should provide using keypad and the details are displayed on OLED the provided data will upload to cloud and compare the details than servo motor gate opens, than user can enter to park the vehicle in there booking space and can leave through other gate.

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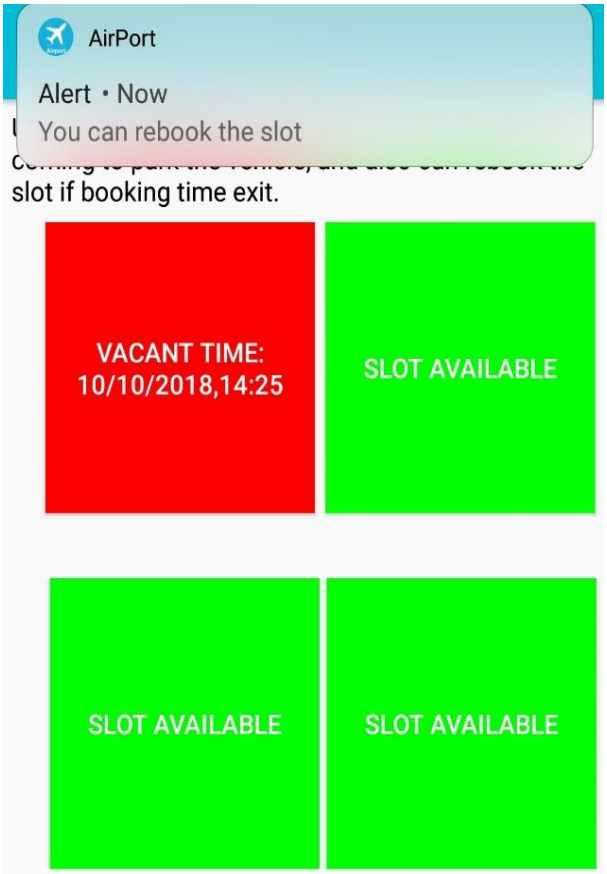

Fig12: The alert is send to user if they want to extend the slot timings, they can rebook the slot.

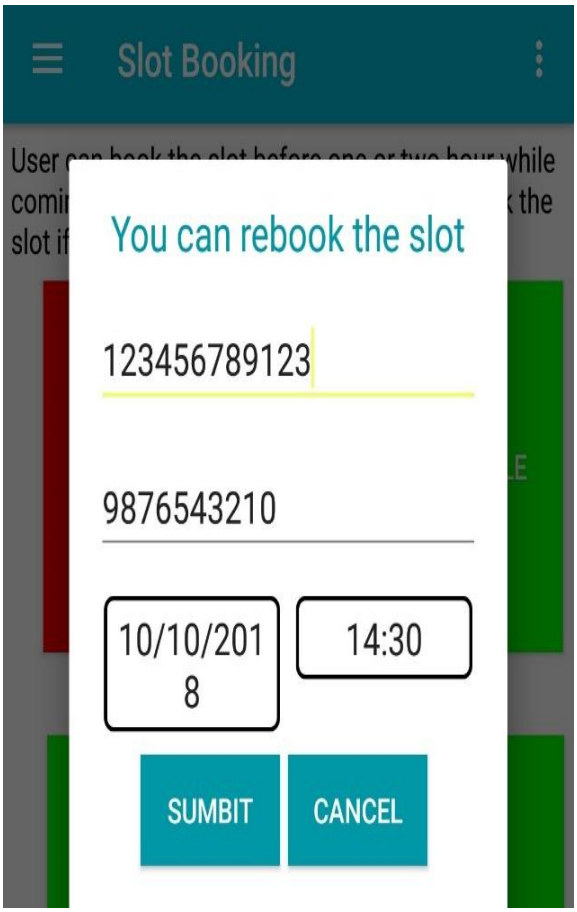

Fig13: By touching the booked slot same user who booked it can rebook the slot in mobile app and the response is send to cloud.

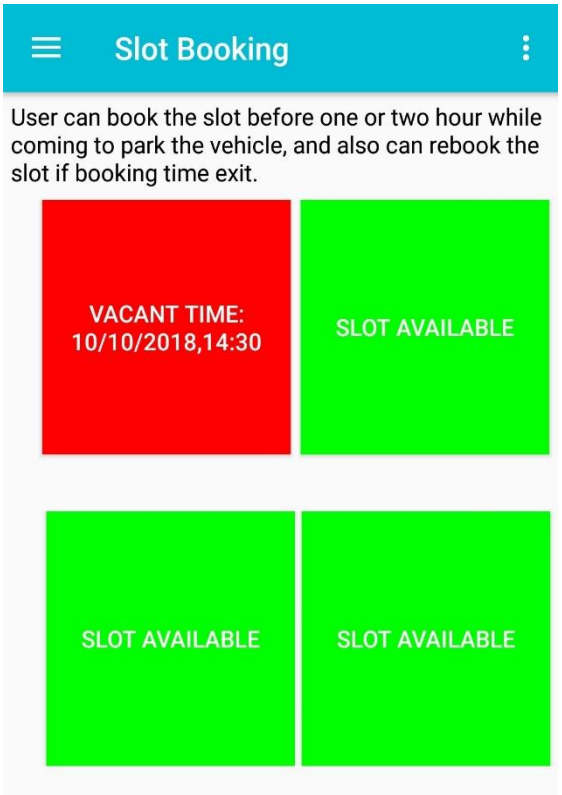

Fig14: Extend slot time and date are displayed in mobile app.

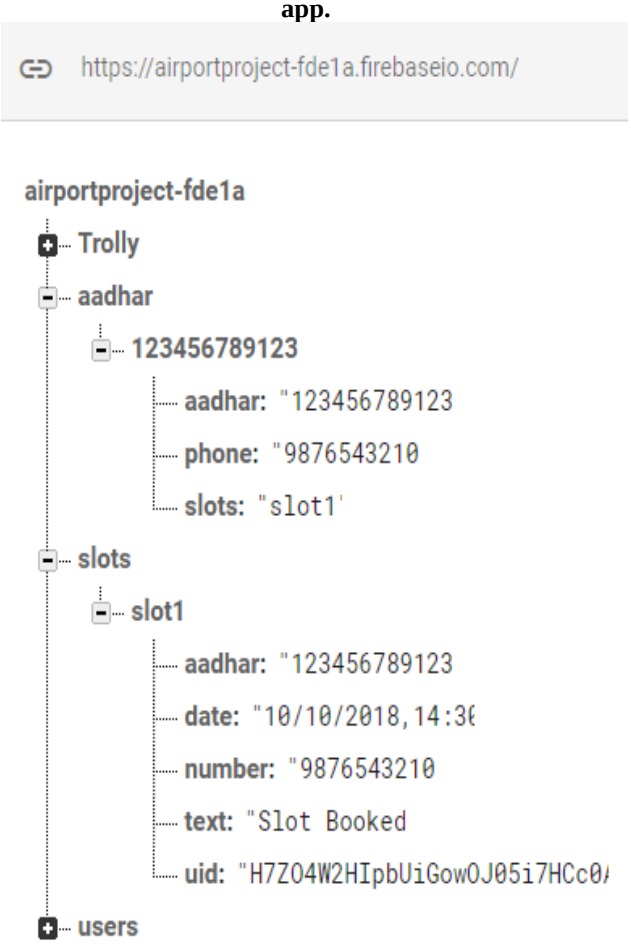

Fig15: The rebooking details are stored in cloud real-time data.

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B. Parking Area Outputs (Exit)

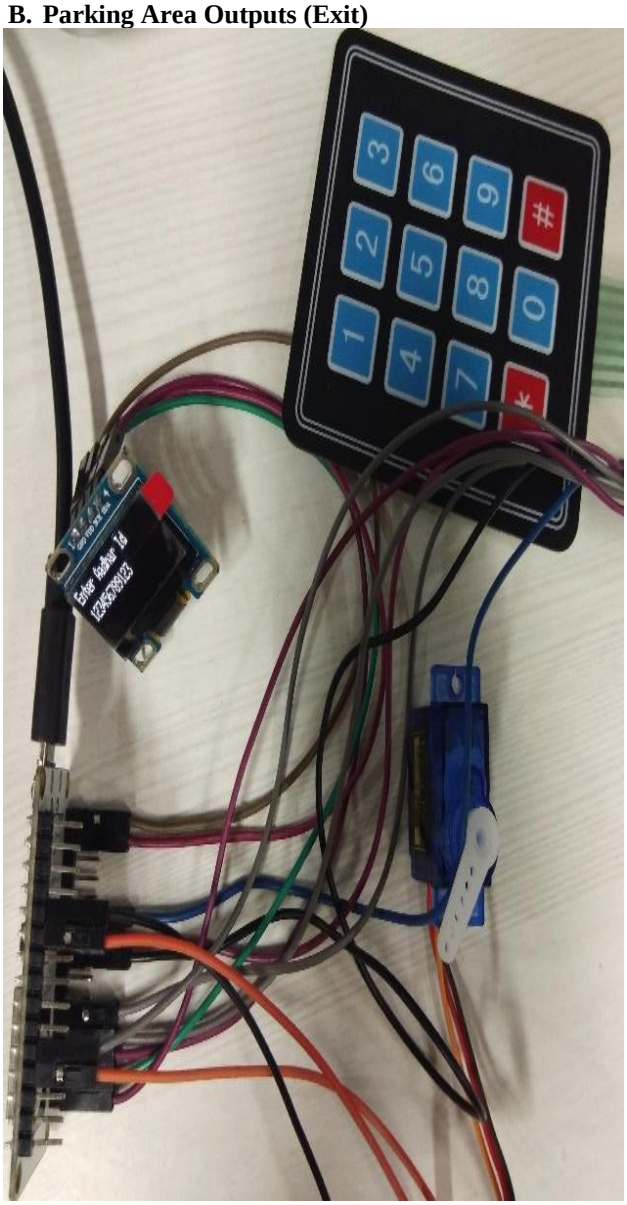

Fig16: Exit gate setup at parking area whenever user come to pick the vehicle the login details should provide using keypad and the details are displayed on OLED the provided data will upload to cloud and compare the details than servo motor gate opens than user can leave the parking area. Till the user come to exit gate and provide details the slot in app will show unavailable in mobile app.

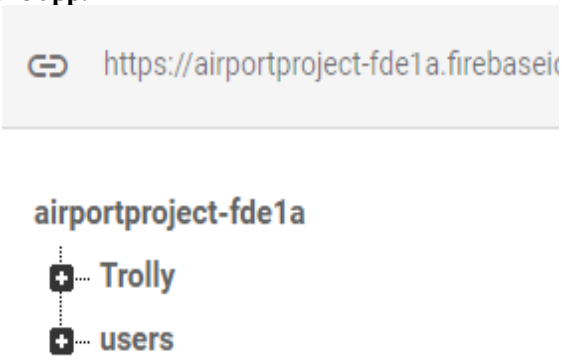

Fig17: Cloud real-time data after user exit the parking area.

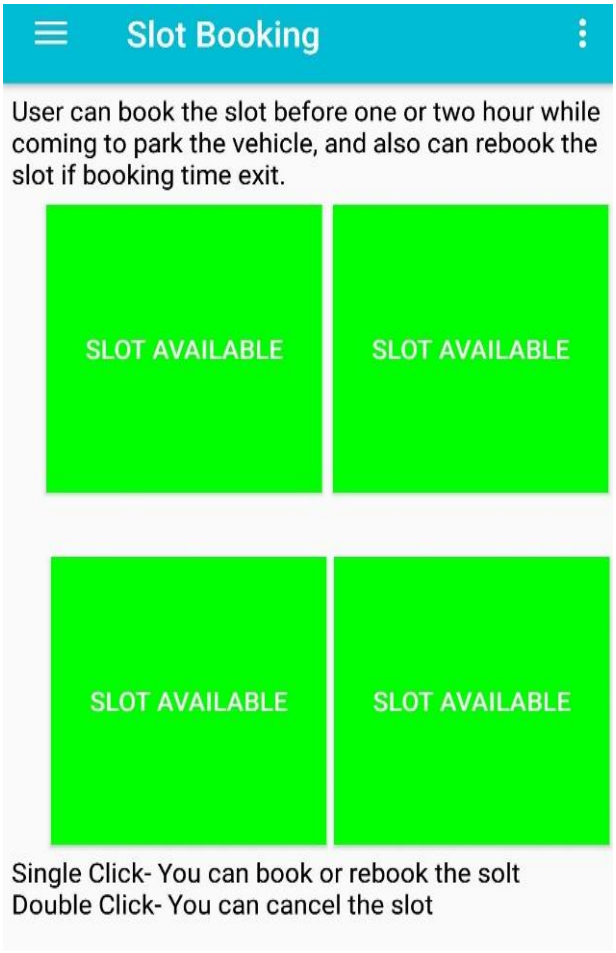

Fig18: After the response went to cloud the mobile app will show available so that other user can book the slot.

C. Trolley Identification Outputs

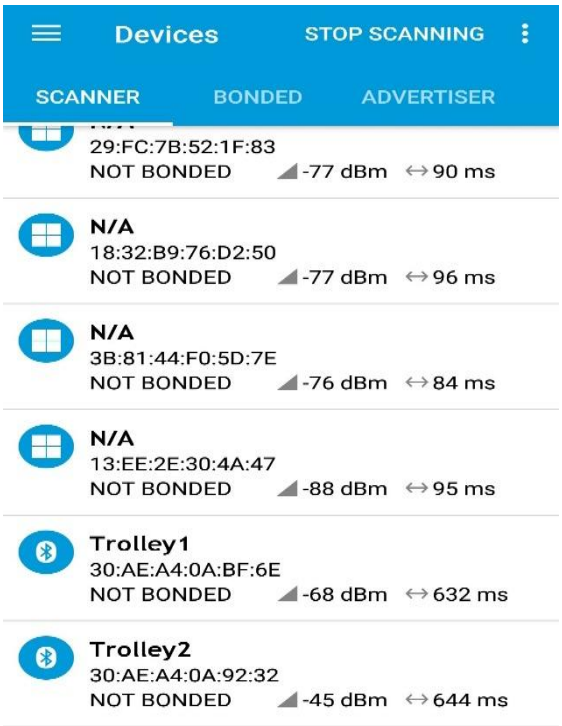

Fig19: It is an nRF connect mobile app to identify the id (mac address of each beacon this app is used).

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Fig20: The esp32 devices which acts as both beacon scanner as well as beacon. Scanners are fixed in different areas like parking area and beacons which are fixed to trolleys (the trolley beacon mac address are stored in scanner programming to cloud) whenever in the range of scanner the trolleys are identified it gives alert in mobile app.

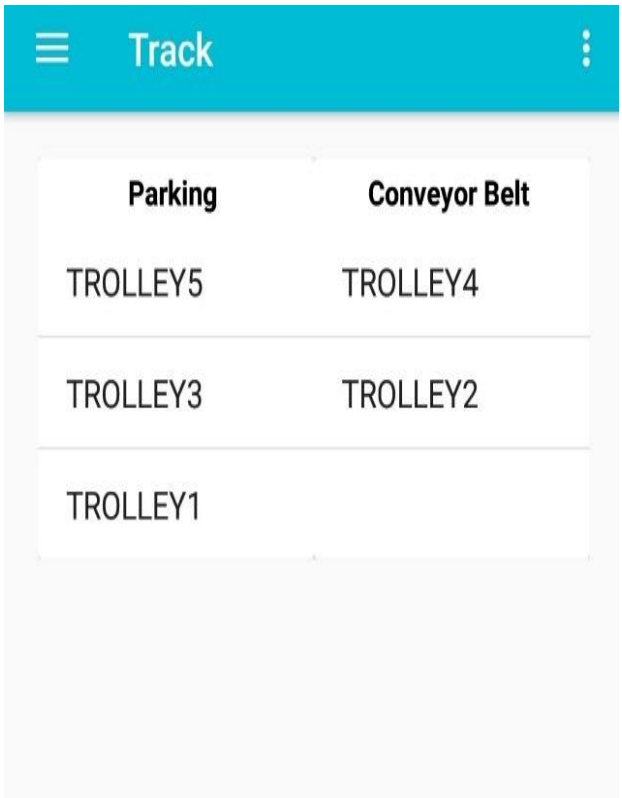

Fig21: The result in mobile app one scanner name is given as parking and other scanner name as conveyor belt, whenever the scanner find trolley in range it gives alert in mobile app and update the real-time data in cloud.

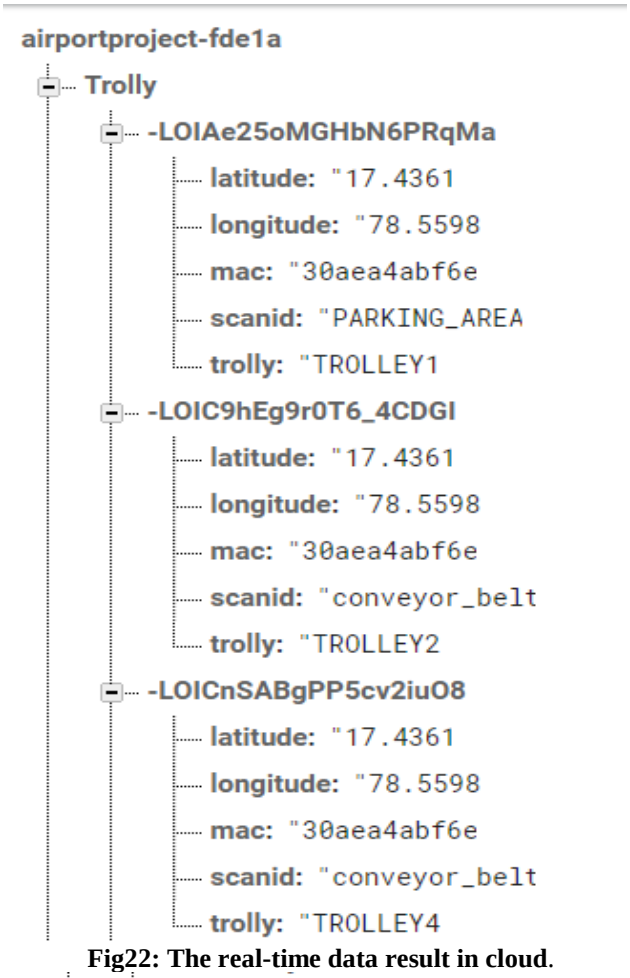

Fig22: The real-time data result in cloud.

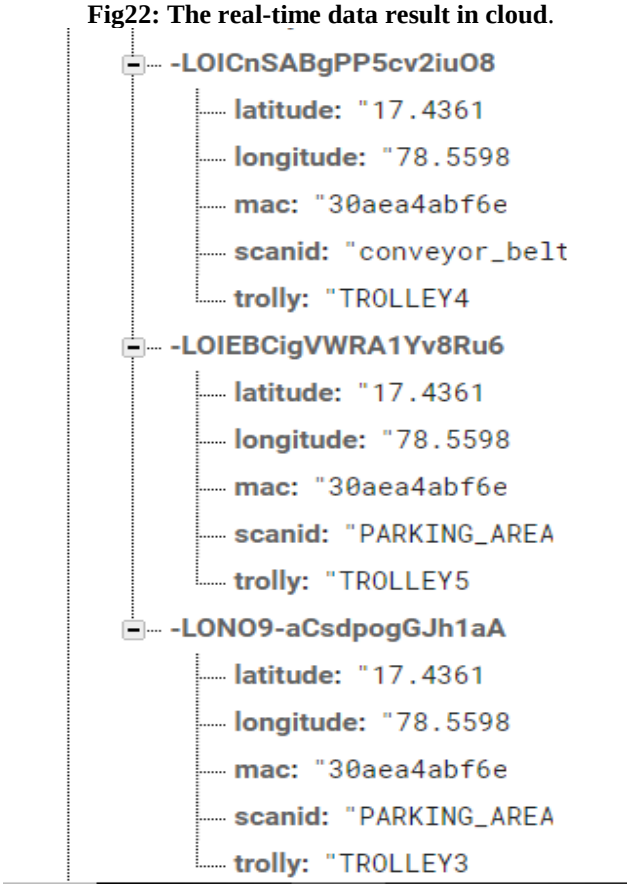

Fig23: The real-time data result in cloud.

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D.Outdoor Mapping Outputs

Fig24: Whenever user open location field the three different nearby places like schools, restaurants and hospitals and current position are displayed, now they can select and view the direction.

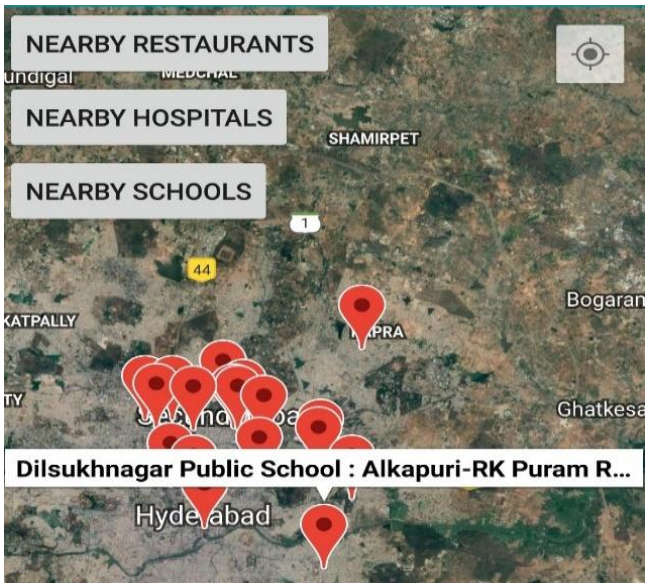
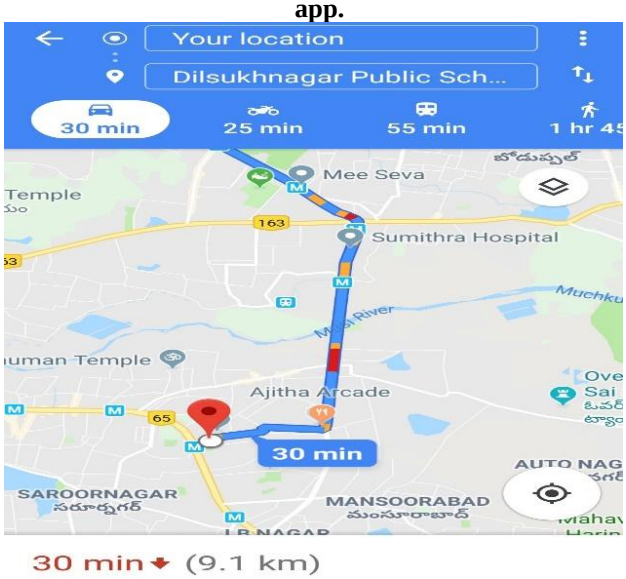


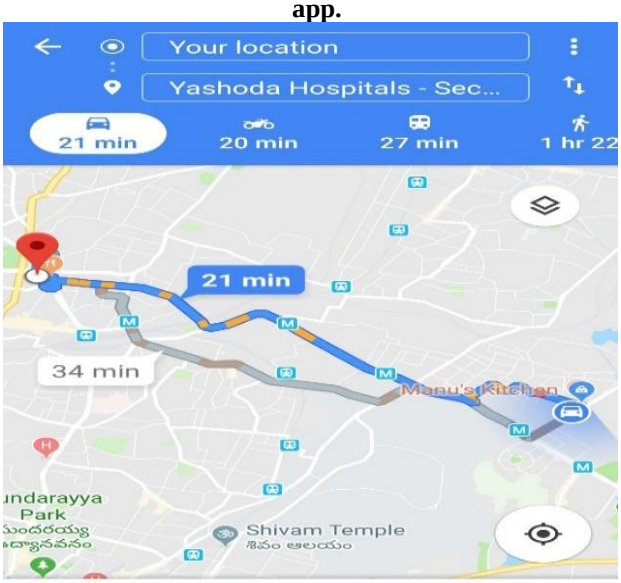
Fig25: Nearby school location with address in mobile app.



30 min (9.1 km)

Fig26: The location of particular school from current position of user in minutes and km.

Fig27: Nearby hospital location with address in mobile app.



21 min (7.2 km)

Fig28: The location of particular hospital from current position of user in minutes and km.

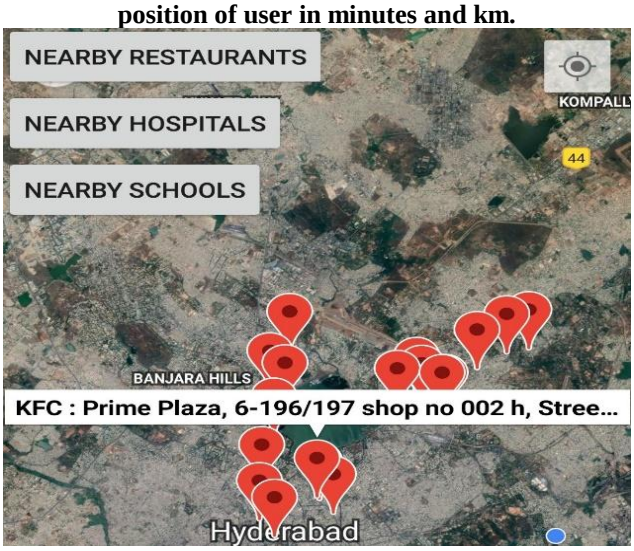


Fig29: Nearby restaurant location with address in mobile app.

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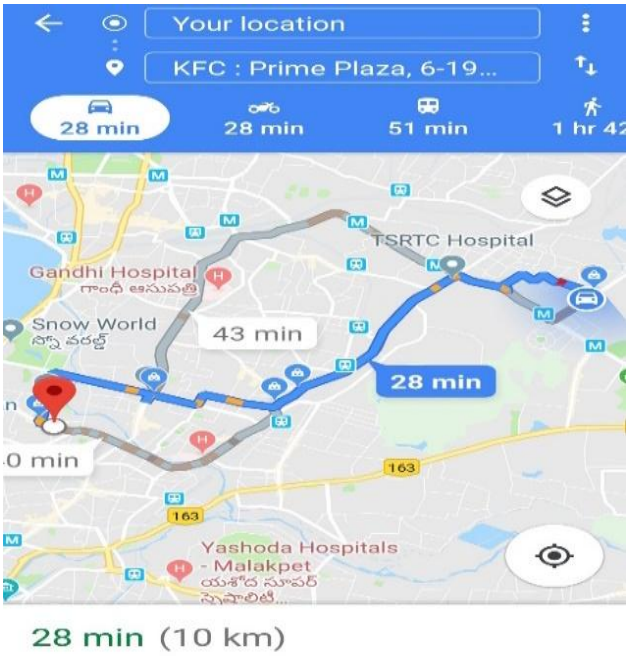

Fig 30: The location of particular restaurant from current position of user in minutes and km.

VII. CONCLUSION

We conclude that proposed IOT based system, where passenger can register and login with user id and password and then check for free space availability of parking slot. If space is available, they can pre book the slot accordingly with time and date as per there covenant in mobile app, this will help users and authorities less traffic at parking area. The other statement is about left over trolleys can be identified using mobile app at which scanner are they left, so that this will help authorities to find them, and can prevent the jam at parking area and other places. The outdoor mapping system is very useful for those who are new to city and for those who find difficult in finding nearby places at airport, in mobile app few directions like nearby schools, hospitals, and restaurants, are given.

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