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RFID-Based Online Parking Finder

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Abstract— It has been seen throughout the last decade that the daily addition of parking facilities at public locations is directly proportional to the number of automobiles. Not knowing where parking spots are available at a particular time and location is a major cause of stress for drivers in many cities, especially during rush hours. In the absence of designated parking spots, traffic congestion rises and the risk of accidents rises as drivers park illegally on the side of the road wherever they can find a spot. In many communities, this has become a serious problem. Many new technologies have emerged in recent years, enabling the construction of solutions to parking concerns, but with caveats. As a result, there is a need for a system that monitors and manages parking lots automatically in order to provide drivers with greater ease and security while also generating income for the authorities responsible for managing parking lots. This article provides a summary of a system that aims to address the problem of inadequate parking at public venues like shopping centers, movie theaters, etc. RFID, wireless sensor networks, optimum algorithms for seeking the closest parking lot, etc., are also discussed, along with other cutting-edge technology. The idea makes use of cutting-edge technology for things like tracking parking spots, taking reservations, and setting prices on the fly. People may be certain that they will have a parking spot at their preferred time and place if they book in advance. It saves time and energy that would otherwise be wasted looking for parking in a certain area.

***Keywords*— Wi-Fi Sensor Networks, Radio Frequency Identification, and Intelligent Parking System**

INTRODUCTION

There has been a dramatic spike in the number of automobiles on the road as the urban population has expanded. As a consequence, roads are congested and parking lots are at capacity. Finding a parking spot is more difficult than usual because of this annoying problem. Finding a parking spot at busy periods, such as rush hour, weekends, and holidays, is already a challenge. Our system is a smart parking prototype, designed to help drivers quickly and easily locate available parking spaces. Drivers may use well-designed software to locate and book parking places in advance. The smart parking system is a piece of cutting-edge technology that facilitates forethought for motorists. In addition, it will reveal to the driver the entire capacity of the parking facility. The paper covers the methodology, technology, and real-world examples of implementing system components such parking availability monitoring, parking reservation, and dynamic pricing. Therefore, upgrades or new features are still required in today's parking systems from a variety of perspectives, such as strong range and power of sensor devices, reliable and timely sensor networks, and high quality and flexible urban service.

LITERATURE REVIEW

In the traditional way of parking people in general have to face the problem of looking out for parking spaces and slots to be precise. In the paper that's been published by Jatin Desai et. al. introduces a system in which user can see the parking slots. They assign the QR code to every user, so that the user can view the balance, make a reservation of the parking slot with the timings. Through the QR scanner the system are identifying the user and their vehicle along with the transaction. There is a display screen at the entry point in which user can see the car number and selected parking slot. Also there is a special reservation which do not have time limit. The QR scanner code is a 2D scanner code which can be accessed through smart phones. QR scanner used for identification of item. Drawback in this system is that there is so much complication in the tool at the time of using it in a prototype model.

Using the technology of Internet of Vehicles as their core technique and a means to determine the quickest route, Xiaobo Zang et. al. built a system that addresses the traffic issue. In essence, IOV is a robust network connecting vehicles and people. The dynamic wireless interchange of data between neighboring cars has a big potential to enhance safety with this technology.They looked at several shortest route algorithms, such as A* and Dijkstra, but ultimately settled on the optimum path method due to its ease of implementation and comprehension. Users may see available parking spots and directions on their phones. However, there is no way to make a purchase using this method.

In this study, Savan Vachhani et al. discuss the many algorithms and sensors that may be utilized to improve the effectiveness of an Internet of Things (IoT) based parking system. For automobile queue allocation, the initial method is first-come, first-served (FCFS). For the purpose of automobile assignment in the queue, a priority algorithm is implemented. Round Robin is employed for load balancing, while the Study State Evolutionary Algorithm is used to allocate parking spaces in the most efficient way possible. The quickest route and the precise position of the automobile may be determined using algorithms based on Dijkstra's, Ant colony's, and geometry problems. Wireless sensors including infrared detectors, radio frequency identification readers, image detectors, motion detectors, weight scales, LED displays, magnetometers, etc. are used extensively in this system.

In their proposal, Yadnesh Joshi et al. make use of existing technologies like radio frequency identification (RFID) and optical character recognition (OCR) to facilitate the identification of objects using radio waves and the recognition of text, respectively. The major use of optical character recognition in this article is to pinpoint the location of the automobile parked illegally. Both the approved and illegitimate versions of the RFID tag are shown. An authorized user is given a permanent RFID tag, while an unauthorized user is given a temporary RFID tag; once the latter departs the parking spot, the out time is extended and

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the RFID tag is erased. Proof-of-authenticity details

Smart parking using RFID sensors is introduced by S. S. Thorat. A smart parking system is being developed in this area as part of efforts to make the city more "smart." In this case, they are implemented in a novel algorithm that expands the capabilities of the intelligent parking system. The high price tag of implementing this technology in urban areas is a major drawback. The parking lot lacks any kind of signage to direct drivers. It may be challenging to integrate a new system into an existing infrastructure, and if the proposed system's footprint is larger than that of its predecessor, mechanical components will need to be designed for that space.

We have learned from our literature review that there are many approaches to finding parking spots. With the use of the aforementioned publications, we were able to deduce that the next system's benefits extend over both space and time. We are developing an RFID and sensor-based online parking spot identification system prototype. We've used cutting-edge technology in this system, making it useful even for the uninitiated while also putting users at rest.

IMPLEMENTATION

To overcome the challenges of the existing system, we have proposed an automatic parking system. One of the main purpose of this system is to provide assistance to both the customer as well as the management of the parking system to view current status of the system. The main aim is to provide users efficient and effective parking system.

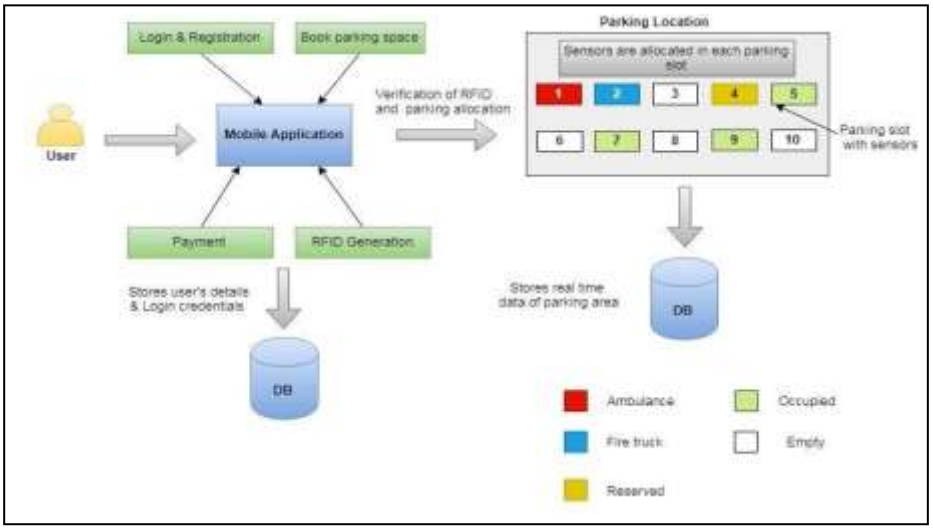

Fig. 1 Architecture of the system

Here the above Fig. 1 shows he system architecture of the proposed system and the work flow of the entire system. We have created a mobile application which will allow the users to book the parking slot at the desired location. This will save their time, instead of going at the parking area and find an empty slot to park the car. To book the parking slot, the app should be downloaded by the user in his/her mobile phone. The modules in the system are as follows:

1) User login & registration

For searching the parking areas and booking the parking slots, it is necessary for the user to have the app downloaded on his phone. Then the user has to login and register, and fill all the data of the vehicle. Once the user has registered his/her car, they can search the parking location and book the desired parking slot for the desired time as shown in Fig. 2. If the user has more than one car, and if he wants to use any one of them in future then he has to register all his cars, so that he can use any one of them. A unique RFID tag is given to all the cars of the owner. When the car arrives at the parking area, where he has booked the car he will get the RFID card, which will be read by the RFID reader and verified. Then the driver or car owner can go and park the car at his reserved slot. The IR sensor which is present in every slot will detect the car and then give the updated status of the slot to the server after the vehicle is parked. When the user is about to leave the slot, he has to do the payment and generate then again verify the RFID card and then leave the parking area.

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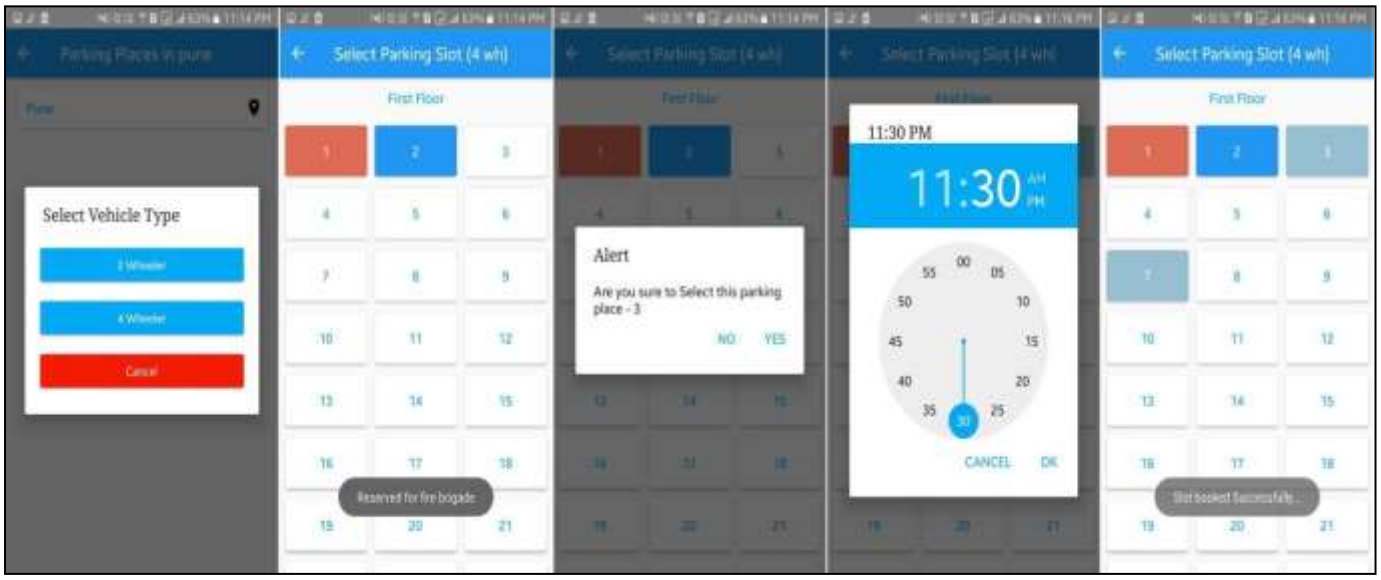

Fig. 2 Application for booking parking slot

2) Administrator Login

In the parking system most of the things are managed by the system itself, but for first time installation, maintenance and to handle some unexpected situations all controls are provided to the administrator. Admin can login into the system using web application and check out the details of the registered car owners and the real time updates of the parking area. The figures below shows the Admin module of the proposed system. The slots which are reserved and occupied are visible to the administrator on the screen. Not only that he can monitor and update the parking system database.

Fig. 3 Admin ca add parking locations

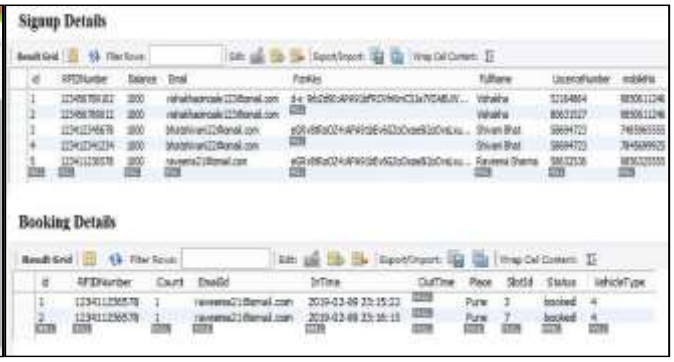

Fig. 4 Sign-up & booking details

3) Parking slot status

We have provided the current run-time status of the selected parking area. The status is identified with the help of IR sensors situated in every slot of the parking area. The recognized data is then forwarded to the database using the sensor node and the status is updated as and when the slot is occupied or reserved or free. These slots can be seen by the user using our specific application that we have created. And this facility is also available to the random user who is unaware about the app or web portal. Such users can see the slots through the LCD screen which will timely display the run-time status of the slots. The status can be in the form of either occupied or reserved or free. Here ‘occupied’ means the user has booked the slot and also occupied the space and ‘reserved’ means the user has just booked the slot using the application or the web portal whereas ‘free’ means the user has neither booked nor occupied the space of the slot. Fig. 4 shows the verification of RFID tag at the entrance and the exit when the car arrives at the parking area.

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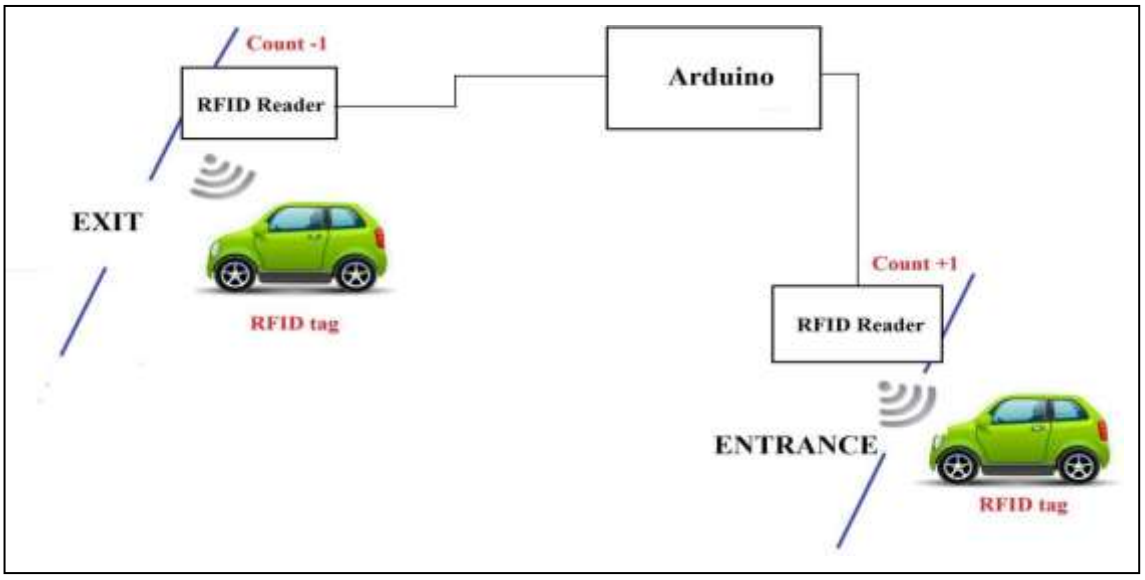

Fig.5 RFID tag verification at the parking area

4) RFID tag

RFID stands for Radio-frequency identification. It is the use of a wireless non-contact system that uses radio-frequency electromagnetic fields to transfer data from a tag attached to an object, for the purposes of automatic identification and tracking. There are two broad categories of RFID, active tags and passive tags, depending on their source of electrical power. Active RFID tags contain their own transmitter and power source, usually the power source is an on-board battery. Passive RFID tags obtain power from the signal of an external reader.

A. Types of RFID:-

Because they have their own power source, active tags transmit a stronger signal, and readers can access them from further away. The on-board power source makes them larger and more expensive, so active RFID systems typically work best on large items tracked over long distances. Low-power active tags are usually slightly larger than a deck of playing cards Readers can communicate with active RFID tags across 20 to 100 meters.

1) Active RFID

Active RFID tags have their own in-built batteries that can help extend the read-range to about 100 meter by beaming its information towards the reader just like your mobile phone. Active tags can remain inactive until they come in range of a receiver or can constantly broadcast a signal. Active RFID tags found its application when it came to monitor your high-value equipment or packages in warehouses and the railways packages. There are some of the drawbacks of active RFID tags Inability to scale due to its proprietary nature

2) Passive RFID

Passive RFID tags do not have in-built battery. In passive RFID tags the reader and reader antenna send a radio signalto the tag. The tag then uses the transmitted signal to power on and reflect energy back to reader. It can operate in the low frequency, high frequency radio bands. The range of passive RFID tag is less than 10 meter. Passive tags only require antenna and a tag chip instead of power source or transmitter. This makes them cheaper comparatively to active tags. Passive tags are used for tracking low-cost items for example, at gates and checkpoints of a warehouse where the read-range needed islow.

B. Difference between RFID & QR code

QR code can only be used for reading purpose while RFID tag can be used for both reading and writing. QR scanners need humans to operate but RFID bare fixed scanners which don‘t need human labour. In QR code manual tracking is required while RFID doesn’t requires tracking. Information capacity of QR code is less as compared to RFID. Hence we prefer to use RFID.

5) Hardware used

A. IR Sensor

We are using IR sensors mainly for the detection of object (which is car in our case) through the signals generated by the sensor. These signals are transmitted through IR transmitter and received with the help of IR receiver. IR sensors are categorized into two different types which are active IR sensors and passive IR sensors. In our project, we have made use of active IR sensors as it is more profitable as compared to passive IR sensors. Active IR sensors are of self illuminating type, and can directly measure velocity and range of targets. The main advantage is that these sensors can function effectively in day, dark and with cold target type.

B. ESP8266

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The ESP8266 is a cheaper wifi based microchip with a capacity of micro-controller. This module allows and maintains the connection between wifi network and micro-controllers and generates TCP/IP connections. The module contains one VCC pin for power and GND pin for ground. TX and RX pins are used for transmitting & receiving purpose respectively. It also contains 2 GPIO pins, a RESET pin and we need to set CH_PD pin by turning it on or off.

C. Arduino Mega 2560

Arduino Mega 2560 is a simple platform used for implementing real time applications. It mainly consists of a circuit board which is nothing but a micro-controller and can be programmed using inbuilt software named as Arduino IDE. These boards are capable of reading analog as well as digital inputs from various types of sensors and convert it into the output. We can connect the software and Arduino board using a simple USB cable.

D. RFID Tag & Reader

There are basically two different types of RFID tags which are Active and Passive. We are using passive RFID tag as it does not requires any internal power supply. Instead of power supply electromagnetic energy is used which is transmitted from RFID reader. A radio frequency identification reader (RFID reader) is a device used to gather information from an RFID tag, which is used to track individual objects. Radio waves are used to transfer data from the tag to a reader. RFID is a technology similar in theory to bar codes. However, the RFID tag does not have to be scanned directly, nor does it require line-of-sight to a reader. The RFID tag it must be within the range of an RFID reader, which ranges from 3 to 300 feet, in order to be read. RFID technology allows several items to be quickly scanned and enables fast identification of a particular product, even when it is surrounded by several other items.

RESULTS

The IR sensors, RFID reader and the ESP8266 have been properly interfaced with Arduino Mega 2560 to give us the proper functionality of the hardware side of the system. The IR sensor emits infrared radiations to sense the vehicle in the parking area. The electrical barrier acts as a gate which allows the vehicle to enter he parking area after verification. The RFID reader reads the RFID tag and after verification of vehicle details allows the car owner or driver to park the car in the reserved parking slot booked by him/her. The ESP8266 is a microchip which **is a** WiFi Module that is a self contained SOC with integrated TCP/IP protocol stack that can give any micro-controller access to your WiFi network. The RFID tag is verified again at the exit gate after the owner has done the payment before he/she leaves the parking slot.

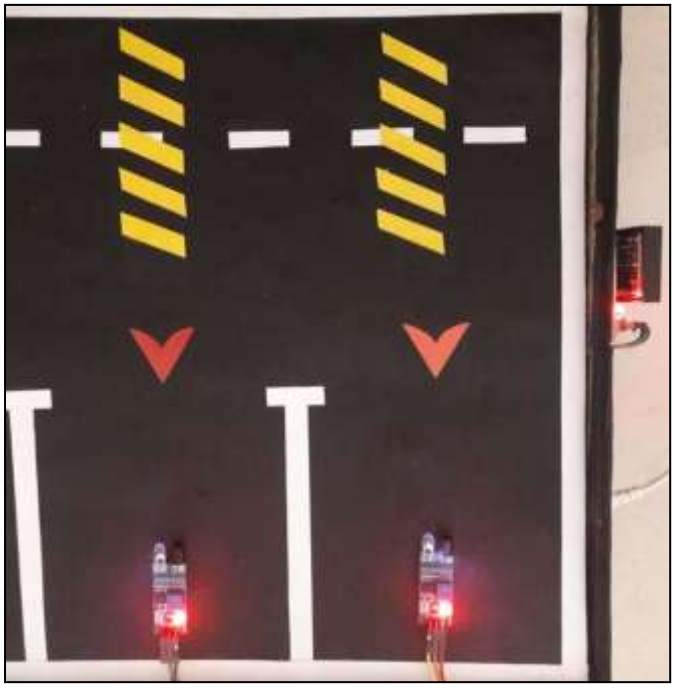

Fig. 6 IR sensor before detection of vehicle

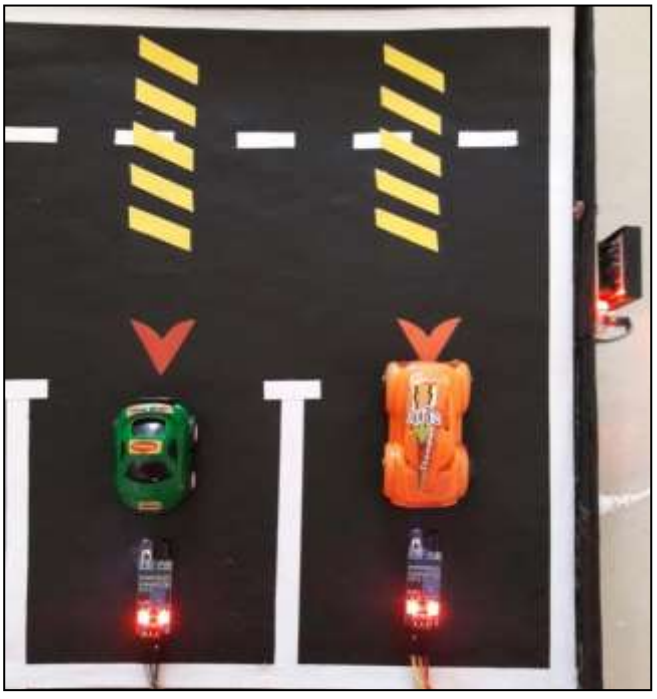

Fig. 7 IR sensor after detection of vehicle

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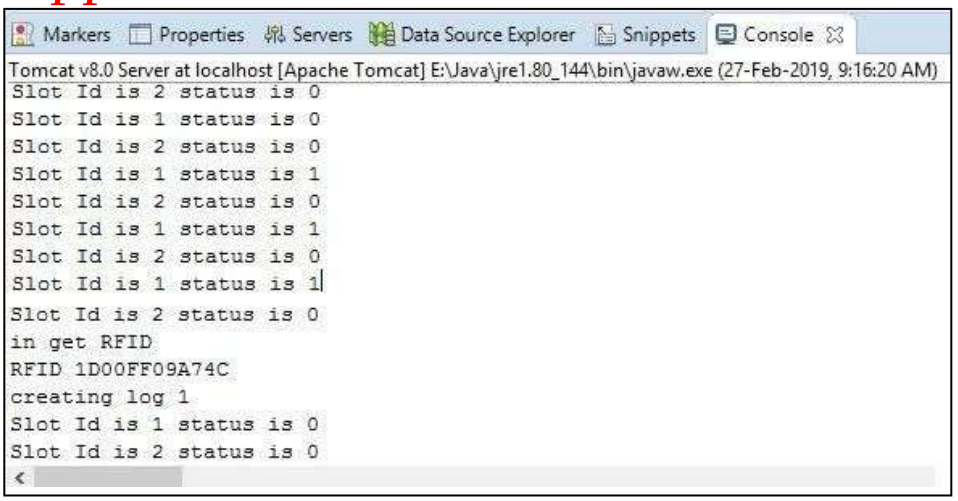

Fig. 8 Results after detection of car and RFID tag

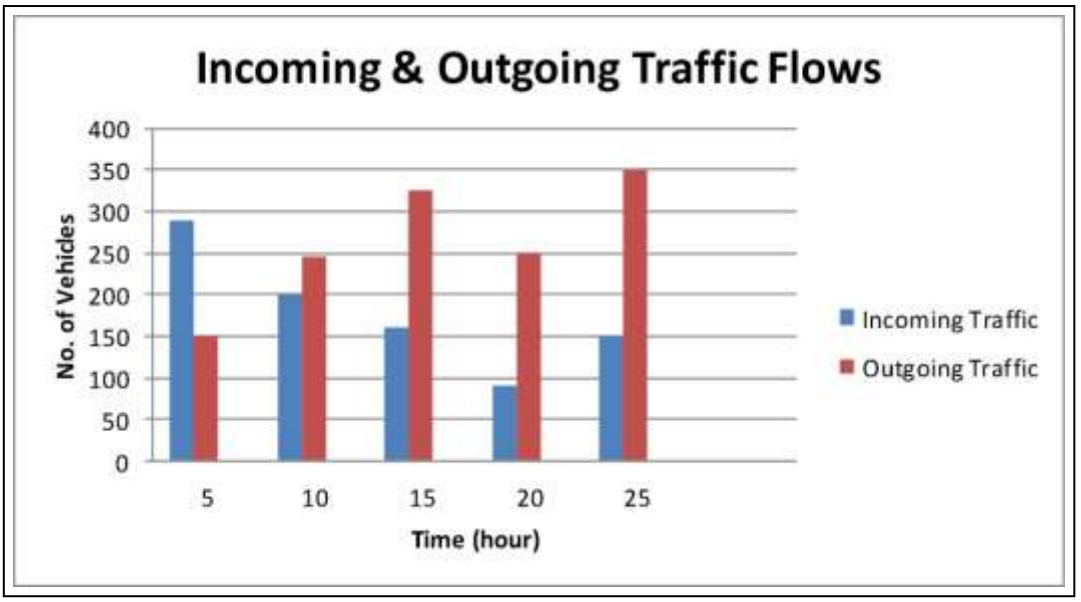

Fig. 9 Graph of traffic flow of cars in a parking area

From the above graph we can see the traffic flow of incoming and outgoing cars in the parking area. Now at a particular time, if the user can see the the slot time for which it is booked and at what time it will be vacant or available, or if he will get a notification about the time when the slot will be available then he can easily book the parking space or slot for the desired time period he wants. But in the traditional system, when the user arrives at the parking area he/she has to search for a parking space to park his/her car. During this searching time the user does not know which slot will become vacant or available within few minutes, hence he has to search for a new parking slot or parking area. This will impact the profit earned by the traditional parking management system, whereas in our proposed system the profit earned would be more.

CONCLUSIONS

The concept of smart parking system and the different technologies used, have been defined in this paper. Its features and functionalities have also been described. The current model of the project is simply a prototype of the bigger- scale version which will be developed in the due course of time. To reduce the problems of existing system, we have provided efficient framework for the automated smart parking system. Several techniques such as RFID, WSN, optimal algorithm, scheduling are

used for developing efficient parking solutions. This model helps us to understand the basic working and interfacing of various components used in this project, which help us to determine the flaws that must be overcome before being implemented on a larger scale. Thus we can implement an efficient and effective parking system based on the above study.

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