Smart Parking Management System

A Project Report submitted in partial fulfillment of the requirements for the award of the degree of

Bachelor of Technology

in

Computer Science and Engineering

By

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BONAFIDE CERTIFICATE

This is to certify that the project report entitled **"Smart Parking Management System"** submitted by **Pushkal Pandey** bearing the **MIS No: 112015106**, **Parth Sharma** bearing the **MIS No: 112015098**, **Pratyush Kottawar** bearing the **MIS No: 112015103**, **Shrikant More** bearing the **MIS No: 112015135**, in completion of his project work under the guidance of **Dr. Anagha Khiste** is accepted for the project report submission in partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology** in the **Department of Computer Science and Engineering**, Indian Institute of Information Technology, Pune (IIIT Pune), during the academic year **2022-23**.

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Conflict of Interest

Manuscript title: Smart Parking Management System

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Problem Statement

In many metropolitan malls the parking management problem can be viewed from various angles such as high vehicle density.

This results in annoying issues for the drivers to park their vehicles as it is very difficult to find a parking slot.

The drivers usually waste time and effort in finding parking space and end up parking their vehicles finding a space on the street which further leads to space congestion.

In the worst case, people fail to find any parking space especially during peak hours and festive season.

Objectives:

The basic objective of a smart parking solution is to identify a vehicle's presence or absence in a particular parking space

To pass on this data (Number plate data) into a system for visualization and analysis – to be available for parking asset managers and/or enforcement officers.

Keeping in mind the objectives mentioned above, the next step is to take into consideration following important features:

- Accuracy of detecting a vehicle number plate
- Total cost of solution
- Privacy concerns

The cameras installed are well known for their accuracy of detecting a vehicle presence – therefore the camera located at the entrance and exit of a parking area will count with high accuracy the entrance and exit of the vehicles, taking into consideration even two cars stopping very close to each other.

The total cost of the solution considering the initial purchasing and installation cost, you will have low maintenance cost and no need of replacing batteries or camera.

ACKNOWLEDGEMENT

This project would not have been possible without the help and cooperation of many. I would like to thank the people who helped me directly and indirectly in the completion of this project work.

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Abstract

According to the size of the vehicle, the Smart Parking Management System assigns the vehicle to the closest parking space to the entry after detecting the license plate number on the given vehicle. There are several parking systems types that have been developed, including smart parking systems that use Wireless Sensor Networks (WSN), but each of these approaches has its own benefits.

limitation. In addition, there are other issues with the present parking system, such as ineffective parking management. Consequently, it is suggested that the Smart Parking Management Systembe used to improve the effectiveness of the present parking management system. The consumer will be given the option to park close to the door thanks to this smart automated parking system. The parking is given based on the size of the vehicle that will be using the slot. Before permitting the car to enter the parking lot, the parking space is then shown on the monitor next to the boom gate. The motorist will not need to manually search the parking lot because the parking number and precise location will make it easier for them to locate a parking space quickly.

According to Dijkstra's Algorithm, the input signal from the entry camera and the hash lot matrix are processed to allocate the closest parking lot. In this project, the simulation is carried out utilizing the Dijkstra shortest path method and data collecting through machine learning. This simulation comprises finding the location of the closest parking lot and choosing the one that is the shortest. Hash lot matrix programming is used to determine the closest parking lot using Dijkstra's algorithm. In conclusion, real-time applications are possible for the Smart Parking Management System.

Keywords: Dijkstra's algorithm, Mapping matrix, Number Plate Detection, Optical Character Recognition, Deep Learning

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Chapter 1
Introduction

The conventional and existing Malaysian parking system, which was built in standard-sized parking lots, has led to wasteful use of scarce parking places. As a result, parking lots will be quickly filled and most drivers will park their cars quickly, especially in their preferred spots near to the mall entrance, without giving traffic congestion or the comfort of other drivers a second thought. In addition, the traditional parking system necessitates that the driver wait in line at the boom gate until a ticket becomes available, which only happens when a parking spot is available. Additionally, the driver must independently search the parking lot.

The "Smart Parking Management System" is proposed to ensure that these requirements can be met to be applied at parking zones and is capable of scanning, counting, displaying, assigning the closest lot, and displaying the location on the monitor at the boom gate in order to address the limited number of parking lot spaces.

When a driver arrives at the entrance gate of a parking space, a monitor at the boom screen indicates the availability of parking spaces. If parking is available, the camera will scan the license plate of the vehicle, and the driver will then receive the specified direction of the closest vacant lot to the mall entrances based on the size of the car displayed on the monitor at the boom gate.

However, once the parking lots are filled, the technology prevents the boom gate from opening until there is a parking lot available, prohibiting any drivers from entering the parking lot. As a result, the system may significantly reduce the amount of time spent looking for vacant spots and facilitate efficient parking lot circulation. As a kinesthetic mode to improve the driver's awareness of the parking lot location due to the repeal of the ticket system for encouraging the green environmentally friendly and long lines at the entrance gate, the driver must confirm the location again before the boom gate opens in the form of the parking lot number.

The designated empty lot is closed for a brief period of time to permit parking, and it reopens for the next motorist after that time has passed or no cars are parked because our data storage system, which uses a hash matrix to constantly detect occupancy, does so. For the purpose of calculating distance and showing the number of occupants on the LCD display at the boom gate, the controller will be shown the hash matrix.

Additionally, a top LED display serves as a parking lot availability indicator. Each parking lot cell on the LED display of the hash matrix will illuminate red when the parking lot is occupied and green when the parking lot is empty. Modified The closest distance between each lot and the mall entrance is determined using Dijkstra's algorithm based on first come, first serve. All parking lots that are organized according to the algorithm's distance priority order.

The primary controller will collect data input from cameras at the entry and exit to trigger the system to be

rescanned at a specific time in order to continuously update the parking status and maintain real-time synchronization of the LCD counter display for the parking lot.

Additionally, this system's machine learning integration will make it simple to gather entering and exiting data. This feature has aided the parking system operator in controlling and monitoring each parking lot's condition through an LCD counter display. The motorist and parking lot management will both profit greatly from this automated parking advice system.

1.1 Overview of Work

The system operation started when the car came to the boom gate. Then, the camera scans the number and specifies the size of the car. The size of the car and the shortest distance from the entrance to the parking lot available will determine the placement of the parking.

1.2 Motivation of the Work

Optimized parking – Users find the best spot available, saving time, resources and effort. The parking lot fills up efficiently and space can be utilized properly by commercial and corporate entities.

Reduced traffic – Traffic flow increases as fewer cars are required to drive around in search of an open parking space.

Reduced pollution – Searching for parking burns around one million barrels of oil a day. An optimal parking solution will significantly decrease driving time, thus lowering the amount of daily vehicle emissions and ultimately reducing the global environmental footprint.

Increased Safety – Parking lot employees and security guards contain real-time lot data that can help prevent parking violations and suspicious activity. License plate recognition cameras can gather pertinent footage. Also, decreased spot-searching traffic on the streets can reduce accidents caused by the distraction of searching for parking.

Decreased Management Costs – More automation and less manual activity saves on labor cost and resource exhaustion.

Enhanced User Experience – A smart parking solution will integrate the entire user experience into a unified action. Driver’s payment, spot identification, location search and time notifications all seamlessly become part of the destination arrival process.

1.3 Literature Review

Various parking systems have been introduced in the past because of the rising need for a smart parking system. To make smart parking systems effective and dependable so that individuals may quickly locate the right parking lot according to their needs, several researchers have invented and improved them. Various strategies and tactics have been used in the past with varying degrees of success.

proposed a smart parking system that would allow customers to book automobile parking while also directing them to available spots. The suggested method not only significantly reduces traffic caused by searching for parking spaces but also increases occupancy by making it simple to manage parking space, a valuable resource in big cities.[1] By lowering the carbon footprint, this method significantly lessens the detrimental effects on the environment.

An intelligent multi-agent cooperative parking system has been developed by Alkharabsheh [2]. The offered solution was mostly composed of a multi-agent strategy coupled with hardware components like IR sensor nodes to determine the condition of the parking spot and afterwards transfer the information to Arduino. The status of the sensors may be wirelessly gathered using a device known as a gateway. The system of agents will be utilized to evaluate the data gathered, and after that, it will transmit the drivers the pertinent results through the Internet in real time. Numerous problems, including the cost of gasoline, auto accidents, and traffic management, can be resolved with this technique. The findings show how successfully the suggested approach worked and how it is practical.

With the use of an ultrasonic sensor and the idea of the Internet of Things, Mendiratta et al. [3] proposed a system for the identification of automobile parking spaces. It was accomplished by posting the status of the parking space on the Internet. With the help of the IoT platform, this method uses Wi-Fi to transmit data from an ultrasonic sensor. The ultrasonic sensor in that system was having surface corrosion, which was a concern. This caused the system to act improperly.

IoT was also employed by Caballero-Gil et al. [4] to create a smart parking guidance system. A central system to estimate available indoor parking spaces and a low-cost smartphone app to gather information on expected and actual parking occupancy are included in their solution. This plan uses data from each of the two sources in a different direction so that the dispersed system, which is based on cell phones, may supply the central prediction system with data, and vice versa. The mobile application makes use of a variety of wireless technologies to provide real-time parking information to the estimating system and receive insightful parking spot proposals from the system. Their findings support the strengths of the suggested approach, including the reduction in the time and energy needed to locate a parking space.

The estimated number of empty parking spaces is considered an important parameter to reflect the difficulty in finding available parking spaces, and a queuing theory-based technique was suggested to roughly calculate the expected number of spaces, according to the Bo et al [5] algorithm .'s for smart parking regulation. For finding a parking spot that might work, another idea called MADM (multiple attributes decision making) was also put out. The results of the experiments demonstrate how effective it is to obtain parking places that are suited for the needs of the users.

According to the literature research, a variety of smart parking systems have been created to provide users with top-notch amenities. However, a Smart Parking Management System based on the guiding system for the user to identify the parking lot closest to the entrance is still not implemented, especially in a retail complex. initially we go through the robust method to find path using normal iterations which leads to wastage of time and causes inconvenience to the user then we started to optimize it at some point of time we founded that the structure of parking is very much important when it comes to find shortest path and accordingly we designed it also we can modify any parking space according to it lastly for finding shortest path to find parking for vehicle we used Dijkstra's algorithm and using heap and normal hash map to insure incoming and outgoing of vehicle Therefore, the suggested Smart Parking Management System Will provide useful guidance to the user in order to discover the closest parking lot to the closest entry and will provide more room for parking management by introducing additional parking bays in accordance with two distinct vehicle sizes.

1.4 Research Gap

Going through all the literature reviews, the most common gap is that when the parking area is open and too wide to efficiently we can design the parking space such that we can give optimized shortest path to park the vehicle. Another most important gap is what plate detection goes wrong ?, then we need to improve the machine learning model to at its best efficiency and effectiveness. These are some broad gaps that we found in overall research.

Chapter 2

Problem Statement

1) In many metropolitan malls the parking management problem can be viewed from various angles such as high vehicle density.

2) This results in annoying issues for the drivers to park their vehicles as it is very difficult to find a parking slot.

3) The drivers usually waste time and effort in finding parking space and end up parking their vehicles finding a space on the street which further leads to space congestion.

4) In the worst case, people fail to find any parking space especially during peak hours and festive season.

Locating a parking spot during peak hours in most populated areas like shopping malls, universities, exhibitions or convention centers is difficult for the drivers. The difficulty rises from not knowing where the available spots may be at that required time. Smart parking is a solution to metropolitan cities to reduce congestion, cut vehicle emission totals and save persons' time by helping them in finding a spot to park.

2.1. Research Objectives

1) The basic objective of a smart parking solution is to identify a vehicle's presence or absence in a particular parking space

2) To pass on this data (Number plate data) into a system for visualization and analysis – to be available for parking asset managers and/or enforcement officers.

Keeping in mind the objectives mentioned above, the next step is to take into consideration following important features:

- Accuracy of detecting a vehicle number plate
- Total cost of solution
- Privacy concerns

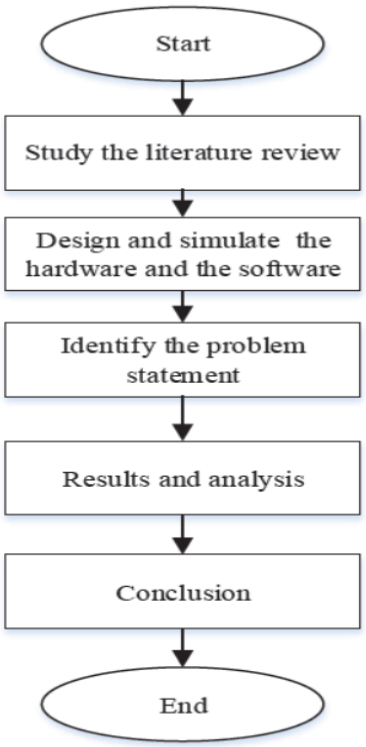
The cameras installed are well known for their accuracy of detecting a vehicle presence – therefore the camera located at the entrance and exit of a parking area will count with high accuracy the entrance and exit of the vehicles, taking into consideration even two cars stopping very close to each other.

The total cost of the solution considering the initial purchasing and installation cost, you will have low maintenance cost and no need of replacing batteries or camera.

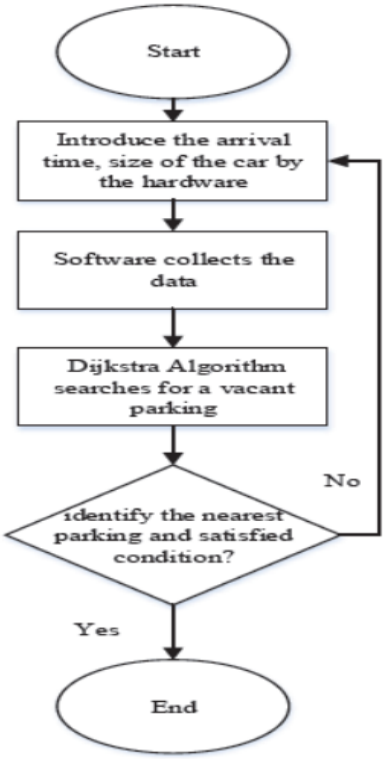
2.2. Methodology of the Work

The Smart Parking Management System is intended to efficiently organize the parking system by utilizing all of the available parking and assist the motorist in locating open parking without wasting their time or the fuel consumption of their vehicle. In addition, this parking system has classified the parking spaces based on the size of the vehicle. Software development and machine learning implementation are required to create this parking system. OCR (Optical Character Recognition) is used to construct simulation machine learning.

The suggested implementation's coverage is shown as in Fig. The design of the Smart Parking Management System begins with this project overview, which also ensures the project's success.



The proposed coverage of study



Methodology flowchart

Chapter 3

Analysis and Design

A. System Design

The Smart Parking Management System can be illustrated as in Fig. 3. The parking to the car is assigned according to the vacant parking that is nearest to the entrance boom gate.

The system operation started when the car came to the boom gate. Then, the camera scans the number and specifies the size of the car. The size of the car and the shortest distance from the entrance to the parking lot available will determine the placement of the parking.

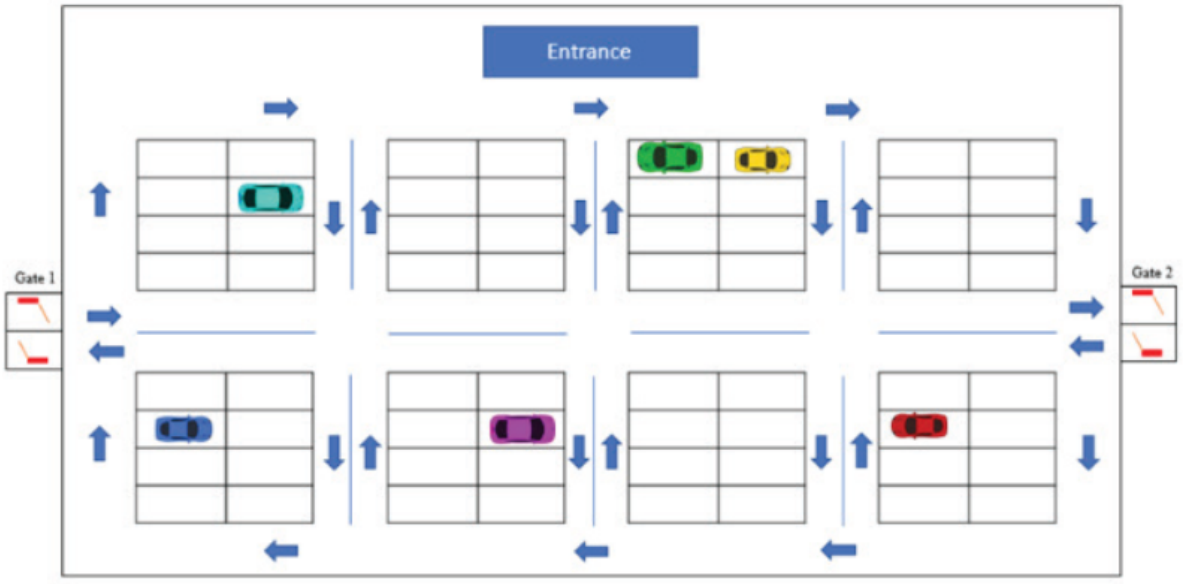


Fig 3. Floor plan of the parking system

This parking system consists of three main parts:

1) Show the availability of sizeable parking on LCD screen at boom gate (hash lot matrix)

2) If available -> scan the number plate and store in data

3) According to the size of vehicle assigned shortest path till available lot/space

4) Generate the bill at exit according to entry and exit time (total duration)

B. Dijkstra's Algorithm

Dijkstra's algorithm is an algorithm for finding the shortest paths between nodes in a graph, which may represent, for example, road networks. It was conceived by computer scientist Edsger W. Dijkstra in 1956 and published three years later [7]. The algorithm exists in many variants; Dijkstra's original variant found the shortest path between two nodes, but a more common variant fixes a single node as the source node and finds shortest paths from the source to all other nodes in the graph, producing a shortest-path tree. The Dijkstra algorithm has been implemented in the parking system. The way that has been used to determine the distance via a pathway. The algorithm used the minimum value between two points. The algorithm finds the shortest path between that node and every other [8]. It can also be used for finding the shortest paths from a single node to a single destination node by stopping the algorithm once the shortest path to the destination node has been determined.

For example, if the nodes of the graph represent cities and edge path costs represent driving distances between pairs of cities connected by a direct road, Dijkstra's algorithm can be used to find the shortest route between one city and all other cities. The algorithm can be explained and understood properly using an example. The example briefly explains each step that is taken and how distance is measured [9]-[10]. Consider the examples shown in Fig. 5.

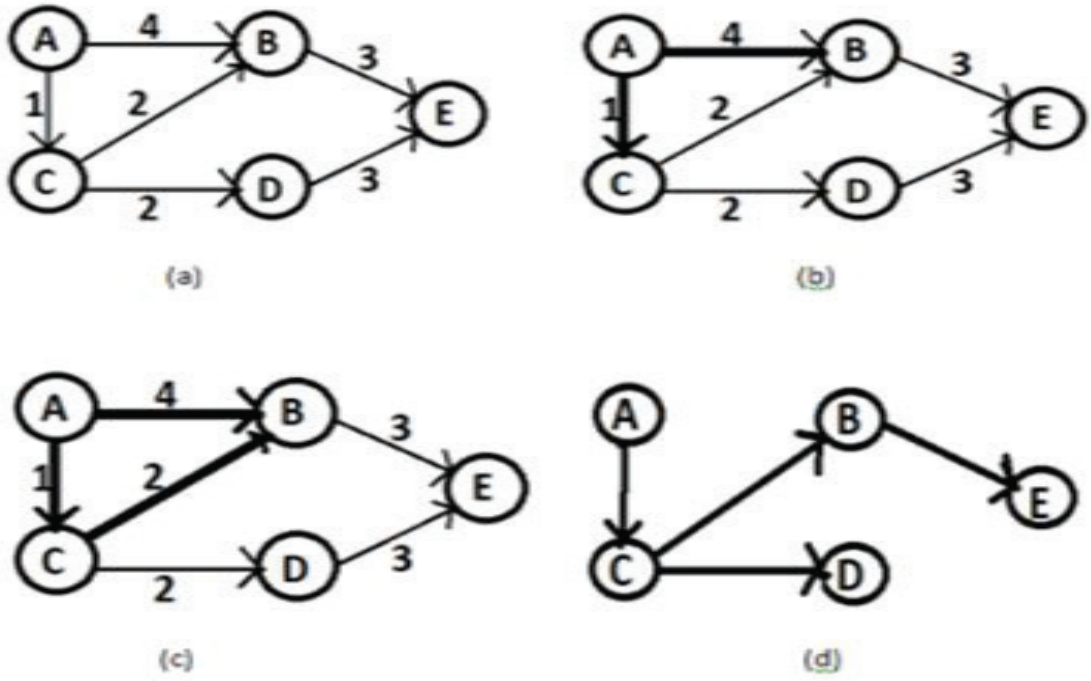


Fig.5.

(a) Weighted-Directed Graph, (b) Shortest Path to vertices B, C from A, (c) Shortest Path from B, D using C as intermediate vertex(d) The path obtained using Dijkstra's Algorithm [9]-[10]

The above-weighted graph has 5 vertices marked from A-E. Edge cost is the term used for the value between two vertices [9]-[10]. For example, the edge cost between A and B is 4. To find out the shortest path from the source A to the remaining vertices, Dijkstra's algorithm is applied to the above-shown graph. The example is solved as follows:

Step 0: sDist[A]=0; the value to the source itself

sDist[B]= inf, sDist[C]= inf, sDist[D]= inf, sDist[E]=inf ; as the nodes have not been processed till now.

Step 1: Adj[A]={B,C}; computing the value of the adjacent vertices of the graph.

sDist[B]=4; sDist[C]=1;

Step 2: Computation from vertex C Adj[C]={B,D}; sDist[B]>sDist[C]+EdgeCost[C,B] 4>1+2(True) Therefore,sDist[B]=3;sDist[D]=2;

Step 2 is clearly explained in Fig. 5(b).

Step 3: Computation from vertex B Adj[B]={E}; sDist[E]=sDist[B]+EdgeCost[B,E]=3+3=6;

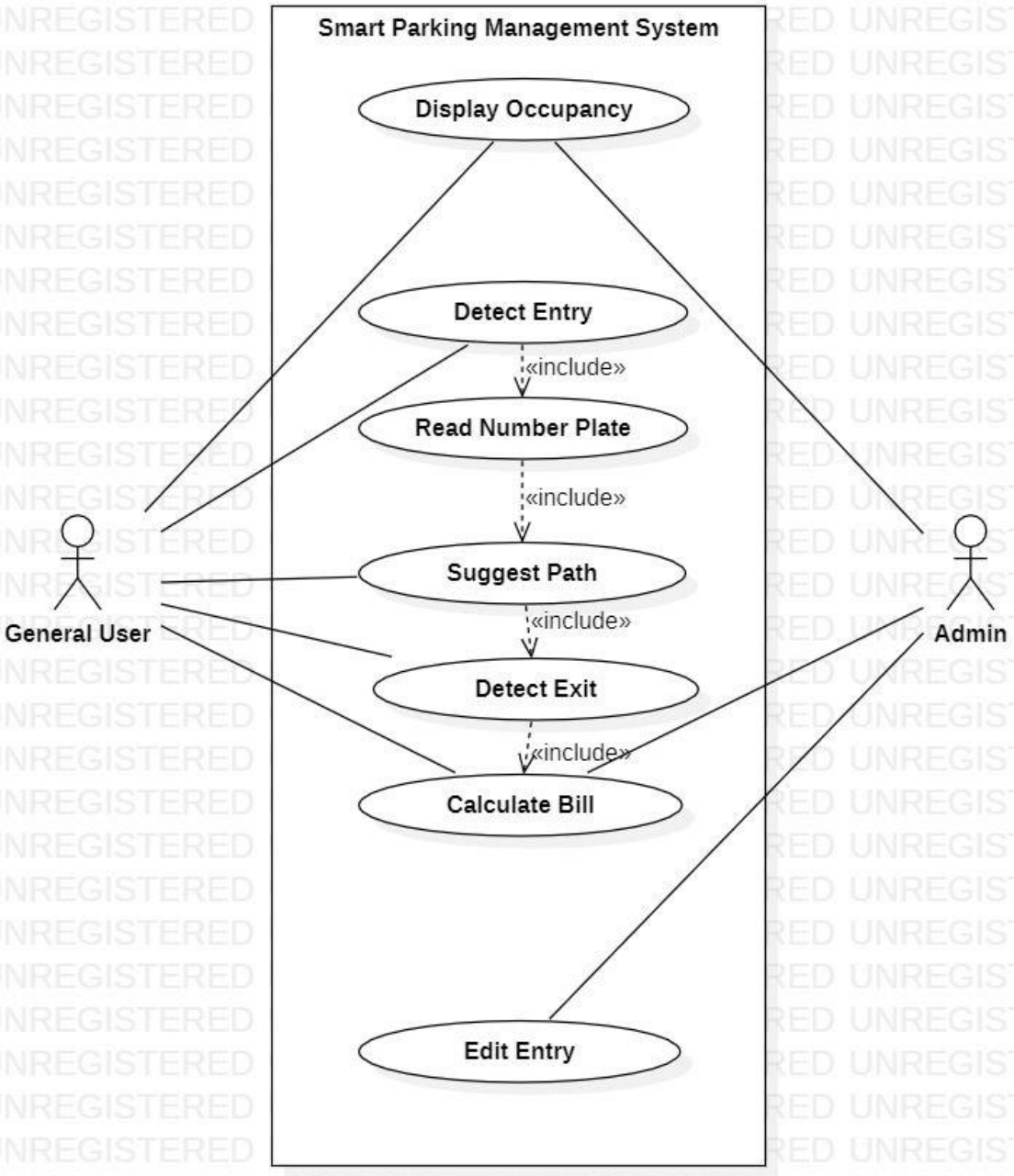
Adj[D]={E};sDist[E]=sDist[D]+EdgeCost[D,E]=3+3=6

This is the same as the initial value that was computed so sDist[E] value is not changed. See Fig. 5(c).

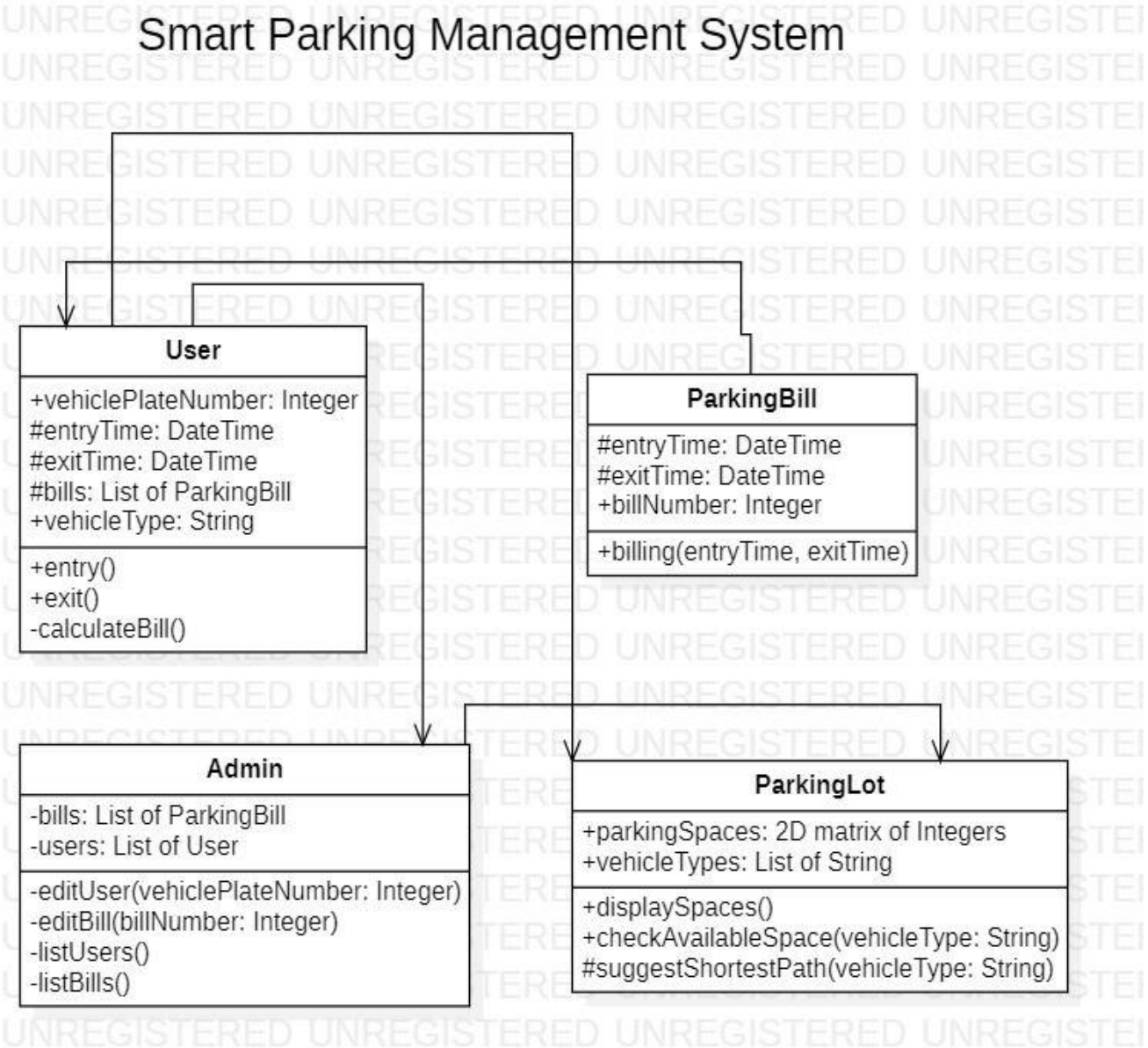
Step 4: Adj[E]=0; shows that there are no outgoing edges from E And no more vertices branching from it, algorithm terminated. Hence the path which follows the algorithm is shown in Fig. 5(d).

C. Software Design

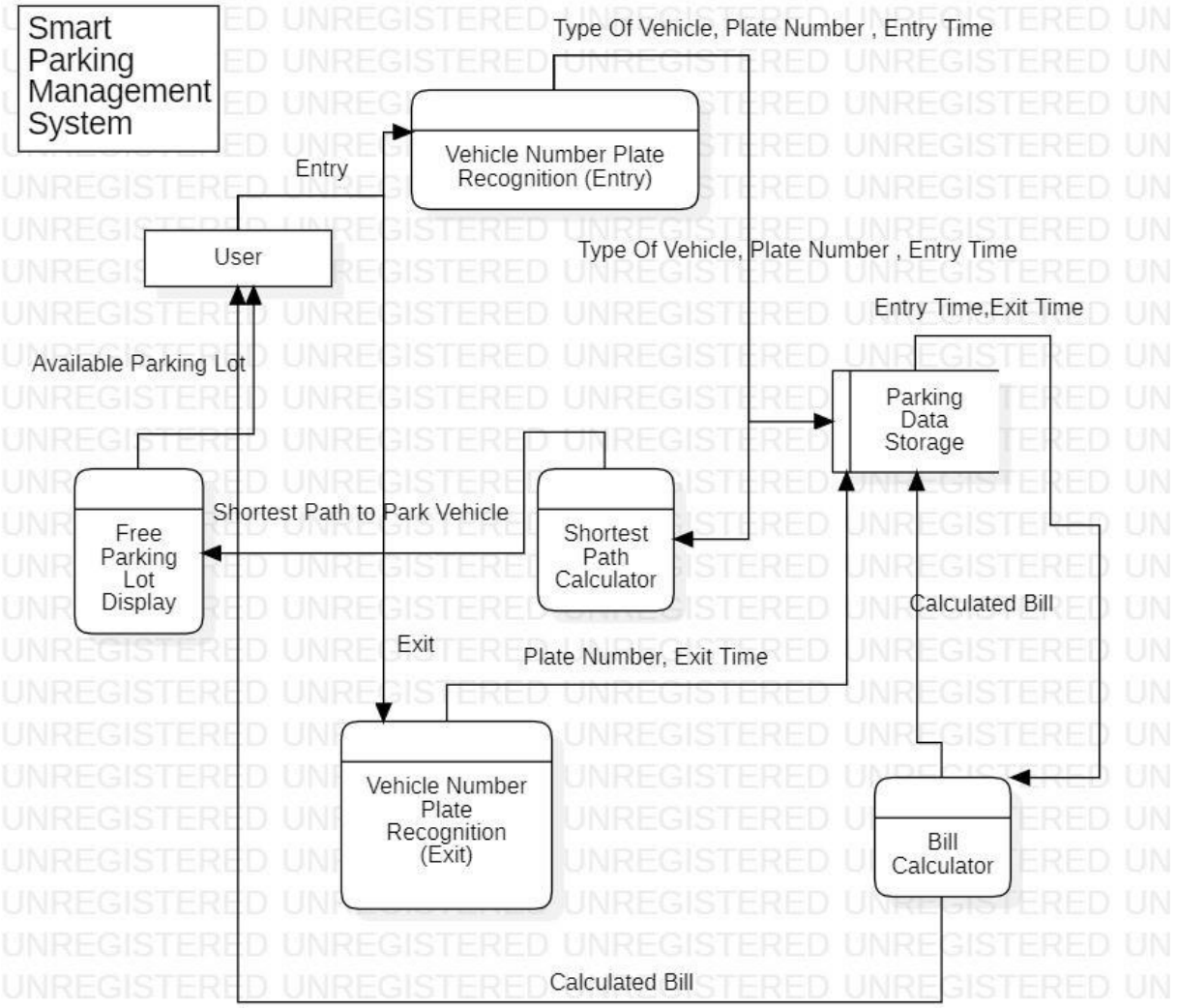
C.1 Use Case Diagram



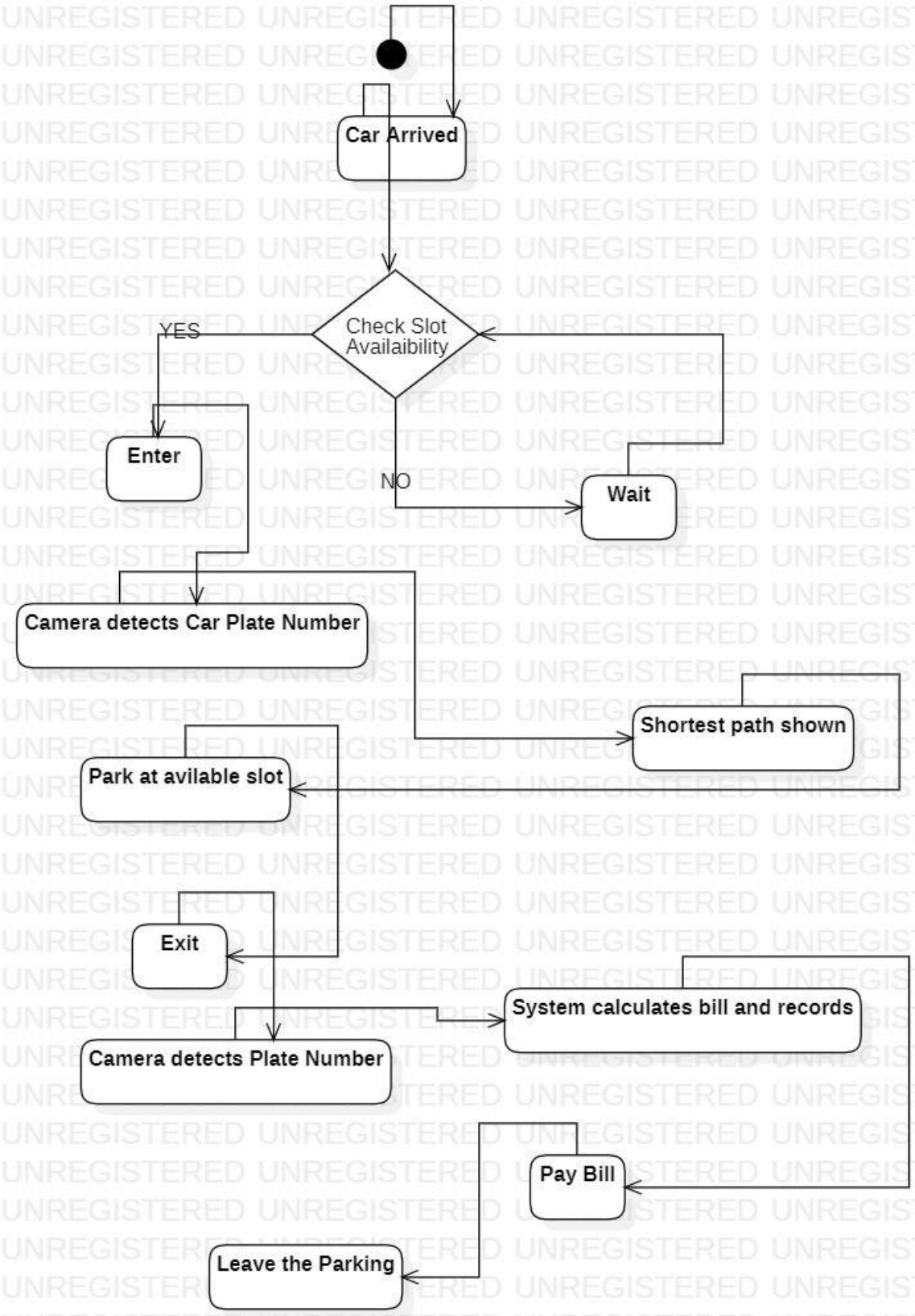
C.2 Class Diagram



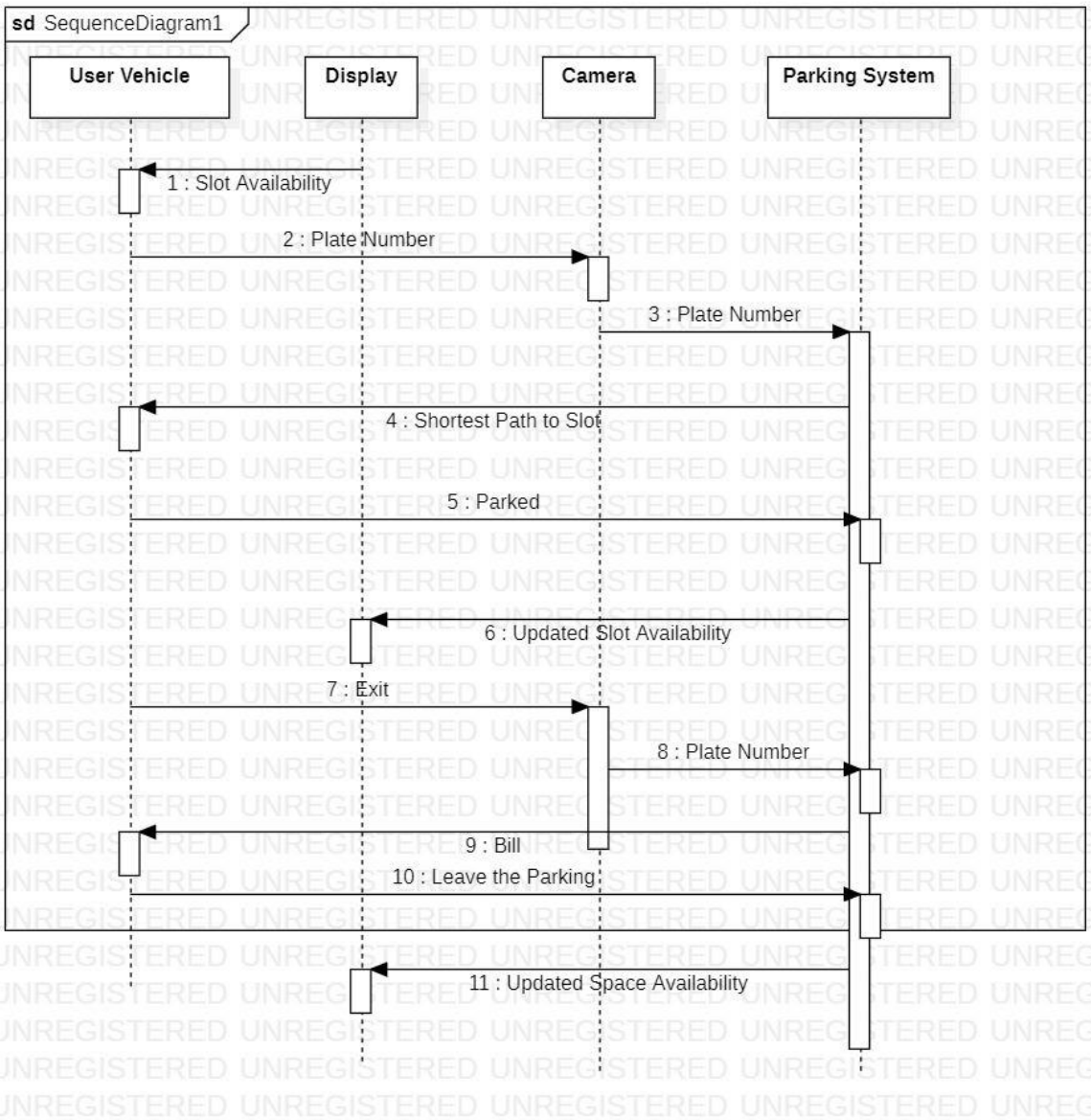
C.3 Data Flow Diagram (DFD)



C.4 Activity Diagram



C.5 Sequence Diagram

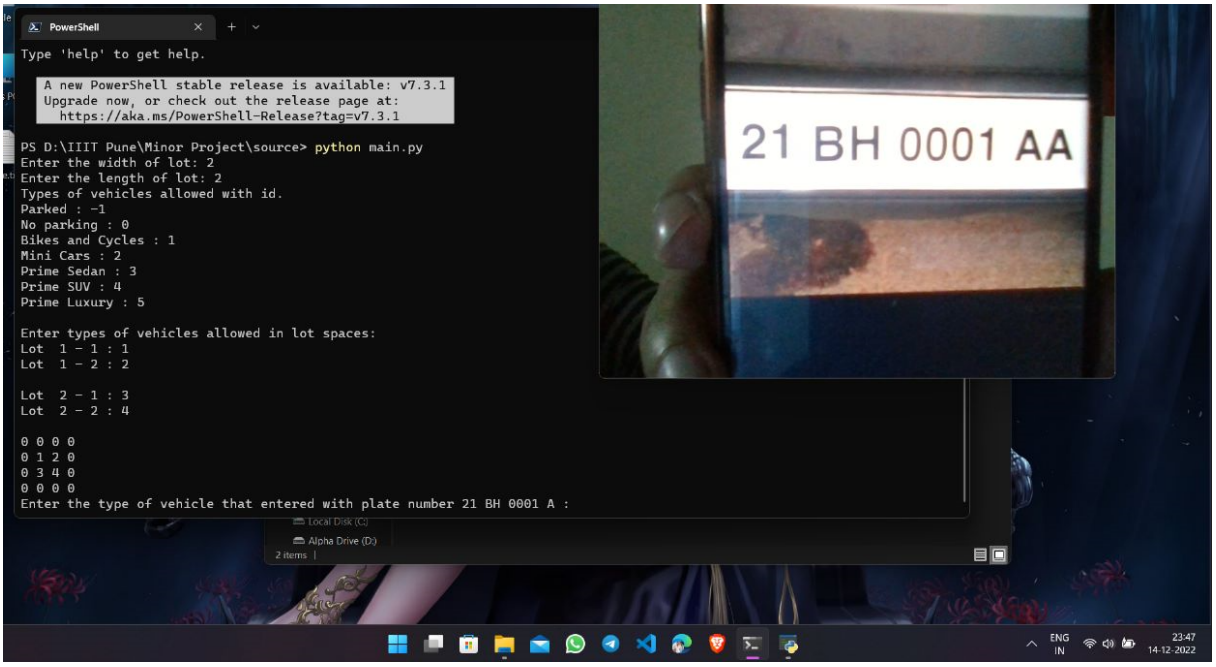


Chapter 4

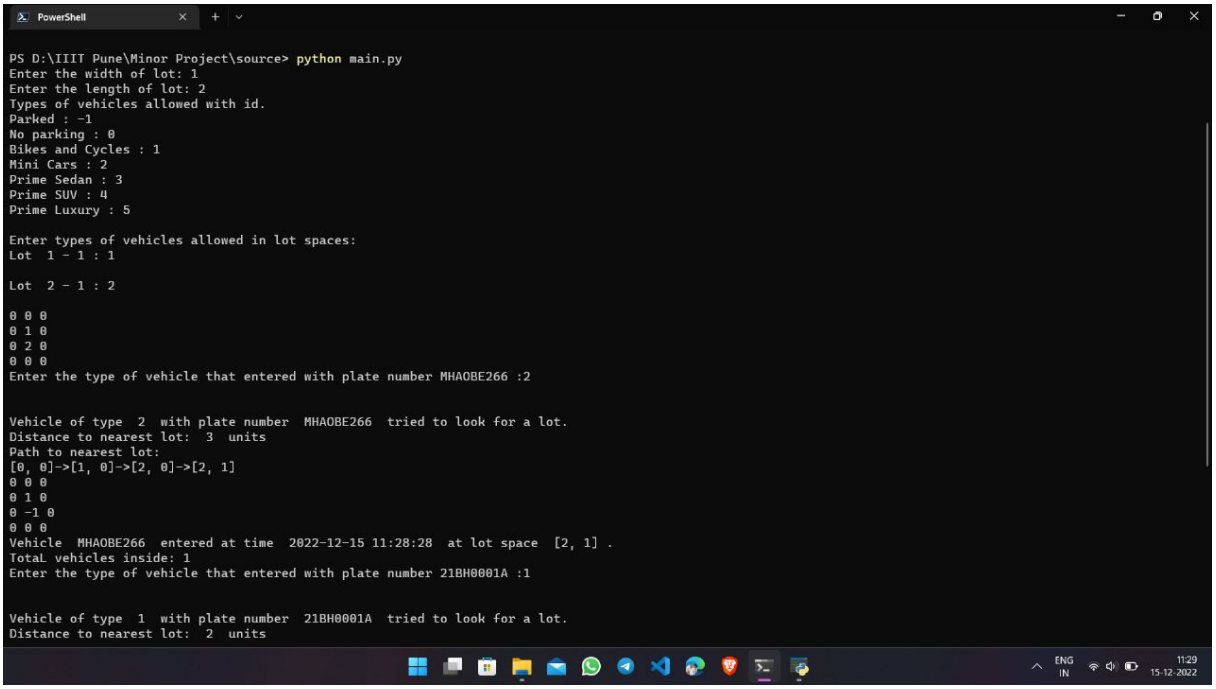
Results and Discussion

Traditional systems use loop detectors(sensors) in the entry and exit points in the tracking process of parking availability. However, the new smart parking system needs the installation of cameras individually and the system is cost effective and accuracy is pretty good.

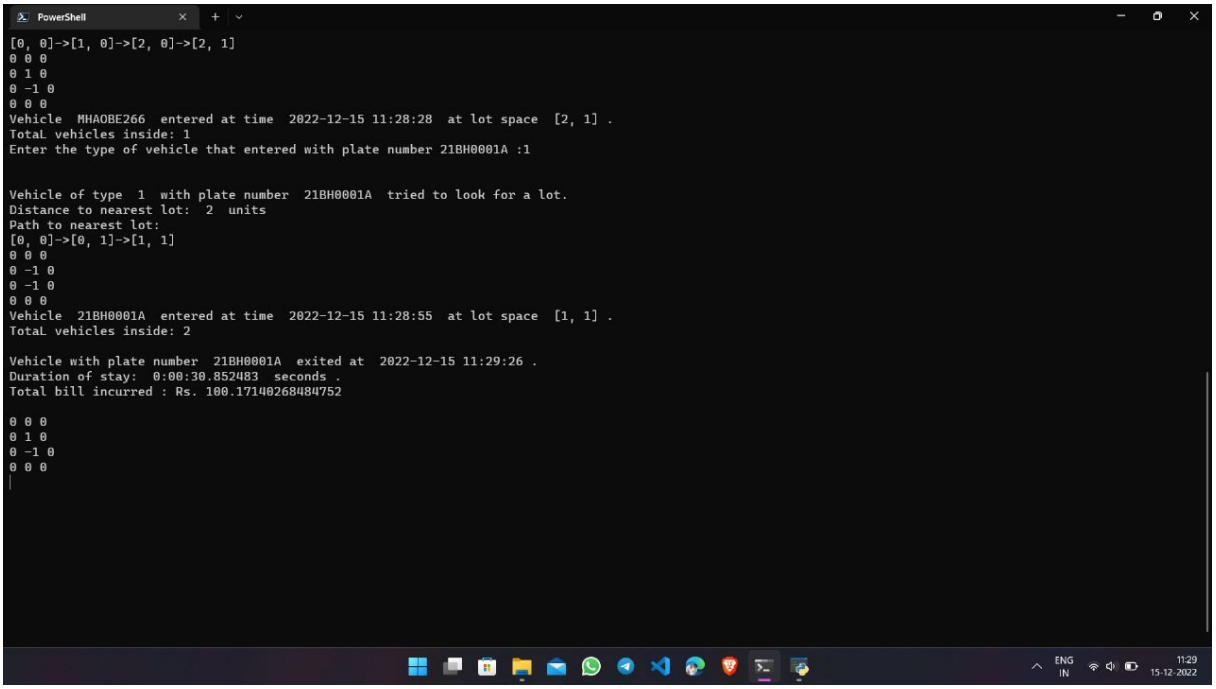
First Car Entering



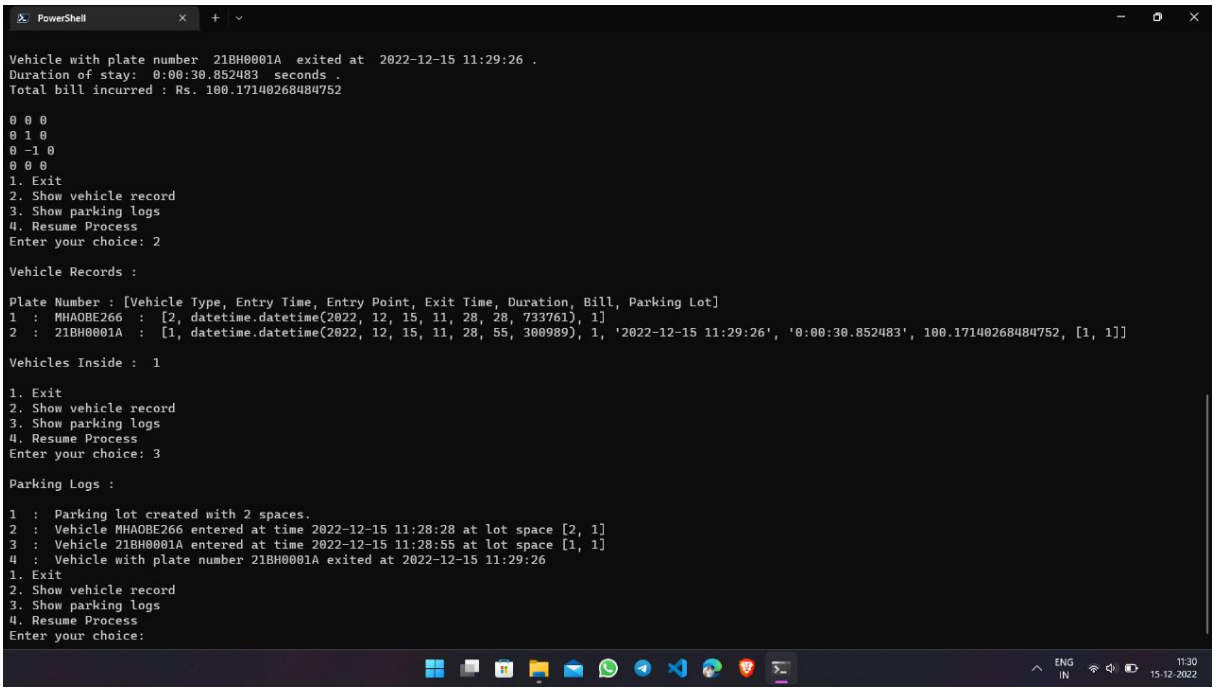
Second Car Entering



First Car Exiting



Parking History Log



Chapter 5

Conclusion and Future Scope

The Smart Parking Management System has been successfully designed and developed accordingly. Based on this system, it is proved that the system has provided a convenient parking system to the user. since the priority is to find and provide the nearest parking lot to the entrance for the user. The driver does not need to waste their time searching the vacant parking lot and he also can obtain the nearest parking to the entrance with the help of the system. It is also provided parking according to the size of the car, so that all parking can be utilized efficiently. Besides that, the Smart Parking Management System has provided the nearest parking lot to the entrance according to the Dijkstra Algorithm. Dijkstra Algorithm is the calculation method for determining the shortest distance. By applying the Dijkstra Algorithm, all the parking lots in the parking system can be utilized efficiently.
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8.1 Future work

We will host the platform on online servers to make it accessible worldwide.

Create the master and slave database structure to reduce the overload of the database queries

Implement the backup mechanism for taking backup of codebase and database on regular basis on different servers

● The future of smart parking systems is expected to be significantly influenced by the arrival of automated vehicles(AVs).

● Several cities around the world are already beginning to trial self -parking vehicles ,specialized AV parking lots and robotics parking valets.

● This project can be enhanced for tracking vehicle speed on the roads.

● Developing a smart parking solution within a city solves the pollution problem .

● Addition of Machine learning to store various other information of the vehicle like its color, design and number which would further add security.

8.2 Limitation

• Hardware fits on the vehicle.

• Driver can recognize if the parking space found is an appropriate spot to park in.

• Vehicle is less than 9 feet wide for perpendicular parking.

• There are parallel parking spots 1.2 times the length of the vehicle.

• HMI[Screen] is responsive and accurate if HMI is not responsive then the availability will not be shown.

• cameras are responsive, accurate, and aligned properly.

• Camera view is clear and aligned properly

•If Parking space of required size of full then there will be problem to allocate free space to that car

•As our system works on image processing if car is suv it will take more time as compared to compact cars

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