A Project/Dissertation ETE Report

on

Smart Parking System

Submitted in partial fulfillment of the

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Under The Supervision of
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CANDIDATE'S DECLARATION

I/We hereby certify that the work which is being presented in the project, entitled **"SMART PARKING SYSTEM"** in partial fulfillment of the requirements for the award of the **BACHELOR OF TECHNOLOGY IN COMPUTER SCIENCE AND ENGINEERING** submitted in the **School of Computing Science and Engineering** of Galgotias University, Greater Noida, is an original work carried out during the period of **July-2021** to **December-2021**, under the supervision of **Mr. Sudeept Singh Yadav, Assistant Professor, Department of Computer Science and Engineering** of School of Computing Science and Engineering , Galgotias University, Greater Noida

The matter presented in the project has not been submitted by me/us for the award of any other degree of this or any other places.

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This is to certify that the above statement made by the candidates is correct to the best of my knowledge.

Supervisor

(Mr. Sudeept Singh Yadav,

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CERTIFICATE

The Final Thesis/Project/ Dissertation Viva-Voce examination of **18SCSE1010139 – Anjali, 18SCSE1010163 – Tushar Maheshwari** has been held on _____ and his/her work is recommended for the award of **Bachelors of Technology in Computer Science and Engineering.**

Signature of Examiner(s) **Signature of Supervisor(s)**

Signature of Project Coordinator **Signature of Dean**

Date: 20th December,2021

Place: Greater Noida

Abstract

In this project, we will build an android application using android studio that will scan a code available on the parking site and alot that space of parking for our car at the same time the application also supports the payment mode for the user. As covid-19 unfolds across the nation, it will be an active area of research; the task is non-trivial and in this project we will build an android application along with a research paper on Stocks Prediction using LSTM in reputed SCOPUS conference publication.

Within this project we provided an overview of Smart Parking System term and approaches which we experience with our research. We believe (and the results of questionnaire support and our belief) it helps to improve the quality of education in the field and contribute to the solution for some of the problems in higher education system.

Anjali, Tushar Maheshwari

Signature of Students Signature of Guide

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Acronyms

SPS	Smart Parking System
QR Code	Quick Response Code
IR	InfraRed
GPS	Global Positioning System
LPR	License Plate Recognition
WSN	Wireless Sensor Network
SPAC	Smart Parking Area Control Unit
PACU	Parking Allocation Control Unit
RFIT	Radio Frequency Identification Tag

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INTRODUCTION

1.1 Introduction- As the number of people in cities grew, so did the use of automobiles. Finding a car park in many metropolitan areas, especially during rush hour, are difficult for drivers. Improper parking can lead to injuries. There is therefore a need to provide adequate parking spaces with multiple spaces to help the user park his car safely. Basically the parking system is one of the most accepted and fast-moving solutions of a smart city. Currently, most of the existing car parks do not have a systematic system. Most of them are manually managed and a little inefficient.

This project would be mainly focused on assisting driver to easily find vacant parking spaces in a specific parking region with the help of QR code based Smart Parking System and to reduce traffic and energy consumption and air pollution. Thus this project has come up with an optimal solution that gives liberty to the people to book their own parking space as per their need and specification of the vehicle. The purpose of this project is to make people more convenient to park their vehicle, which in this case is Reservation Based Smart Parking System using QR code(Quick Response Code). The idea behind our Android Application is to help the user for reserve free space to the car owner who wants to park their car.

In this android application the user scan the QR code or barcode available at the parking site then that slot would be booked for that user and user can also check the distance of themselves with their parked car apart from this in this project we provide user to pay their bill using different payment modes like UPI, debit ca.

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Searching for a parking spot has become a daily habit for a lot of people all around the globe. It is usually a time consuming and frustrating process that a lot of citizens have to go through. Next to parking being such a daily pain, it also has a big impact on the pollution of the planet.

After naming the various problems that arise from looking for parking spots, only one question remains: How can this problem be fixed? The answer is Smart Parking, but what is it?

Current Situation- In the modern society, there is an ever-increasing number of vehicles. This is leading to problems such as large urban parking lots becoming inefficient, increasing difficulty to find open spaces in busy parking lots, as well as the increasing need to devote larger areas of land for additional parking spaces. One may ask, why are these problems significant?

1.2 Formulation of Problem Statement- The three main problems that the increasing number of vehicles and the decreasing efficiency of modern busy parking lots are:

1. Valuable time wasted from inconvenient and inefficient parking lots
   On average, 3.5 - 12 minutes spent waiting for a spot in urban parking lots
2. More fuel consumed while idling or driving around parking lots, leading to more CO2 emissions being produced
   - Average distance traveled looking for a spot = 1.2km
   - Average CO2 produced per car per day = .14 kg CO2
   - 14kg for 1000 cars per day and 5110kg per year just for 1000 cars!!
3. Potential accidents caused by abundance of moving vehicles in disorganized parking lots

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- 413 accidents occurred in public parking lots in Canada last year
- There were 788 parked car collisions, 5 being fatal
- 2/3 of traffic accidents in parking lots involve only 1 moving vehicle
- Parking Structure Issue!
- 1/3 of these accidents involved 2 moving vehicles
- Parking System Issue!

1.3 The Definition of Smart Parking

In a nutshell, Smart Parking is a parking solution that can include in-ground Smart Parking sensors, cameras or counting sensors. These devices are usually embedded into parking spots or positioned next to them to detect whether parking bays are free or occupied. This happens through real-time data collection. The data is then transmitted to a smart parking mobile application or website, which communicates the availability to its users. Some companies also offer other in-app information, such as parking prices and locations. This gives you the possibility to explore every parking option available to you.

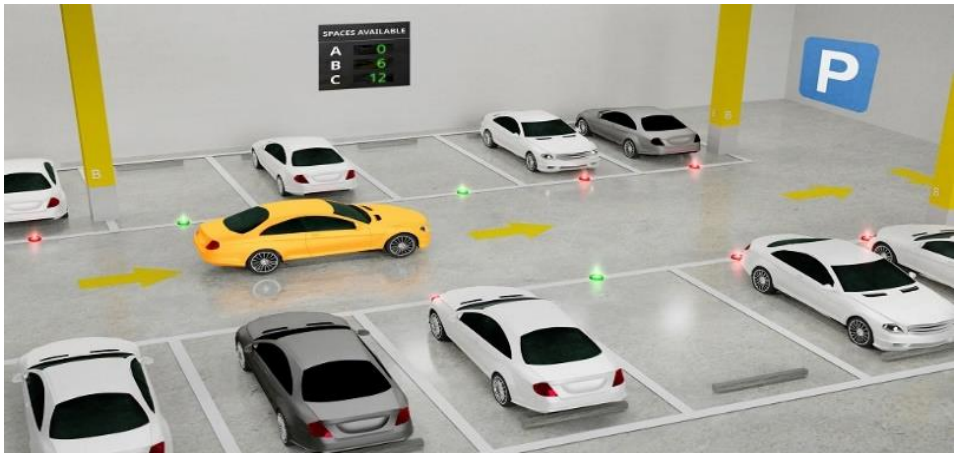

Fig-1: Parking slots indicating sensors

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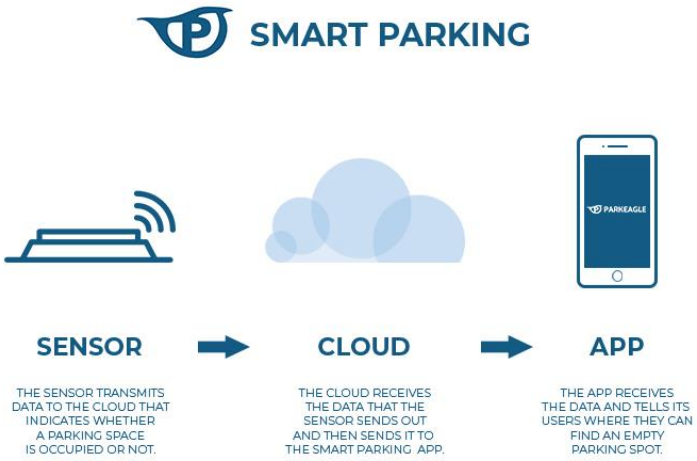
Smart Parking and its Smart Parking Sensors can be seen as a part of smart cities. These smart cities are cities that are driven by an IT infrastructure and by using this infrastructure, cities can enhance the quality of life and improve economic development for its inhabitants. Becoming a smart city can be a good way to collect historical data in a relatively easy way. By collecting this data, cities can analyze how processes, like parking can be optimized.

As a result of using Smart Parking, people who are looking to find a parking spot will find it in the most efficient way possible and companies or municipalities can optimize their parking territories. It also makes cities more livable, safer and less congested.



1.3.1Advantages for Cities

- **Less pollution:** Smart Parking contributes to a cleaner environment. Reducing the time that is necessary to find a parking spot will reduce the amount of fuel that is used when looking for a parking space. This makes the

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process of finding a parking spot contribute to less pollution, which is beneficial for everyone.

- **The space of a municipality will be utilized more efficiently:** because Smart Parking sensors transmit live-data, drivers will have a real-time overview of the occupancy of parking bays. This means that free spots can be filled quicker, which will reduce the time that a parking spot is empty.
- **Safety:** The use of Smart Parking Sensors can optimize safety within cities. As a result of placing, for instance, on-ground sensors on parking bays, people will not be as stressed as when they are looking for parking spaces. Because these people will know where they are going, they can simply navigate to their parking spot and they will not have to stress out about it.
- **Real-time parking analytics for cities:** Parking space will become intelligent by use of the smart parking sensors on the parking bays. This means that as a city you're able to see historical data which is stored and you're able to make data driven decision and predictions based on the parking sensor data.

In general, Smart Parking solutions, such as sensors, give municipalities and companies the opportunity to make parking a more fluid and efficient process. Furthermore, it saves people a great amount of time, money, and reduces the frustration that a person might have when wanting to find a parking spot.

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1.3.2 Tools and Technology used -

Smart parking tools consists of sensors, technologies and applications which are used to identify parking occupancy information and facilitate to improve parking efficiency. Found literature reviews on smart parking technologies and sensors are shown in Table 1. In this context, literatures are reviews about various types of smart parking sensors, technologies along with their uses while, identifies research gap in designing smart parking system for stakeholders. Furthermore, reviews about intelligent parking technologies and their economic analysis and reviews the advantages and drawbacks of sensors and technologies. As shown in Table 1 in appendices, machine vision using visual camera is referred by all the review articles. Sensors like ultrasonic and magnetometers are widely reviewed and tested which are used in various smart parking applications. Vehicular Ad hoc networks and fuzzy logic were not reviewed prior to 2013. Detailed description of each sensors and technologies can be found in this section along with emphasis on expenditure.

1. **Smart Parking Sensors**: There are various sensors which facilitate in detecting parking occupancy information and these are mentioned in the following sections. Sensors are one of the common tools which were widely tested in several previous literatures. Descriptions of these sensors are mentioned in the following sections.
2. **Passive Infrared Sensor**: These sensors detect changes in energy and when a vehicle occupies a parking space, these sensors identify the change in energy and detects occupancy. The sensor observes a change in energy when a vehicle is placed or a person standing above the sensor.

Based on the amount of energy change, it can be used to isolate outliers. However, these sensors are sensitive to environment and they would not be accurate when there is snow or rain. Passive infrared sensors should be placed under the ground or on the ceiling. Therefore, they require high investment for procurement and maintenance of these sensors. These sensors would be suitable for closed parking lots which are inside buildings and are not suitable for outdoor open parking lots.

3. **Active Infrared Sensor**: These sensors would emit infrared energy and detect any object or vehicle by the amount of energy reflected. They are also sensitive to environmental changes such as rain or snow. Therefore, they should be placed in all the parking spaces and require high investment and maintenance. Deploying sensors in all the parking spaces would help to attain parking occupancy status. These sensors are usually placed overhead and are suitable for indoor closed parking lots. As these sensors are sensitive to environmental changes it is not suitable to open parking lots.
4. **Ultrasonic Sensor**: These sensors would emit sound waves between 25 to 50 kHz and detect objects based on reflected energy. They are usually mounted on ceiling and are sensitive to environmental changes such as rain and snow. Therefore, they are suitable for indoor parking lots rather than open parking lots. Based on the distance at which waves are reflected it can distinguish between a vehicle and a person. In order to get parking occupancy status these sensors should be placed on top of every parking space. These sensors would be available for low cost but installation and maintenance of multiple sensors and connecting them to

a grid would be expensive in the long run. Wireless ultrasonic sensors are also used to gather parking occupancy information. They are connected using wireless sensor networks such as ZigBee protocol or other similar networks. However, wireless sensors involves periodic maintenance costs. In another study, ultrasonic sensors are used on a drive-by vehicle and parking occupancy information is collected at regular periods. Real time parking occupancy information cannot be attained using drive-by vehicle.

5. **Inductive Loop Detectors**: These detectors are installed using underground wiring system and they use principles of electromagnetism to detect the presence of a vehicle. They are commonly used at the entrance and exit to know the count of the vehicles which can be used to know availability of parking spaces. These detectors are expensive to install and maintain and they are commonly used in indoor parking lots to get the count of available parking spaces. Accurate count of vehicles would be provided using these detectors in a closed parking lot and these are in use at multiple commercial parking lots. However, individual parking occupancy status cannot be attained using inductive loop detectors.

Smart Parking Technologies: Sensor technologies are tools which facilitate the driver in occupying a vacant parking space and descriptions of these technologies can be found in the following sections below.

1. **Global Positioning System** (GPS): GPS based navigational directions are provided to the driver for occupying a vacant parking space. GPS will

facilitate in finding the shortest/optimal route from the current location. However, GPS alone cannot gather occupancy information of parking spaces. In one study occupancy of parking spaces is estimated using historical occupancy information and navigational directions are provided using GPS to the estimated parking space. The accuracy of the GPS with a single frequency receiver is less than or equal to 7.8 meters. If a dual frequency receiver is used, the accuracy is less than 0.71 meters. A normal parking space would be between 2.3 to 2.7 meters and most of the smartphones are provided with single frequency receiver which have higher error compared to dual frequency receivers. Dual frequency receivers are usually used for military products for greater accuracy. A GPS is also perceptible to errors when the signal is blocked due to tall towers, walls within a building or under the ground. Therefore, navigational directions using GPS will be prone to errors in a closed indoor parking lot. Usage of GPS is suited for outdoor open parking lots where there is less chance for signal blocking. Accuracy of the GPS signal is also dependent on availability of satellite.

2. **Machine Vision**: A visual camera can be used for license plate recognition or identifying parking lot occupancy using machine vision. The camera should be placed near the entrance of a closed parking lot for license plate recognition (LPR). Based on the number of vehicles entered and exited it can help to get the count of vacant parking spaces. However, occupancy status of parking spaces cannot be attained using this system. Video processing of parking lot using a camera is not ideal as it requires continuous transfer of large bandwidths. Therefore, a video should be broken to images at regular intervals and frame rates to facilitate continuous monitoring of the

parking lot. For parking spaces occupancy detection, a camera can be installed overhead to a parking lot and relevant image detection algorithms can be used to segment vehicles and detect occupancy of parking space. There are publicly available datasets such as PKLot which consists of large number of outdoor parking lot images. In one of the studies, support vector machine classifier produced 89% accuracy on their test dataset. Similar image classification algorithms such as logistic regression, Viola and Jones also produced higher accuracy results. A camera is suited for open parking lots as it can cover large number of parking spaces. However, it is susceptible to limitations such as; occlusion and shadow effects, distortion and lightning change. These limitations can be removed with the use of 3-D scene information. Since limited number of cameras can cover large number of parking spaces the expenditure is considered minimal.

3. **VANET:** This system uses wireless communication devices to provide services such as; smart parking and antitheft. Road side unites (RSUs) would be widely placed across parking lots and vehicles should be installed with on-board units (OBU). A trusted authority will be responsible for registrations of OBU and RSUs Therefore, once a vehicle approaches the parking lot installed with RSUs navigational information to the vacant parking space will be provided to OBU. The OBU's can also be used by the vehicles to avoid collision while driving. Such features are also incorporated in self-driving vehicles. These devices are not sensitive to environment and are suitable for closed and open parking lots. However, installation and maintenance of RSUs in the parking lot would be expensive. In order to achieve accurate parking occupancy data and navigational information all the vehicles must install

OBU. Parking occupancy data is prone to errors if there are vehicles without OBU are parked.

4. **Multi-Agent Systems**: These kind of systems makes use of multiple mediums such as sensors, mobile, algorithms, visual camera, etc. These systems are also capable of incorporating aspects such as user preference, importance, etc., in finding a vacant parking space for the driver. Multi-agent systems are considered as foundation for automation of smart parking systems. A user can select a parking space using a mobile or web application and based on the user importance and preference, a parking space will be selected. The user will also receive navigational information to reach the parking space. Java tools such as JaCaMo and environment such as CArtAgo can be used in the architecture. Machine vision systems or VANETs can be used instead of using sensors. Usage of multiple systems are supported in this architecture. These systems are suitable for both open and closed parking lots. The expenditure would be dependent on the usage of technology to identify occupancy status of parking spaces.
5. **Neural Networks**: Neural network is a data processing system which is inspired by brain nervous system. Neural networks have volved over the years and various types of neural networks were developed such as; fuzzy, neural network, fluid neural network, feed forward and convolutional neural network. Neural networks can be combined with machine vision to achieve automation. Neural networks were used in efficient recognition of license plates in real time videos. In one study, images from morning and night were taken separately to train the neural network and a two layered feed-forward network with hidden sigmoid is used to produce accurate results in detection

of available parking spaces. Deep learning is a branch of machine learning which uses neural networks in object detection and classification. There is another evolving technology such as convolutional neural networks which would take images as input and is more efficient in analysing images. In a recent study, convolutional neural networks was used along with machine vision to capture parking occupancy information efficiently. Convolutional neural network was also used to facilitate a self-driving vehicle. The network was trained using a set of connected cameras which observe the road while driving. Using limited training, the vehicle with convolutional neural network was able to operate on parking lots and roadways without lane markings. This technology would function as an efficient tool in data processing while it is not involved in real time data capturing. Therefore, it is suitable for open and closed parking lots with minimal expenditure.

6. **Fuzzy Logic**: Fuzzy logic is an approach which incorporates multivalued logic in evaluating. Fuzzy logic can be used to develop forecasting models based on sample data. Similar to neural networks, fuzzy logic can also be used in multi-agent systems. According to a study, a sample of parking spaces availability information for 5 days using machine vision was taken to predict the availability of parking spaces in future dates using fuzzy logic . Fuzzy logic supports autonomy in providing information on the availability of parking spaces. The accuracy of forecast models would not be high without validating with real time data. Therefore, combination of fuzzy logic models with machine vision or sensor technologies would increase the accuracy of the overall system. These systems are suitable for both open and closed parking lots. The expenditure would be minimal if image

processing is used along with fuzzy logic to estimate available parking spaces for the future as well as provide real time availability of parking spaces. Since this technology is not involved in the real time data capturing process, it can be used for closed and open parking lots with minimal expenditure. Not all of the sensors and technologies are suitable for gathering real time occupancy information of open parking lots as mentioned in Table 2 in appendices. Even though sensors are widely to acquire parking occupancy information, they would be expensive to install and maintain on large number of parking spaces. Few sensors such as infrared and ultrasonic are sensitive to environment and are not suitable for open parking lots. Technologies such as; machine vision, multi-agents systems are suitable for open parking lots to acquire parking occupancy information and GPS can be used to provide navigational directions

1.3.3 Smart Parking Applications –

There are already many free smart parking applications available online in web and mobile stores of Android or iOS. Previously, reservation of parking space was done by calling to the service provider and now with the current usage of internet and smartphones, these services are provided online using mobile and web applications. These applications serve as decision support systems for the driver in occupying a vacant parking space. For instance, if the application shows a particular parking lot of choice to be full, the driver can search for nearby parking lots with available parking spaces or choose another destination. In this way smart parking applications serve as decision support systems in occupying available

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parking spaces. Smart parking tools improve efficiency based on the following three categories.

1. Guide the driver to parking lot using display boards
2. Reserve and authorize the driver to a parking lot
3. Reserve and guide the driver to a specific parking space using navigational information

The three categories mentioned earlier are the ways in which efficiency of parking is improved using existing smart parking tools. The level of efficiency varies with each category. The first category would improve the parking efficiency, however cruising for the empty parking space would still be involved. The second category reserves a parking space for the driver, however, the driver would still search for the reserved parking space manually which also involves some amount of cruising while searching for the location of reserved parking space. The third category provides improved efficiency compared to the two previous categories as it facilitates in reserving and guiding the driver using navigational information to the parking space. The first category to guide the driver to a parking lot was provided with the use of parking guidance systems. This parking system facilitates the driver in taking a decision to park the vehicle. It is suitable to open parking lots as well. The second category would use RFID or license plate recognition technologies. If a parking space is reserved by the driver, then RFID or license plate recognition would authorize the vehicle to park. These are common methods for staff parking in an organization and are not applicable to open parking lots. The third category would use web applications or smartphones to reserve the parking space and guide the

driver using navigational directions through GPS. Table 3, shows smart parking applications available online which provide smart parking services as mentioned in the third category. All the applications are provided in limited cities of mentioned countries. All the applications mentioned in Table 3 provide smart parking services in closed parking lots which support reservation and all of them are available in mobile application stores. However, Open Spot is the only application which is currently unavailable and discontinued by Google. Navigational directions to the free available parking space are provided which improve the efficiency of parking behaviour. A percentage or number of available parking spaces are shown for selected parking lots. None of the applications give the driver a choice in selecting a particular parking space. Most of the applications use underground wireless sensors such as magnetometers to get real time parking occupancy information. Setup and maintenance cost of wireless sensors will be high and it is mandatory to replace all sensors again when the battery life is depleted. Since, a sensor needs to be placed in all the parking spaces, operational and maintenance costs of such sensors would be high. Crowd sourcing application are suited for open/closed parking lots and the expenditure is considered very minimal as no hardware installations or maintenance is required. However, the users need to update occupancy details of parking spaces every time they park the vehicle and the accuracy of the information will be dependent on the user updating the occupancy details and is prone to human errors. Applications such as; Parkopedia and EasyPark Group use historical data for predicting parking occupancy information. Algorithms like fuzzy logic, time series are used to predict parking occupancy information based on historical or sample data. These applications are operational in more number of

cities and countries compared to other applications. All these applications provide an overview of parking occupancy which facilitates in decision making.

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LITERATURE REVIEW

Among the challenges that we face in our day to day life one of most unavoidable challenge is parking the car wherever we go. As our need increases our travelling increases but due to drastic increase in usage of vehicles and increase in population we face the tough task of parking our car particularly during busiest hours of the day. During peak hours most of the reserved parking area gets full and this leaves the user to search for their parking among other parking area which creates more traffic and leaves them with no indication on availability of parking space. To overcome this problem there is definitely a need for designed parking in commercial environment. To design such parking slot we need to take into the account of reservation of parking slot with optimal parking space which depends on cost and time. Additionally, four hours prior to his expected arrival, the user can pre-book a slot in the area he desires if it is available. This will help reduce the load on the administrator as his physical work reduces drastically and user can search the parking slot through Android Application. Payment services are made available using Google Wallet, so the user is required to own a credit card or debit card. Application relieves the user from the hassle of manually searching and waiting for empty slots to park the vehicle. Below are some existing scenarios as follow:-

2.1. Wireless Sensor Network Parking (WSN) In these system Infrared (IR) sensor nodes senses the status of the car space and transfers the information to a controller. It thereby displays the information on a LED screen with which the user can check for empty vehicle slots, in turn reducing his time. As infrared cannot penetrate walls, therefore it cannot be used in closed parking areas due to low

wavelength. (E.g. shopping malls or residential area where parking is done in enclosed area).

2.2. Smart Parking Designing, developing and producing a leading edge parking technology is called as Smart parking. It is a vehicle parking system that helps drivers find a vacant spot. Using the IR sensors in each parking slot, it detects the presence or absence of a vehicle, and sends messages to user. Smart Parking system is proven as an exact, robust and cost efficient way to ensure that road users know exactly where unoccupied car parking spaces are.

2.3. SLOT Allocation Algorithm The slot allocation method follows a sequence as discussed above. It has the Parking Area Control Unit and the Smart Parking Area control Unit (SPAC). The functions are as follows:

- Initially the slot selection is made from the mobile phone
- Transforming request for parking slot from the mobile using Android application
- The Parking Allocation Control Unit (PACU) gets the request slot number from the mobile
- Checks for the parking slot for availability. If it is free go to the next stage. If the slot is not free goes to the initial state.
- If the parking slot is free, the requested slot is reserved in the parking area
- After reserving the parking slot in the parking area, it checks for a condition if it is available. (i.e. Whether GREEN led is on)

If the parking slot is not free then it will go to the initial stage.

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- After reserving the parking slot in the parking area then the status of the led will be RED=ON && GREEN=OFF.
- If car gets entered into the parking slot, the timer gets ON and measures the total time. If not, the timer waits till car to get in.
- Once the car is to move out of the parking slot, the timer gets OFF and displays the total cost.
- Displays the total cost finally and updates the free slot information.

The above steps conclude the slot allocation algorithm. Initially the driver sends request via mobile phone using Android application and do reservation as mentioned in the smart parking overview. They have the database of all drivers request and according to the requests with the slot allocation method; the parking slot is allocated to the drivers in the parking area. And finally updates the information to the mobile phone users. Here we can reserve our own parking slot. It is user friendly. Driver can choose the parking slot which is comfortable for them. It overcomes the process of time saving compared to the dynamic resource allocation method and also cheaper than that. Using the FCFS scheduling method the priority will be scheduled. Initially the driver sends request via mobile phone using Android application and do reservation as mentioned in the smart parking overview. They have the database of all drivers request and according to the requests with the slot allocation method; the parking slot is allocated to the drivers in the parking area.

2.4. IR sensor An infrared sensor is an electronic device which is used to sense the light wavelength of its surroundings by either emitting or detecting infrared

spectrum. It will also capable of measuring the heat being emitted by an object and detecting motion. LED will be glow with respect to the IR sensor detection. Green LED will be glow if no object is detected and Red LED will be glow if object is detected.

2.5. RFID A Radio Frequency Identification Tag (RFID) tag is an electronic tag that exchanges data with a RFID reader. Here we are going to use Active tag of RFID. While RFID's original uses were primarily for inventory tracking in retail environment, this technology has quickly created a presence in an extremely diverse number of fields including easy gas payment, credit card replacement. RFID tag has chip, memory and an antenna.

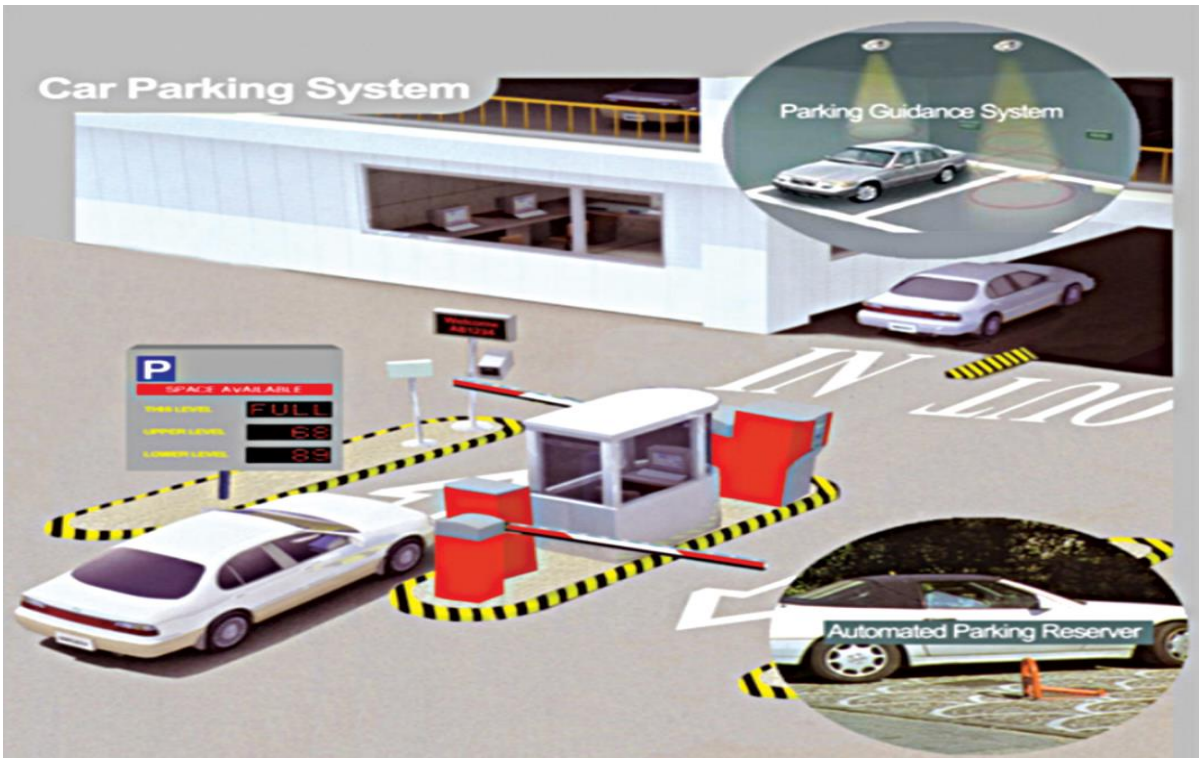

Fig-2: RFID Parking System

The existing parking systems simply gather the available information of vacant parking lots using various sensor networks, and update the data to direct drivers. But the problem lies here, this system will not be able to direct the drivers to their respective parking slots. Blind searching is a common way by which drivers look out for vacant spaces when there is no availability of parking information. The drivers keep searching for empty parking spaces within a close distance to their end location. The drivers will not stop looking around until they find an empty space and keep extending the searching area. To tackle the problem of "many-vehicles-chase-single-slot", the way of sharing the information about the parking slots is modified. The designers intentionally decrease the number of available slots while publishing the information, they act as buffer slots. When there are many vehicles wanting to park in a limited amount of available space, this system will have some extra spaces reserved in order to avoid a conflict. But it is a difficult task to estimate the number of the buffer spaces required. If the reserved space is too small, then we cannot overcome the problem of "many-vehicles-chase-single-slot". If the buffer is too large, then parking space cannot be utilized effectively. Walking distance and Traffic volume are two performance metrics that address these issues. In order to address these challenges few systems have been already proposed such as Reservation Performance where the system continuously retrieves and stores data about the performance metrics, it also includes the status of parking slot(occupied or vacant), reservation time, exact parking location and also about driver's identity. As soon as the reserved space is occupied by a vehicle, the system should automatically verify the driver's identity in order to block that slot. Iris-net has proposed a system which uses cameras, microphones and motion detectors. These sensors are used to detect the availability of vacant parking spaces. It also acquires real time information about vacant parking slots through their web applications. But the problem is that it generates huge amount of data. One of the main limitations of this system is high

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energy consumption and it also suffers from technical aspects. E-parking system makes use of latest technologies to merge reservation of parking slots and the payment systems. A driver can utilize this system to get information about the availability of vacant parking spaces, to reserve a parking space at his desired location and also to make the payment when leaving. The above system can be accessed through a smartphone, or through web. But still there is a requirement of conventional detectors to detect the status of the parking slot. Automated parking system makes a way for an efficient use of limited number of parking spaces

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PROPOSED SYSTEM

The public parking system developed within the SPS project will partially remodel the public off-street parking system so that only the authorized users can use these facilities and only these users can be reserved the parking space. First, the users can register at the SPS Android App and also book the vacant parking slot. In the rest of the paper, we will refer to an on-street public space managed by SPS as SPS parking spot/space. To establish the SPS architecture, the following business rules have been defined. First, Reservation confirmation with a QR Code can be sent only to the authorized customers. Second, A reservation is held for a grace period (e.g. 15 min) after the start of the reserved interval in order to account for customers who do not show up in time. If the customer arrives within that period he will park his vehicle to his reserved area. If the customer does not reach within that particular period a message will inform him/her about the expiration of his/her reservation. Third, If the customer can arrive anytime between the grace period, a vacant and unreserved spot will be offered for the remaining period if any free space is available although he has to reserve a new space from his app. The customer will be billed from the start to the end of his/her original reservation. Fourth, No-show customers will not be billed for the canceled reservation. On a further modification of the project, If the customer fails to clear their parking slot at the scheduled time then he can pay the additional charge. A message (e.g. SMS or email) will be sent to the customer to notify these events. SPS business policies do not allow overbooking since IPA is thought for customers who are willing to pay for an on-street parking stall in order to have the absolute certainty to find a parking spot at their arrival in a high-density trafficked area of the city. If SPS allowed overbooking, there will be no difference between a regular parking spot

CHAPTER-3

PROPOSED SYSTEM

and an SPS stall. Furthermore, SPS parking stalls must be paid independently at the time of exit from the slot, so there is no loss of revenues. The SPS architecture consists of two modules user and server(admin). This subsystem is a core module of the SPS system. It manages the communication with the customer, for example, accounting, reservation, cancellation, and billing. This module communicates with the user. First user login to the system then enters the destination then choose the suitable parking space. i.e The user can see the available slot in the parking space and book the slot before arriving at the venue. Book the slot. The booking is confirmed by the generation of unique QR code which is used in future for verification purpose. The user can cancel the booking. Next module is Server(admin). The administrator is the person who manages the domain. This module provides the facilities for the admin for managing users. This module could update the details of a new parking area to the existing system. The booking will expire if the user does not turn up within 15mins from the time specified. The QR code is generated when the slot is booked. Once the user leaves, the system updates the database.

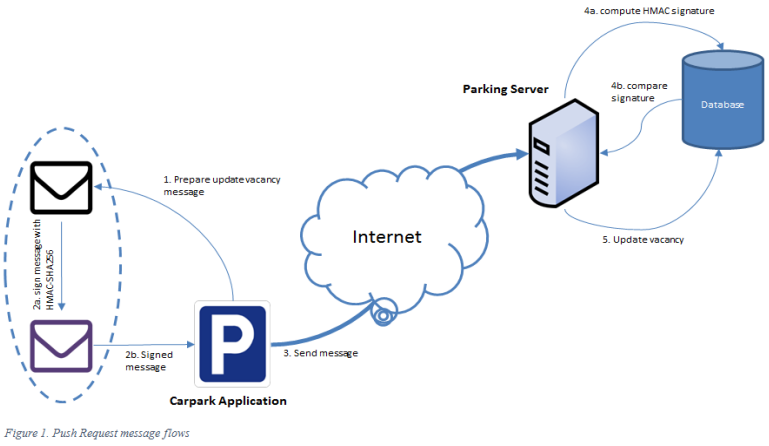

Figure 1. Push Request message flows

Fig-3: Push Request System

CHAPTER-4

UML DIAGRAMS

System Architecture

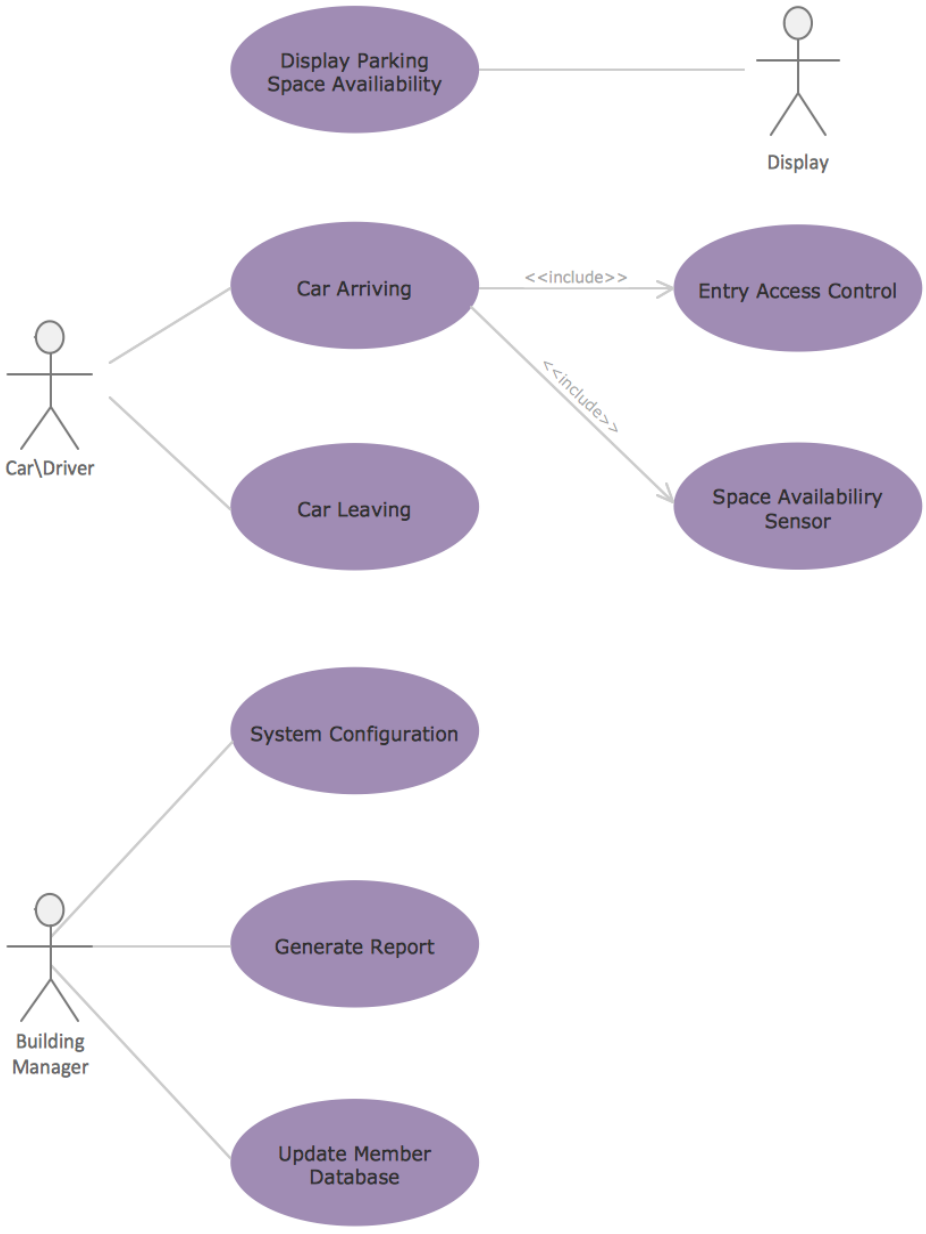

Fig-4: System Architecture Diagram

CHAPTER-4

UML DIAGRAMS

Class Diagram

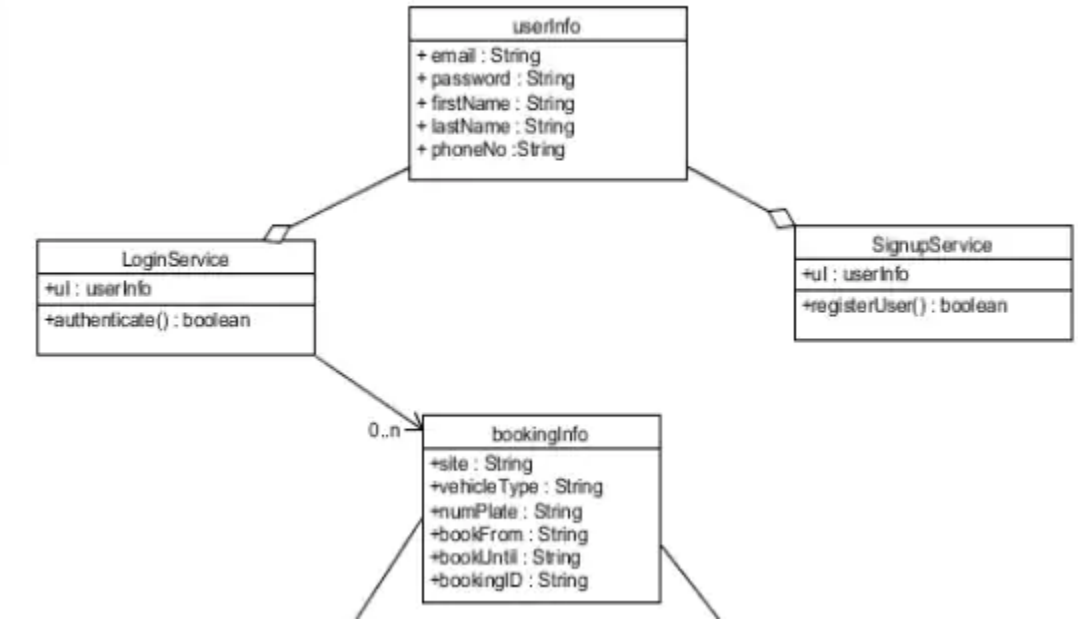

Fig-5: Class Diagram

CHAPTER-4

UML DIAGRAMS

Use Case Diagram

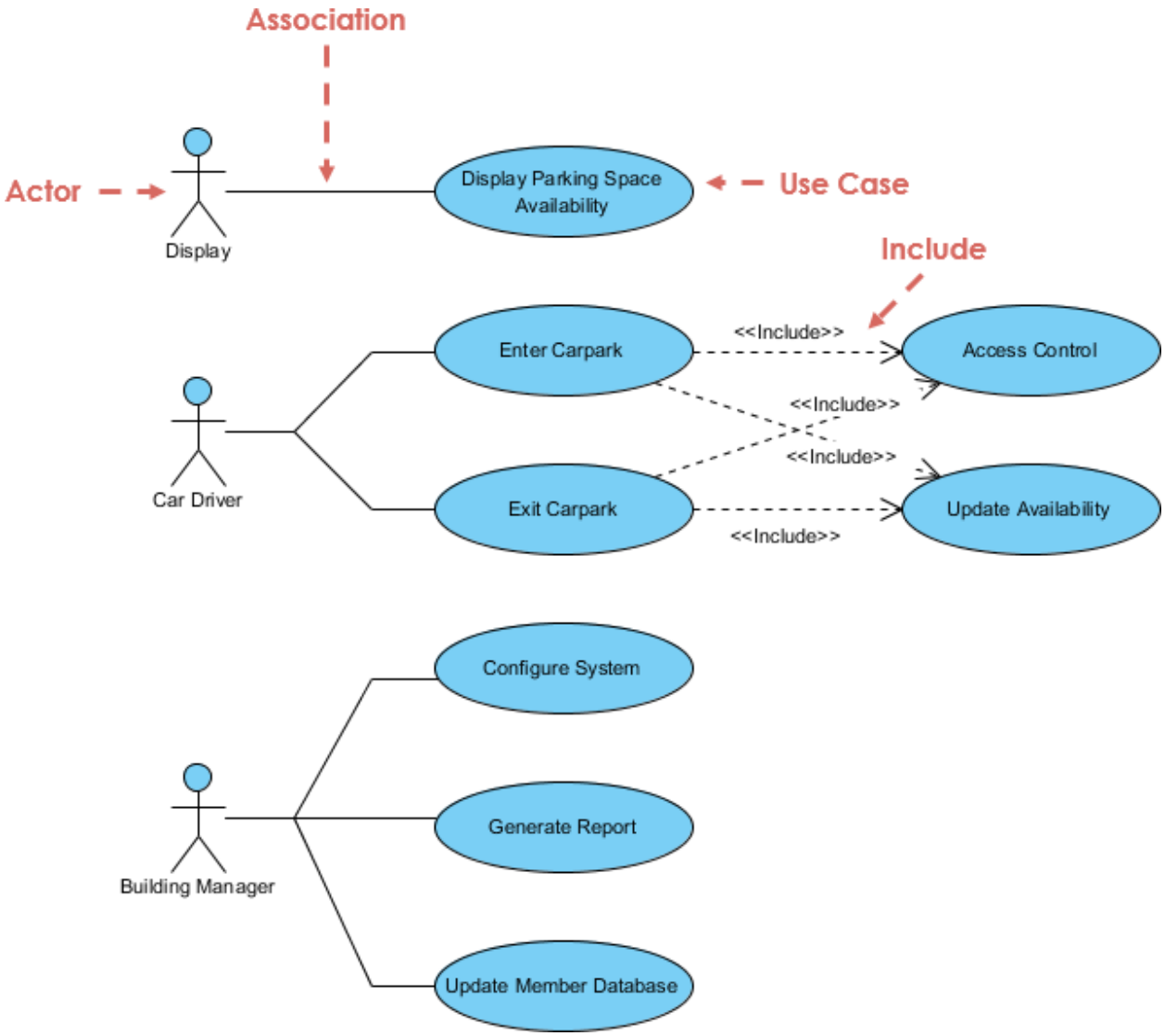

Fig-6: Use Case Diagram for Association.

CHAPTER-4

UML DIAGRAMS

Use Case Diagram

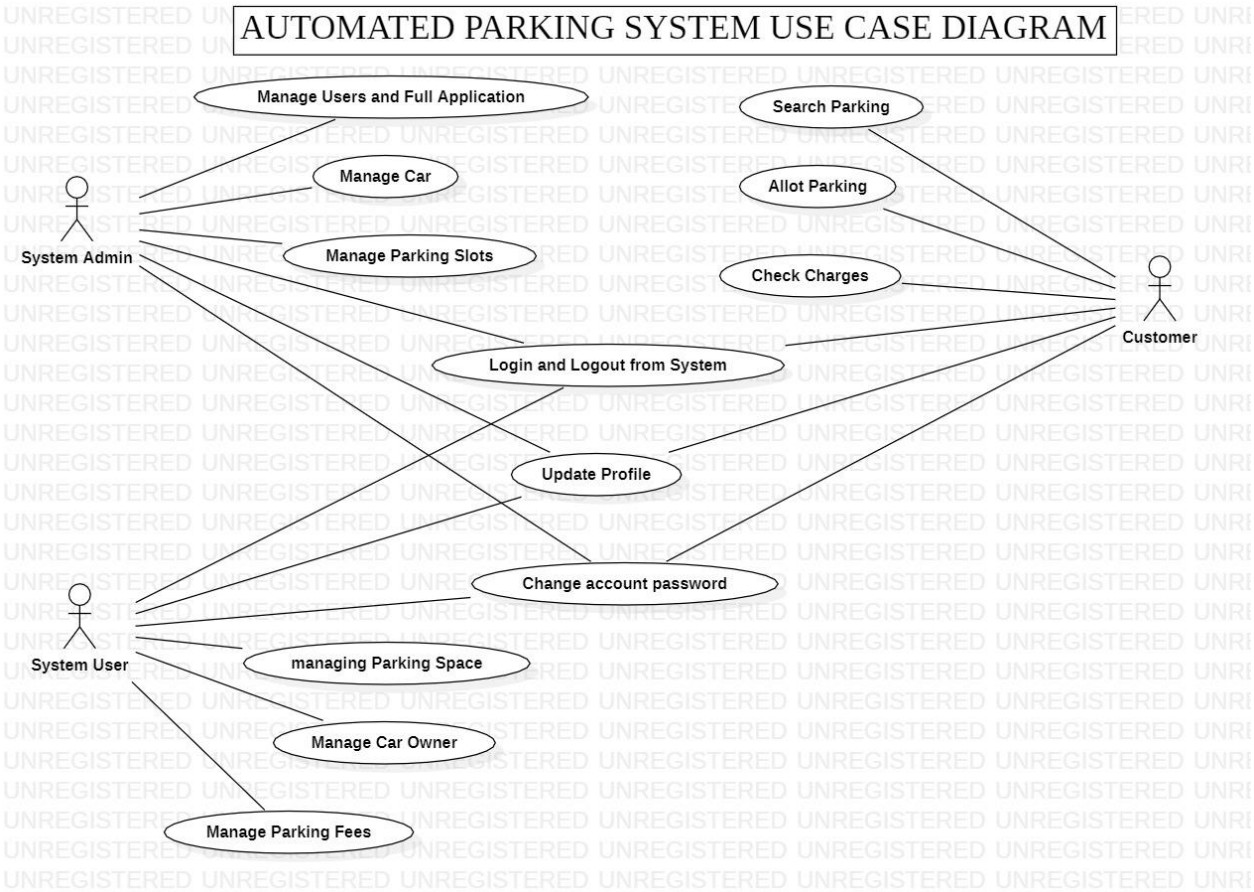

Fig-7: Automated Use Case Diagram.

CHAPTER-4

UML DIAGRAMS

Data Flow Diagram

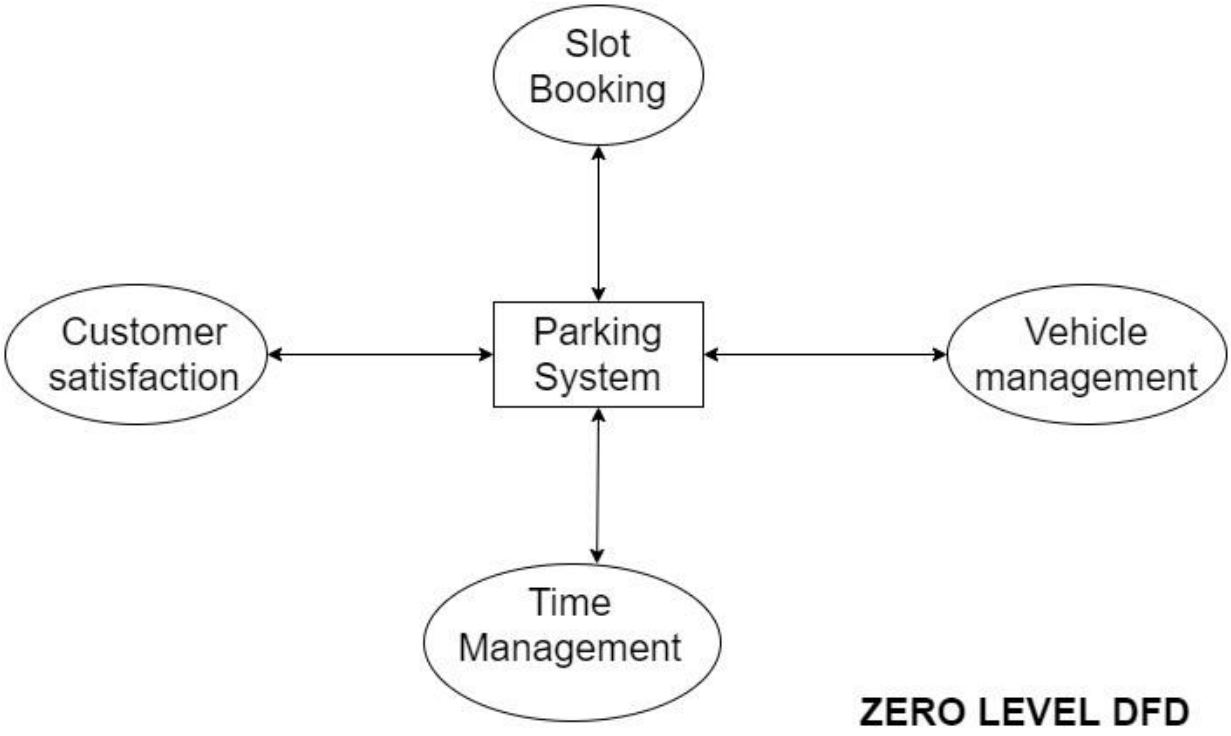

Fig-8: Data Flow Diagram

CHAPTER-5

MODULE DESCRIPTION

JAVA

Java is a high-level, class-based, object-oriented programming language that is designed to have as few implementation dependencies as possible. It is a general-purpose programming language intended to let programmers write once, run anywhere (WORA), meaning that compiled Java code can run on all platforms that support Java without the need for recompilation. Java applications are typically compiled to bytecode that can run on any Java virtual machine (JVM) regardless of the underlying computer architecture. The syntax of Java is similar to C and C++, but has fewer low-level facilities than either of them. The Java runtime provides dynamic capabilities (such as reflection and runtime code modification) that are typically not available in traditional compiled languages. As of 2019, Java was one of the most popular programming languages in use according to GitHub, particularly for client–server web applications, with a reported 9 million developers.

Java was originally developed by James Gosling at Sun Microsystems (which has since been acquired by Oracle) and released in 1995 as a core component of Sun Microsystems' Java platform. The original and reference implementation Java compilers, virtual machines, and class libraries were originally released by Sun under proprietary licenses. As of May 2007, in compliance with the specifications of the Java Community Process, Sun had relicensed most of its Java technologies under the GPL-2.0-only license. Oracle offers its own HotSpot Java Virtual Machine, however the official reference implementation is

CHAPTER-5

MODULE DESCRIPTION

the OpenJDK JVM which is free open-source software and used by most developers and is the default JVM for almost all Linux distributions.

As of October 2021, Java 17 is the latest version. Java 8, 11 and 17 are the current long-term support (LTS) versions. Oracle released the last zero-cost public update for the legacy version Java 8 LTS in January 2019 for commercial use, although it will otherwise still support Java 8 with public updates for personal use indefinitely. Other vendors have begun to offer zero-cost builds of OpenJDK 8 and 11 that are still receiving security and other upgrades.

Oracle (and others) highly recommend uninstalling outdated and unsupported versions of Java, because of serious risks due to unresolved security issues. Oracle advises its users to immediately transition to a supported version, such as one of the LTS versions (8, 11, 17).

Principles of Java- There were five primary goals in the creation of the Java language:

1. It must be simple, object-oriented, and familiar.
2. It must be robust and secure.
3. It must be architecture-neutral and portable.
4. It must execute with high performance.
5. It must be interpreted, threaded, and dynamic.

Java JVM and bytecode- One design goal of Java is portability, which means that programs written for the Java platform must run similarly on any combination of hardware and operating system with adequate run time support. This is achieved by

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MODULE DESCRIPTION

compiling the Java language code to an intermediate representation called Java bytecode, instead of directly to architecture-specific machine code. Java bytecode instructions are analogous to machine code, but they are intended to be executed by a virtual machine (VM) written specifically for the host hardware. End-users commonly use a Java Runtime Environment (JRE) installed on their device for standalone Java applications or a web browser for Java applets.

Standard libraries provide a generic way to access host-specific features such as graphics, threading, and networking.

The use of universal bytecode makes porting simple. However, the overhead of interpreting bytecode into machine instructions made interpreted programs almost always run more slowly than native executables. Just-in-time (JIT) compilers that compile byte-codes to machine code during runtime were introduced from an early stage. Java's Hotspot compiler is actually two compilers in one; and with GraalVM (included in e.g. Java 11, but removed as of Java 16) allowing tiered compilation.[47] Java itself is platform-independent and is adapted to the particular platform it is to run on by a Java virtual machine (JVM) for it, which translates the Java bytecode into the platform's machine language. Performanc*e*- Programs written in Java have a reputation for being slower and requiring more memory than those written in C++ . However, Java programs' execution speed improved significantly with the introduction of just-in-time compilation in 1997/1998 for Java 1.1,[51] the addition of language features supporting better code analysis (such as inner classes, the StringBuilder class, optional assertions, etc.), and optimizations in the Java virtual machine, such as HotSpot becoming Sun's default

CHAPTER-5

MODULE DESCRIPTION

JVM in 2000. With Java 1.5, the performance was improved with the addition of the java.util.concurrent package, including lock-free implementations of the ConcurrentMaps and other multi-core collections, and it was improved further with Java 1.6.

Why is JAVA important?

Java is one of the most popular programming languages used to create Web applications and platforms. It was designed for flexibility, allowing developers to write code that would run on any machine, regardless of architecture or platform. According to the Java home page, more than 1 billion computers and 3 billion mobile phones worldwide run Java.

Use - Java is used to build applications and platforms for a number of devices, including computers, laptops, gaming consoles, Blu-ray players, car navigation systems, medical monitoring devices, parking meters, lottery terminals and smartphones. It is also a key language for networking, particularly for data centers that store and transfer Web-based data.

Applets - Java is also used to create miniature, dynamic programs that run alongside or are embedded within Web pages. These programs are called applets and can be used to display maps, weather, games or other interactive widgets or tools on a Web page.

Programming - Based on a C and C++-based syntax, Java is object-oriented and class-based. Developers adopt and use Java because code can be run securely on

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MODULE DESCRIPTION

nearly any other platform, regardless of the operating system or architecture of the device, as long as the device has a Java Runtime Environment (JRE) installed. The JRE varies depending on the specific type of device, but essentially it runs a “virtual” machine, or environment, that translates the code into an application or program.

Java and JavaScript - Although their names are quite similar and they are both used to create dynamic tools and games on a Web page, Java and JavaScript are different languages. Java is more robust and can be used as the sole programming language for an application, while JavaScript is a lightweight scripting language that adds functionality -- like a Java applet -- onto a Web page.

ANDROID STUDIO - Android Studio is the official integrated development environment (IDE) for Google's Android operating system, built on JetBrains' IntelliJ IDEA software and designed specifically for Android development.[8] It is available for download on Windows, macOS and Linux based operating systems or as a subscription-based service in 2020. It is a replacement for the Eclipse Android Development Tools (E-ADT) as the primary IDE for native Android application development.

Android Studio was announced on May 16, 2013 at the Google I/O conference. It was in early access preview stage starting from version 0.1 in May 2013, then entered beta stage starting from version 0.8 which was released in June 2014. The first stable build was released in December 2014, starting from version 1.0.

On May 7, 2019, Kotlin replaced Java as Google's preferred language for Android app development. Java is still supported, as is C++.

CHAPTER-5

MODULE DESCRIPTION

FEATURES –

A specific feature of the Android Studio is an absence of the possibility to switch autosave feature off.

The following features are provided in the current stable version:

- Gradle-based build support
- Android-specific refactoring and quick fixes
- Lint tools to catch performance, usability, version compatibility and other problems
- ProGuard integration and app-signing capabilities
- Template-based wizards to create common Android designs and components
- A rich layout editor that allows users to drag-and-drop UI components, option to preview layouts on multiple screen configurations[18]
- Support for building Android Wear apps
- Built-in support for Google Cloud Platform, enabling integration with Firebase Cloud Messaging (Earlier 'Google Cloud Messaging') and Google App Engine[19]
- Android Virtual Device (Emulator) to run and debug apps in the Android studio.

Android Studio supports all the same programming languages of IntelliJ (and CLion) e.g. Java, C++, and more with extensions, such as Go; and Android Studio 3.0 or later supports Kotlin and "all Java 7 language features and a

CHAPTER-5

MODULE DESCRIPTION

subset of Java 8 language features that vary by platform version." External projects backport some Java 9 features. While IntelliJ states that Android Studio supports all released Java versions, and Java 12, it's not clear to what level Android Studio supports Java versions up to Java 12 (the documentation mentions partial Java 8 support). At least some new language features up to Java 12 are usable in Android

Why Java with Android Studio?

There are solid reasons why java is used for android development.

The main objective behind Android development was to create a platform-independent application environment that can run on every device. As we know java already have this quality so java was chosen for android development. Android applications run on a special virtual machine called the Dalvik VM that is a direct inspiration from java virtual machine called JVM. Android application can run on any device where special Dalvik VM is implemented. These way android applications are compiled and run in optimum performance environment with the feature of platform independence. The good approach towards software development is the object oriented approach. Java is based on the oops concept. Android relies heavily on Java fundamentals like classes and objects and its other useful features of oops. Java has an extensive set of libraries. It is easy to take advantage of these libraries. Android SDK has many standard Java libraries included. These provide functionalities for data structure, math functions, graphics implantation, and networking functions and much more. These java libraries help us to do everything else we could want. This way java helps develop Android

CHAPTER-5

MODULE DESCRIPTION

applications fast and inefficient manner. Android is made to run on different platforms i.e. hardware platforms. Thus architectural neutrality is desired and necessary. Android code is written once and to execute need to compile and optimise native code for better performance on various devices. Java has platform independent feature so it is used for android development. Java is very popular language due to its awesome features and performance. The community of Developers those have proficiency is really big. Thus android developers to choose java as there is already a good base of java programmers are available that can help in creating, improving android applications plus with many libraries and tools of java make developers life easier. Large java developer base enables to develop a lot of android apps fast so it is based on java. Developers those do not use java have to deal with serious problems like memory leads and bad pointer usage. Sometimes these problems harm at the highest level like the crash of application or crash of OS. Android easily implement and fix common problems with other programming languages with the help of Java. These are some problems those never occur when you program with java. Java is machine independent and runs only in JVM space so it protects you from these problems.

Java is the best and the first language for native software development. That is really the only option for native applications, native applications are the heart of android.

Java's important core features also motivated android developers to use it for development, these features include easy learning, platform-independent, secure, object-orientation.

CHAPTER-5

MODULE DESCRIPTION

Some Screenshots of Smart parking App

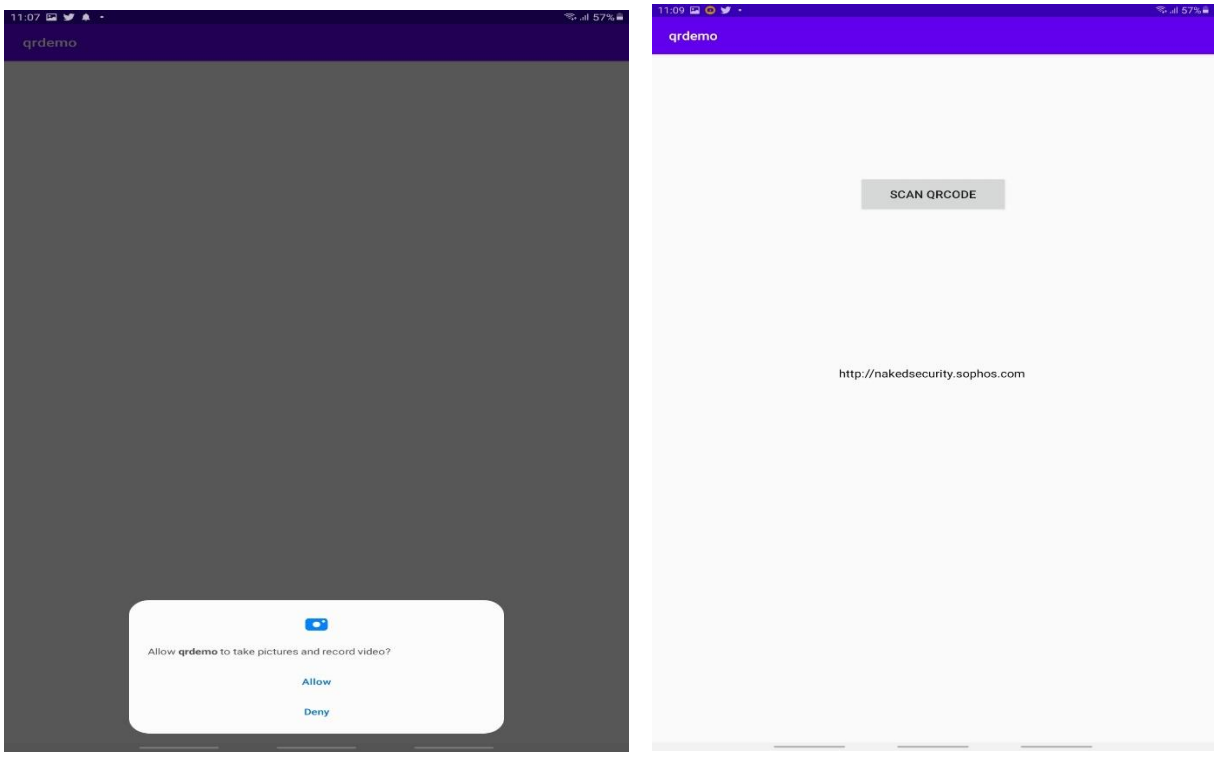

Fig- Allowing access to camera and main scan button.

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MODULE DESCRIPTION

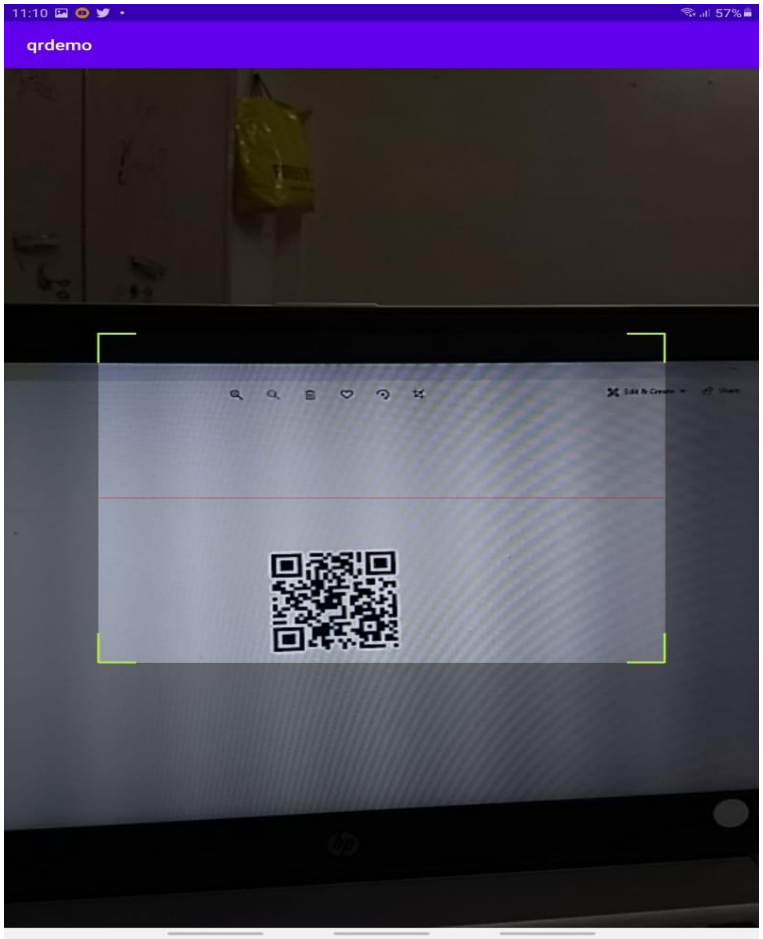

Fig- Allowing access to camera and gallery

CHAPTER-5

MODULE DESCRIPTION

Fig- Splash Activity

CHAPTER-5

MODULE DESCRIPTION

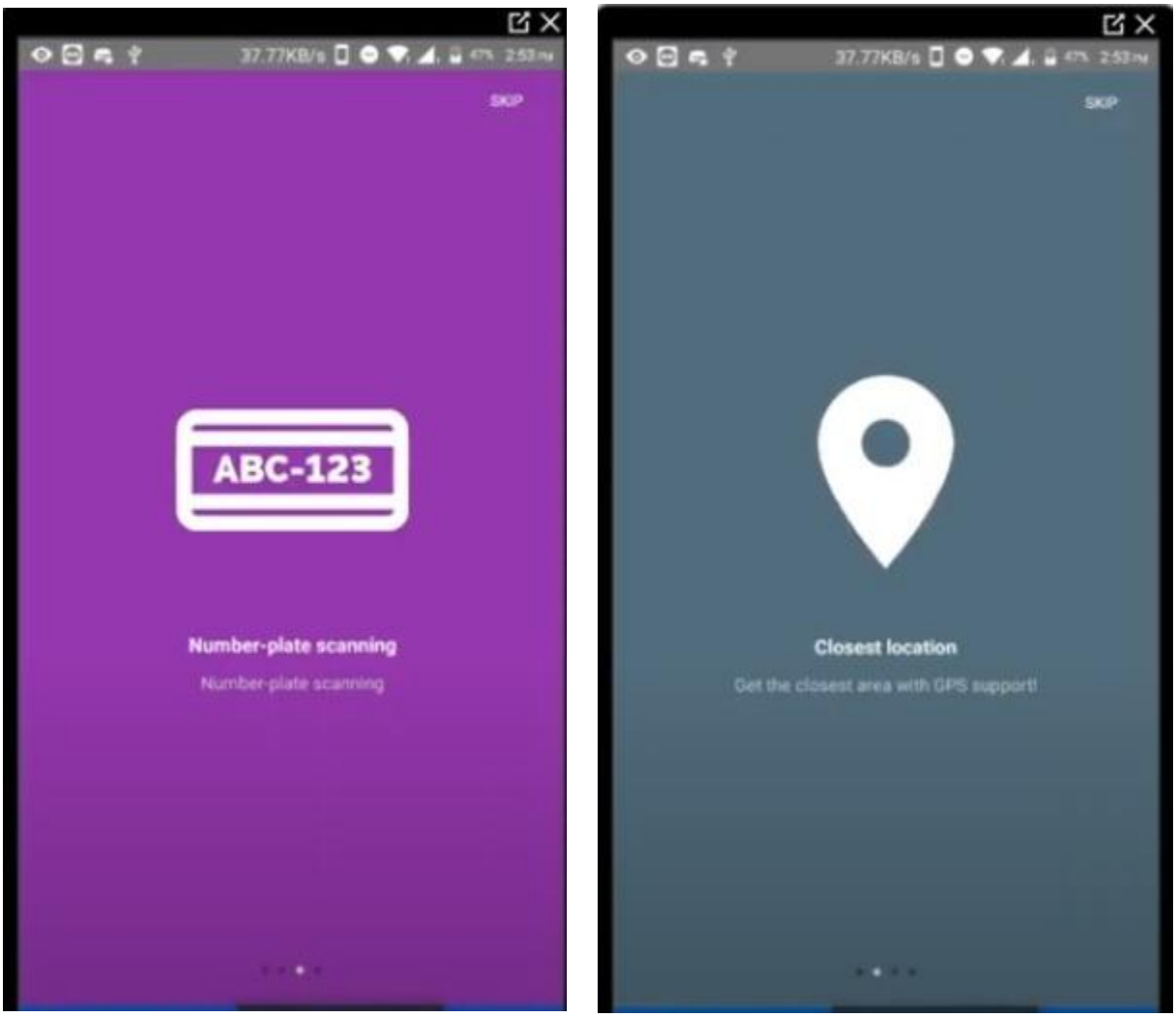

Fig- Splash Activity

CHAPTER-5

MODULE DESCRIPTION

Fig- Sign Up Module

Fig- Log in Module

CHAPTER-6

RESULT AND CONCLUSION

RESULT –

Based on our findings, the Smart Parking System Application can be used as a useful support tool, also used to conventional educational methods in the computer science field. In this android application we have provided in detail the terms and conditions for the transparency we see in our research. We believe (and the results of our sponsorship inquiries and assessments) help to improve the quality of education in the field and contribute to the solution of some of the problems in the higher education system

CHAPTER-6

RESULT AND CONCLUSION

CONCLUSION –

This project identifies a research gap in utilizing smart parking sensors, technologies and applications for open parking lots. All the existing smart parking technologies and applications are not suitable for open parking lots due to varying environmental conditions and high expenditure. As there are no immediate economic gains from providing smart parking services in an open parking lot, expenditure plays an important role in the choice of smart parking technologies. Parking guidance system which is one of the existing smart parking technology, can be used to get the count of available parking spaces in open parking lots. Machine vision is another technology which uses visual camera to acquire real time parking occupancy information on open parking lots due to its minimal expenditure. The usage of visual camera is dependent on regulations supported by the country which needs to be considered prior. However, there is no single ideal technology suitable for parking occupancy detection. Based on the type of parking lot and size, different combination of smart parking technologies and sensors can be used for efficient and financially viable parking occupancy detection. In order to further improve parking efficiency, navigational directions should be provided to a vacant parking space. Therefore, in order to address this challenge further research in the use of deep learning and multi-agent systems would help to provide real time parking occupancy information along with navigational directions to available parking space in an open parking lot.

CHAPTER-6

RESULT AND CONCLUSION

FUTURE WORK –

Current experimental approaches in the field of research to detect theft have psychological limitations and only allow for limited comparisons. Our research presents a challenge here: we present practical steps for smart car parking using Android studio. Future work could be:

• Code testing is also a separate structured format.

• Use more appropriate sensors to retrieve the frequency so that efficiency can be improved and try to reduce time.

Finding a free spot among dozens of cars in an open space is quite challenging. Parking app development products mark an empty spot, making it easy for drivers to find vacant places and park their vehicles. It can show turn-by-turn directions to the nearest car-park lots with real-time information on availability, fees, rules, and fines. Moreover, if an app has a parking reservation feature, drivers can pay and book a space in advance.

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