

CAR PARKING SYSTEM USING MACHINE LEARNING

Submitted in partial fulfilment of the requirements for
the award of

Bachelor of Engineering degree in Electronics and Communication Engineering

by

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**DEPARTMENT OF ELECTRONICS AND
ENGINEERING**

SCHOOL OF ELECTRONICS

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with Grade "A" by NAAC
JEPPIAAR NAGAR, RAJIV GANDHI SALAI
CHENNAI – 600 119

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this project report is the bonafide work of **NAGA SAI SRINIVAS GANGISETTY (Reg. No. 37130267) and NAGAVARAPU RAMA JAGADEESH(Reg. No. 37130270)** who carried out the project entitled “**CAR PARKING SYSTEM USING MACHINE LEARNING**” under my supervision from August 2020 to March 2021.

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DECLARATION

WE NAGA SAI SRINIVAS GANGISETTY (37130267) AND NAGAVARAPU RAMA JAGADEESH(37130270) hereby declare that the Project Report entitled “**CAR PARKING SYSTEM USING MACHINE LEARNING**” is done by me under the guidance of **Dr. R. NARAMADHA, M.E., Ph.D.**, Department of Electronics and Engineering at Sathyabama Institute of Science and Technology is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication Engineering.

DATE:

PLACE: CHENNAI

SIGNATURE OF THE CANDIDATE

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ABSTRACT

In recent years, the population of the world has increased, the complexity of transportation has dramatically increased. Consequently, there is mountain traffic increase in vehicle movement, the work of mountain movement of various institutions. Vehicle parking is an important issue and the need is increasing day by day. In India, we are still using a manual vehicle parking system and that is why we are struggling with the waste of time and fuel problem, when we need to park our car, we need to park our car, which requires a good amount of lighting. Another issue is the chaos that occurs when parking because there is no special system. Anyone can park anywhere that sometimes causes damage to vehicles while going out or in the parking lot. Security is also an issue. To solve these problems we are introducing a new car parking system. an approach to help drivers under smart parking finding the right parking space efficiently and book it.

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CHAPTER 1

1 INTRODUCTION

1.1 Introduction to Automated car parking system:

Over the decades our country has been developed drastically, now we are in this state that we have a lot of well-contacted roads, commercial buildings, and an increasing number of automobiles. While parking these automobiles in parking spaces we use the manual procedure of parking. Most of the cases are unplanned and lack discipline due to this, people can park their cars anywhere they want to, which creates a mess as people do not follow the particular cue most of the time. As a result of this, a huge traffic jam takes place in that place. While parking in and retrieving cars due to mismanagement cars can get dent by bumping with each other as there is a lack of sufficient space. This leads to arguments, fights among people which sometimes makes huge traffic jams. This is also an economical loss as we need to repair our damaged car and also cars consume extra fuel while parking in or out. Traffic jam is an issue here as it kills our precious time. Due to this chaos in parking, our valuable time gets wasted. It harms the students, office-going staff, and emergency patients to a great extent.



Figure 1.1 Existing Car Parking

It also causes economical loss to commercial places like shopping malls, amusement parks as people are more likely not to visit these places due to this parking hazard. As we are advancing with time, the manual car parking system in commercial spaces is creating a hurdle which is causing wastage of time and some economic losses as well. Therefore we need a solution which can overcome these problems. Here we are introducing Automated Parking Systems as a solution to these problems as well as car parking system in commercial spaces is creating

hurdle which is causing wastage of time and some economical losses as well. Therefore we need a solution which can overcome these problems. Here we are introducing Automated Car Parking Systems as a solution to these problems as well as a replacement to the manual car parking systems at commercial spaces. This system not only saves time and money, but it can also earn money by charging for parking spaces.



Figure 1.2 Automatic Car Parking System

1.2. Problems with the Traditional car parking system:

The traditional or manual car parking system is everywhere in our country but this system is full of problems.

They are:

1. We can see in many shopping malls, hospitals huge traffic jams in front of the parking. The parking guard stops the entire vehicle and gives a payment slip, this creates a traffic jam.
2. It is difficult and time-consuming to find out the parking slot which costs extra fuel and wastes time.
3. Security problem is one another problem in manual car parking, people can enter in a parking slot and there snatching, robbery can happen.
4. In manual parking system some guard needs to be appointed for the whole job, it is costly enough.

Advantages of automated vehicle system:

The advantages of automated car parking systems are:

1. Reducing traffic jam:

Automated vehicle system reduce the traffic jam because here we are using a card system for paying the money, punching the card in the payment booth and one tray will place the vehicle in the required place

2. Time-saving:

It is a time-saving system. In a manual parking system, it is too hard to find out the space for parking, it is very much time-consuming. Sometimes it causes late to meetings or other important works.

3. Safety in the parking:

Here no people can enter the parking so that there is no chance of snatching, robbery, stealing, sometimes in silent parking space peoples are being harassed. This system prevents these problems.

4. Fuel-saving:

In this system, we are using an automatic tray that will take the vehicle into the parking space and place it in the required slot. This will reduce the fuel cost. Here we do not need lighting all over the parking space. It will on the light when it moves and where is the path and it is very much electricity-saving also.

5. Operating cost saving:

Over a while, the parking charge collecting cost is reduced. There is a reduction in the man-hour required as the system does not require any human interaction for the money transaction.

Motivation and Objectives:

Motivation:

The motivation of the project is, we want to digitalize our daily life as well as our country. In many countries, this automated vehicle system is available and popular.

Objectives:

The objectives are:

1. Introducing an automatic vehicle parking system in India and get benefited from it.
2. To compare various aspects of this manual parking system with the automated parking system.
3. To find out the economic benefits of introducing an automated vehicle system.

Background of our project:

Over the decades our country has been developed drastically, now we are in this state that we have a lot of well-contacted roads, commercial buildings, and an increasing

number of automobiles. With the increasing amount of roads and highways transportation has become the backbone of our day-to-day life.

Transportation has also become the backbone of our economy for its wide usage in trade and business. So parking of these transportation or vehicles has become a matter of consideration. While parking these vehicles in parking spaces we still use the very old-fashioned manual procedure of parking. Which are maintained in an unplanned manner, without any discipline. Due to this people can park their cars anywhere they want to, which creates a mess as people don't follow any discipline most of the time. While parking in and retrieving cars due to mismanagement cars can get dent by bumping with each other as there is a lack of sufficient space. This leads to arguments, fights among people which sometimes create a traffic jam. This is also an economic loss as we need to repair our damaged car. Cars consume extra fuel while parking in or out. Due to this chaos in parking, our valuable time gets wasted. It harms the students, office-going staff, and emergency patients to a great extent. It also causes economical loss to commercial places like shopping malls, amusement parks as people are more likely not to visit these places due to this parking hazard. Automated car parking systems will provide several benefits. It will save time and fuel costs. In a manual parking system, it is too hard to find out the space for parking, it is very much time-consuming. Sometimes it causes late in meeting or other important works. It will save fuel as in this system an automatic tray will take the vehicle into the required slot. This will reduce the fuel cost of searching for parking space, parking in and out. Here we do not need lighting all over the parking space all the time. It will only have the lights on when it moves and where is the path and it is very much electricity-saving also. It provides security from

theft of the vehicle and it can earn revenue. It can introduce us to advanced digitalized systems which show us the Engineering excellence in our country.

Different Type of Automated Car Parking Systems:

There are mainly seven different types of automated car parking system:

- AGV systems
- Crane systems
- Puzzle systems
- RGC systems
- Shuttle systems
- Silo systems
- Tower systems

AGV Systems:

Automated Guided Vehicle known as AGV technology has been introduced in automated parking system most recently though AGVs has been used in automated warehousing for decades. The vehicles are parked on pallets in the parking space which are collected from the parking entrance by the AGVs driving beneath the vehicle pallet, lifting it, and then parking it in the parking space. The number of AVGs in the system is flexible and can be based on the client's requirements. Generally, AGV systems operate on solid finished concrete floors that can move in both lengthways and sideways directions along fixed paths and can rotate on the spot. This allows the vehicle pallets to be collected by an AGV from any direction and with several AGVs operating on a floor. It also allows for multiple, simultaneous parking and retrieval movements along multiple paths. To move the vehicle pallets with or without an AGV, vehicle elevators are used within the system.



Figure 1.6.1 AGV System

Crane Systems:

This system is used utilizing a single mechanism that is to simultaneously perform the horizontal and vertical movements of the vehicle to be parked or retrieved in the parking system. This mechanism allows the vehicle platform to move to and from one parking spot to another very quickly. The crane mechanism has a vertical elevator platform fitted and it moves horizontally on rails, typically located on the floor and ceiling of the parking system, where vehicles to be parked and retrieved are placed, which means that a floor-to-ceiling opening in the center of the system is required for the crane (s) to operate.



Figure 1.6.2 Crane System

This mechanism can move in line with the normal direction of a vehicle or orthogonal to it depending on the site constraints. The crane system also has two cranes running parallel to one another should the site constraints allow it, if higher throughput or redundancy is required. The system redundancy is potentially low but backup motors; switches, etc. can be installed to increase the system's redundancy as there is typically only one mechanism for the parking and retrieval of vehicles and turning devices can be fitted under the vertical elevator platform.

Puzzle Systems:

Puzzle systems offer the densest form of automated parking as it utilizes around 95% of the floor area and often used in smaller systems. A grid of pallets covers a solid floor or steel frame, and each pallet is supported by a set of rollers and belts that are driven by motors fitted to the support frames underneath each pallet location in a horizontal puzzle system. Until the pallet with the required vehicle on is maneuvered to the desired location, the rollers and belts maneuver the pallets. The frames, supported by the pallets are installed in all possible parking positions. Typically there are two fewer pallets than support frames per floor that provide the necessary free spaces to maneuver the pallets.



Figure 1.6 Puzzle Car Parking System

Puzzle systems provide flexible layout options as the system configuration is highly adaptable because a pallet can be moved in any direction. The system shape can vary greatly, such as rectangular or square, "T" shaped, "U" shaped, "H" shaped, etc. in puzzle systems scissor lifts are typically used as they allow the pallets to move on and off the lift platforms in all directions. We can also use electrical cantilevered lifts but the pallet movements on and off the lift platform are more restricted, turning the vehicles can be done in the parking module, on an elevator, or within the parking system.

RGC Systems:

Rail Guided Cart known as RGC technology operate in similar ways to AGVs except the RGCs are less complex and more robust than AGVs and therefore more cost-effective and more reliable. The RGCs park the vehicles on pallets in the parking modules which are collected from the parking modules by driving beneath the vehicle pallet, lifting it then moving it out of the parking module into the system. The number of RGCs in the system is flexible and can be based on the client's requirements.



Figure 1.6.4 RGC System

Generally, RGC systems operate on solid concrete floors and can move in both lengthways and sideways directions along small guided rails fitted to the floor. Elevators are used within the system to move the vehicle pallets with or without an RGC.

ShuttleSystems:

The shuttle systems utilize autonomous shuttles and elevators to park and retrieve vehicles. The number of shuttles in the system is flexible and is based on the client's requirements. The shuttle moves horizontally to a designated location in a shuttle lane, which is either a set of rails in a steel or concrete structure or recess in a solid floor. A vehicle is parked or retrieved at the designated location by a robot, or parallel exchanger or conveyor belts, located on the shuttle by moving the vehicle from or to the shuttle and the parking space. Generally, there is a single-row vehicle on either side of the shuttle lane but if needed more rows of vehicles can be added. The retrieval process of vehicle for the second row and onwards is slower than for the first row of the robot has a longer distance to travel to retrieve the vehicle and there may

be a vehicle parked in the front of the vehicle to be retrieved, which has to be removed before the vehicle in the second row can be retrieved. When a vehicle is required to be moved from one level of the system to another there are two options for achieving this, one option is with vehicle elevators and the other one is with shuttle elevators.



Figure 1.6.Shuttle System

A shuttle moves adjacent to a vehicle elevator and deposits the vehicle on the vehicle elevator platform when vehicle elevators are used. A shuttle collects the vehicle from the vehicle elevator when the vehicle elevator then moves the vehicle to the designated parking space. In this option shuttles remain on their assigned levels, therefore at least one shuttle is required per parking level which can make redundancy an issue if only one shuttle is used per level, so this can be costly. When shuttle elevators are used the shuttle moves with the vehicle onto a shuttle elevator located at either end of the shuttle lane. The shuttles are free to go to and from any level in the system allowing for fewer shuttles than parking levels and greater redundancy, in this option. We can say that the shuttle elevators are often the system bottlenecks and throughput is much lower than with vehicle elevators.

Silo Systems:

The silo systems are cylindrical systems with a single, centrally positioned mechanism used to park and retrieve vehicles. The central mechanism allows the vehicle platform to move to and from one parking spot to another very quickly by moving vertically and rotating simultaneously. Typically they are installed underground and are most suitable where soil conditions are particularly unfavorable.



Figure 1.6.6 Silo System

It can also be installed above ground. In silo systems typically only one vehicle can be parked or retrieved at one time. System redundancy can be an issue as there is only one mechanism for parking and retrieving vehicles.

Tower Systems:



Figure 1.6.7 Tower System

This system typically consists of a vehicle elevator with a parking space on either side of the elevator shaft. To complete a parking tower, this configuration is repeated over several levels. The vehicle elevator simply rises to one of the parking levels of the tower and deposits the vehicles sideways into a

parking space. A vehicle is retrieved in the same way. System redundancy is an issue with the tower system as there is a single mechanism to park and retrieve vehicles.

Summarization of our project:

Here we are trying to build a suitable computerized Automated Car Parking System with a manual payment system. An assessment of the existing system would be made including the operating system being made as a prototype, the efficiency of the car parking system, a problem faced during operating the prototype, etc. An in-depth analysis of the Automated Car Parking System would then be made. Various aspects of these two systems would then be compared and the benefit of introducing

the AUTOMATED CAR PARKING System would be found out in terms of saving in time, fuel, and emission reduction.

CHAPTER 2

2 Literature Survey

Billions of devices can connect through the internet of things (IoT) at any time, in any place with various applications. Searching for a free parking lot is one of the daily tasks for peoples of any country. The people waste a lot of their valuable time searching for the parking lot. The main motive of this paper is to develop a system by which peoples can access real-time data about the presence of a parking lot nearer to the user wherever they want. In this system we have used Global Positioning System (GPS) to locate the nearer parking, different sensors such as IR Sensor, RFID, GSM, etc. By developing this system we can minimize the searching time, fuel consumption and reduce the pollution.

Wireless sensor networking (WSN)[14] technology has gained momentum in recent years. Due to the wide scope and multifaceted implementation of wireless sensor networks, they have been extensively used to create intelligent systems. In this paper, we have proposed a smart car parking system using wireless sensor networks. The system allocates parking slots to a user (driver) based on availability along with efficiently utilizing the entire parking capacity. Our approach makes use of low-cost sensor nodes in each slot of the parking lot, which signals the availability of the slot. The status of availability is reflected on a mobile application called Blynk so that the user can park the car efficiently. Users can save a lot of time by not having to search for parking lots that are free and can reduce the usage of fuel to a great extent. The system also utilizes ultrasonic sensors to ensure that the vehicle has been correctly parked concerning the parking infrastructure. Furthermore, the system employs a gas sensor so that the leakage of flammable gases can be detected, which makes it safe for the users. By keeping the number of sensors low, the cost is effectively managed without compromising on reliability. Thus, our smart car parking system project is an innovative method for effectively managing the process of parking.

The difficulty of finding a car parking[4] spot has become one of the main considerations to create this paper and focusing on developing our proposed smart parking system. Other than that, the utilization of the internet of things (IoT) technology has become one of the great technology that matches a complex system with minimal use of hardware. With the implementation of IoT based on cloud computing, several smart devices, and also a smart automatic machine, the concept of smart parking system are expected to be able to provide services for car parking spot searching and car parking spot allocation through the mobile application.

The Internet of Things (IoT) [11] can connect billions of devices and services at any time in any place, with various applications. Recently, the IoT became an emerging technology. One of the most significant current research discussion topics on the IoT is smart car parking. A modern urban city has over a million cars on its roads but it does not have enough parking space. Moreover, most of the contemporary researchers propose management of the data on the cloud. However, this method may be considered an issue since the raw data is sent promptly from distributed sensors to the parking area via the cloud and then received back after it is processed. This is considered an expensive technique in terms of data transmission as well as energy cost and consumption. While the majority of proposed solutions address the problem of finding unoccupied parking spaces and ignore some other critical issues such as information about the nearest car parking and the roads traffic congestion, this paper goes beyond and proposes the alternative method. The paper proposes a smart car parking system that will assist users to solve the issue of finding a parking space and minimize the time spent searching for the nearest available car park. Besides, it provides users with road traffic congestion status. Moreover, the proposed system collects the raw data locally and extracts features by applying data filtering and fusion techniques to reduce the transmitted data over the network. After that, the transformed data is sent to the cloud for processing and evaluation by using machine learning algorithms.

The growing population [5] in metro cities is leading to huge vehicle density, the problems for car parking have become an unending question. To avoid roadside parking and associated traffic problems centralized car parking systems are established. In this paper, a centralized system is demonstrated, where the in-car driver is directed to select the closest traffic-free path to reach the parking slot identifying the free slots. Conventional parking systems do not have any intelligent monitoring arrangement; causing wastage of time to find the slot and traffic on the way to park. Conditions are worse when there are multiple lanes and multiple parking slots. Fully automated parking systems are expensive. The availability of a driver can be utilized but he/she should be directed to select a route in such a way that no traffic congestion results and parking/retrieval of car results in minimum time. The use of a semi-automated system presented in this paper can reduce human efforts.

This paper [10] aims to automate the car and the car parking as well. It discusses a project which presents a miniature model of an automated car parking system that can regulate and manage the number of cars that can be parked in a given space at any given time based on the availability of parking spot. Automated parking is a method of parking and exiting cars using sensing devices. The entering to or leaving from the parking lot is commanded by an Android-based application. We have studied some of the existing systems and it shows that most of the existing systems aren't completely automated and require a certain level of human interference or interaction in or with the system. The difference between our system and the other

existing systems is that we aim to make our system as less human dependent as possible by automating the cars as well as the entire parking lot, on the other hand, most existing systems require human personnel (or the car owner) to park the car themselves. To prove the effectiveness of the system proposed by us we have developed and presented a mathematical model which will be discussed in brief further in the paper.

Searching for a suitable parking space in a populated metropolitan city is extremely difficult for drivers[8]. Serious traffic congestion may occur due to unavailable parking space. The automatic smart parking system is an emerging field and attracted computer vision researchers to contribute to this arena of technology. In this paper, we have presented a vision-based smart parking framework to assist the drivers in efficiently finding suitable parking slots and reserve them. Initially, we have segmented the parking area into blocks using calibration. Then, classify each block to identify the car and intimate the driver about the status of parking either reserved or free. Potentially, the performance accuracy of the recommended system is higher than the state-of-the-art hardware solutions, validating the supremacy of the proposed framework.

This article presents [6] the AU Automatic Car-Parking Modeling System, hereafter referred to as the AU-CPS. The AU-CPS is a model of an automatic parking system controlled by PLC. It interacts with the user via HMI, driven by three DC motors with the use of photo-electric sensors. A crane is used to lift and take the car from an initial parking slot and from a parking slot to the exit way. The AU-CPS also shows whether parking is full or not by turning on an LED, and it uses sensors to detect the car in the slot to avoid overlapping in each slot.

This paper [4] describes an approach to overcome a situation of monitoring and managing a parking area using a vision-based automated parking system. With the rapid increase of cars, they need to find available parking space in the most efficient manner, to avoid traffic congestion in a parking area, is becoming a necessity in car park management. Current car park management is dependent on either human personnel keeping track of the available car park spaces or a sensor-based system that monitors the availability of each car park space or the overall number of available car park spaces. In both situations, the information available was only the total number of car park spaces available and not the actual location available. Also, the installation and maintenance cost of a sensor-based system is dependent on the number of sensors used in a car park. This paper shows a vision-based system that can detect and indicate the available parking spaces in a car park. The methods utilized to detect available car park spaces were based on coordinates to indicate the regions of interest and a car classifier. This paper shows that the initial work done here has an accuracy that ranges from 90% to 100% for a 4 space car park.

The work done indicated that the application of a vision-based car park management system would be able to detect and indicate the available car park spaces.

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This paper proposes[6] a smart Parking Management System supported by wireless sensor network technology that provides advanced options like remote parking observation, automated guidance, and parking reservation mechanism. This system uses IEEE 802.15.4 Wireless Sensor Network (WSN) and Internet of Things (IoT) technology. An acceptable shortest path algorithmic program (haversine formula) is employed to seek out the minimum distance between the user and every lot within the system. Thus, the waiting time of the user is reduced. RFID technology is employed in this system to avoid human intervention that minimizes the cost. The system is additionally able to collect data regarding the occupancy state of parking areas and to direct drivers to the closest vacant parking spot by using a customized software system application.

2.2 PROBLEM STATMENTS FROM SURVEY

Automated parking systems require significantly less area and volume for a given number of parking spaces than other parking options. Automated parking systems enable the more profitable use of valuable land for tenants, green space, etc., and provide property developers various options such as: minimizing the area needed for parking to maximizing the number of parking spaces or some optimum point in between the two. In our proposed system we use the Region of interest, Classification algorithm, Otsu's method to detect the free space in the parking area. This paper describes an approach to overcome a situation of monitoring and managing a parking area using a vision-based automated parking system. With the rapid increase of cars, they need to find available parking space in the most efficient manner, to avoid traffic congestion in a parking area, is becoming a necessity in car park management.

CHAPTER 3

AIM AND SCOPE OF THE PRESENT INVESTIGATION

Now a day's most of the parking areas are manually managed by human manpower and there is no automatic system to manage the parking area efficiently. There is a great analogy that when a driver enters any of the parking lots he must look for some kind of information board that tells him about the status of the parking lot that whether it is fully occupied, partly occupied, or vacant. Most of the time the drivers have to circle the parking area in search of free parking space. This kind of problem mostly occurs in cities near shopping malls, hospitals, etc., where the number of vehicles is greater as compared to the parking spaces. The process of searching the free parking space is time-consuming and also wastage of fuel. Most of the time the parking spaces remain unoccupied, however, the total occupancy is low because of bad management of the parking lot. This causes ineffective use of the parking area and also results in traffic jams and congestion near the parking lots. Searching for a suitable parking space in a populated metropolitan city is extremely difficult for drivers. Serious traffic congestion may occur due to unavailable parking space. The automatic smart parking system is an emerging field and attracted computer vision researchers to contribute to this arena of technology. The traditional or manual car parking system is everywhere in our country but this system is full of problems. They are:

1. We can see in many shopping malls, hospitals huge traffic jams in front of the parking. The parking guard stops the entire vehicle and gives a payment slip, this creates a traffic jam.
2. It is difficult and time-consuming to find out the parking slot which costs extra fuel and wastes time.
3. Security problem is one another problem in manual car parking, people can enter in a parking slot and there snatching, robbery can happen.
4. In manual parking system some guard needs to be appointed for the whole job, it is costly enough.

Drawback in the existing system

- Waste of time
- No security
- Huge traffic jam
- Waste of fuel etc

3.1 Proposed system

Automated parking systems require significantly less area and volume for a given number of parking spaces than other parking options. Automated parking systems enable the more profitable use of valuable land for tenants, green space, etc., and provide property developers various options such as: minimizing the area needed for parking to maximizing the number of parking spaces or some optimum point in between the two. In our proposed system we use the Region of interest, Classification algorithm, Otsu's method to detect the free space in the parking area. This paper describes an approach to overcome a situation of monitoring and managing a parking area using a vision-based automated parking system. With the rapid increase of cars, they need to find available parking space in the most efficient manner, to avoid traffic congestion in a parking area, is becoming a necessity in car park management. Current car park management is dependent on either human personnel keeping track of the available car park spaces or a sensor-based system that monitors the availability of each car park space or the overall number of available car park spaces. In both situations, the information available was only the total number of car park spaces available and not the actual location available. In this dynamically growing era, people are facing a new problem on the lack of sufficient parking space. Therefore an automated parking system (APS) with multiple floors is the solution for this problem. An APS is a mechanical system designed to minimize the area required for parking cars. The concept for the automated parking system is driven by two factors; (1) a need for parking spaces and a scarcity of available land. All APS take advantage of a common concept to decrease the area of parking spaces. (2) Removing the driver and passengers from the car before parking. With an APS, the car is driven up to an entry point of the APS and the driver and passengers exit the car. The car is then moved automatically (with some attendant's action required) to its parking space.

The primary benefits of automated parking systems compared to conventional multi-story cars parks are:

- Up to 70% less land area needed.
- Up to 50% smaller building volume.
- Up to 12% ROI.
- Up to 85% fewer CO2 emissions generated by driving.

Advantages:

There is a greater sense of security because patrons do not walk to and from their own space.

* It is highly feasible for extremely small sites that are unable to accommodate a conventional ramped parking structure.

* There is high parking efficiency (i.e. sf/space and cf/space).

- * There is no need for driving while looking for available space.
- * Emissions are greatly brought down and reduced.
- * The patrons wait for their car in a highly controlled environment.
- * There are fewer chances for vehicle vandalism.
- * There is a minimal staff requirement if it is used by known parkers.
- * It is possible that the retrieval time is lower than the combined driving/parking/walking time in conventional ramped parking structures.
- * There is an easier facade integration since there are no ramping floors or openings in exterior walls.

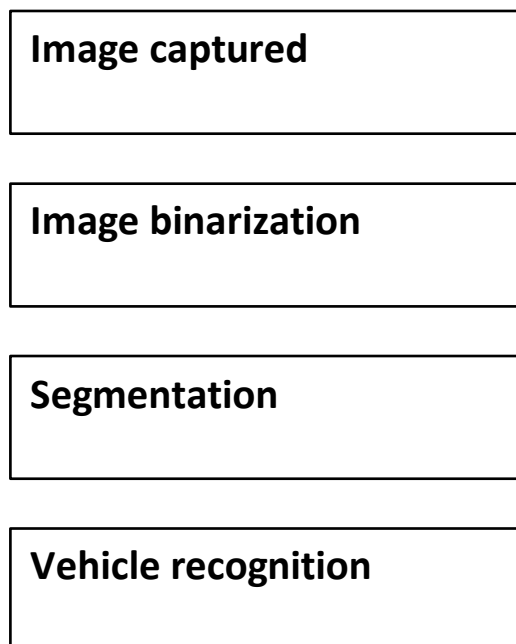
CHAPTER 4

4. ARCHITECTURE AND DISCUSSION

4.1 Algorithm

This examination tries to build up a savvy stopping framework that proficiently permits clients to find void stopping space in the briefest conceivable time and monitors the movement of the stopping space. The framework ought to have the option to record, interact, store and channel stopping movement information. The reason for the Automatic Car Parking Indicator framework is to direct the driver to an appropriate parking spot if one is accessible. The framework would just permit passage to the vehicle leave when there is space free. The framework would likewise show the measure of space accessible in the vehicle left. The vehicle leave framework will comprise a precise passage and leave point, which would permit section relies on the accessibility of spaces. The plan of the framework would likewise include the arranging of a methodical path framework permitting the ideal measure of the stopping opening to be designated to evade blockage just as the trouble in eliminating one's vehicle. Programmed Car Parking Indicator framework proposes efficient section and leaves ways to the vehicle left. A hindrance framework is executed at the passage and leave ways. The efficient section and leave ways will possibly permit passage when parking spots are accessible. There will be points of section and points of exit and a characterized way of movement for vehicles entering and leaving.

4.2 Work flow



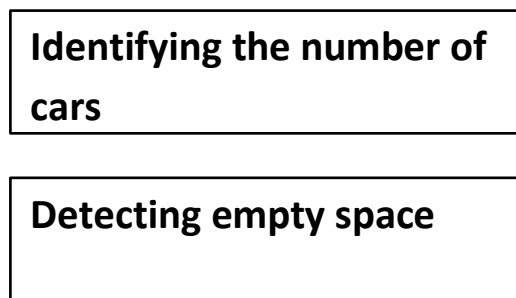


Figure 4.1 Proposed System Architecture

This framework is intended to control a stopping opening searcher to paths with an unfilled stopping space. This will be conceivable with an enormous show situated at the passage point that will be conceivable with a huge showcase situated at the section point that will advise the stopping opening searcher the number of accessible spaces. Whenever passage is permitted, paths that have void stopping opening will be shown to the client also, effectively got to. One won't need to stay and discover a stopping opening. This will likewise help one structure burning through valuable time finding a stopping opening. One's vehicle went into the parking garage, a sensor mounted in the street shows the data of bearing on the inward presentation board. This is the most valuable to the vehicle parker. When the opening is assigned, the vehicle parker leaves the vehicle into the allocated space. The camera is helpful for the specific area of the vehicle and showcases if the opening is full.

Proposed system description

Image capture:

This is a hardware-based process, which is influenced by quality and type of camera, light strength, illumination, and weather conditions. As a result, the image file is collected. The process of obtaining a digital image from a vision sensor, such as a camera. Usually, this entails a hardware interface known as a frame grabber, which captures single frames of video, converts the analog values to digital, and feeds the result into the computer memory.

Image binarization and normalization:

Binarization is the process of converting a pixel image to a binary image. Image range can be obtained in different Binarization methods. It includes global boundaries, integration methods, aerobic algorithms, and so on.

Binarization Process

In computer memory generally, all the documents are stored in the form of gray level which has a maximum of 256 different gray values from 0 to 255. Each gray value generates a different color of the grayscale palette. If some information is required from the document image, then this is required to process the action number of times. To reduce this time requirement for extracting the part of the image, a binary image is more useful.

Binarization is the method of converting any grayscale image (multi-tone image) into a black-white image (two tone image). To perform the binarization process, first, find the threshold value of the grayscale and check whether a pixel having a particular gray value or not.

If the gray value of the pixels is greater than the threshold, then those pixels are converted into white. Similarly, if the gray value of the pixels is lesser than the threshold, then those pixels are converted into black.

There are two types of binarization method is discussed below –

- i. Binarization based on Global or Single Threshold
- ii. Binarization based on Region

1. Binarization based on Global or Single Threshold: Normally, find the global threshold for the whole image and binarize the image using a single threshold. But in this single threshold method generally, the local variance of the image is lost or suppressed which may be having some important information or contents.

2. Binarization based on Region: One another method is also designed for binarization in which the threshold decide according to the region. The image is divided into several regions or windows. Each region or window calculates or decides their local threshold and then converts their region into the two-tone region with the help of their local threshold according to the Saha.

The binarization process is failed in the practical scenario because degradation may occur due to a less efficient acquisition process of the image, poor quality of the source, or non – uniform illumination over the source.

4.3 Segmentation:

Picture division is a basic interaction in PC vision. It includes partitioning a visual contribution to sections to improve on picture investigation. Fragments address items or parts of articles and contain sets of pixels.

Picture Segmentation is the cycle by which an advanced picture is divided into different subgroups (of pixels) called Image Objects, which can diminish the intricacy of the picture, and in this way examining the picture gets less difficult.

We utilize different picture division calculations to part and gathering a specific arrangement of pixels together from the picture. Thusly, we are appointing marks to pixels and the pixels with a similar name fall under a class where they have a few of the other things normal in them.

Utilizing these marks, we can indicate limits, draw lines, and separate the most required items in a picture from the remainder of the not-so-significant ones. In the underneath model, from a primary picture on the left, we attempt to get the significant segments, for example, seat, table, and so forth, and consequently every one of the seats is hued consistently. In the following tab, we have identified examples, which talk about singular articles, and thus the every one of the seats has various tones.

This is how various strategies for the division of pictures work in shifting levels of intricacy and yield various degrees of yields.

Need for Image Segmentation and Value Proposition:

The concept of partitioning, dividing, fetching, and then labeling and later using that information to train various ML models have indeed addressed numerous business problems. In this section, let's try to understand what problems are solved by Image Segmentation.

A facial recognition system implements image segmentation, identifying an employee and enabling them to mark their attendance automatically. Segmentation in Image Processing is being used in the medical industry for efficient and faster diagnosis, detecting diseases, tumors, and cell and tissue patterns from various medical imagery generated from radiography, MRI, endoscopy, thermography, ultrasonography, etc.

Satellite images are processed to identify various patterns, objects, geographical contours, soil information, etc., which can be later used for agriculture, mining, geo-sensing, etc. Image segmentation has a massive application area in robotics, like RPA, self-driving cars, etc. Security images can be processed to detect harmful objects, threats, people, and incidents. Image segmentation implementations in python, Matlab, and other languages are extensively employed for the process.

A very interesting case I stumbled upon was a show about a certain food processing factory on Television, where tomatoes on a fast-moving conveyer belt were being inspected by a computer. It was taking high-speed images from a suitably placed camera and it was passing instructions to a suction robot that was pick up rotten

ones, unripe ones, basically, damaged tomatoes, and allowing the good ones to pass on.

This is a basic, but pivotal and significant application of Image Classification, where the algorithm was able to capture only the required components from an image, and those pixels were later being classified as the good, the bad, and the ugly by the system. A rather simple-looking system was making a colossal impact on that business – eradicating human effort, human error, and increasing efficiency.

Image Segmentation is very widely implemented in Python, along with other classical languages like Matlab, C/C++, etc. More likely so, Image segmentation in python has been the most sought after skill in the data science stack.

Types of Image Segmentation

1. The Approach

Whenever one tries to take a bird's eye view of the Image Segmentation tasks, one gets to observe a crucial process that happens here – object identification. In any simple to complex application area, everything is based on object detection.

And as we discussed earlier, detection is made possible because the image segmentation algorithms try to – if we put it in layman's terms – collect similar pixels together and separate dissimilar pixels. This is done by following two approaches based on the image properties:

Similarity Detection (Region Approach)

This fundamental approach relies on detecting similar pixels in an image – based on a threshold, region growing, region spreading, and region merging. Machine learning algorithms like clustering relies on this approach of similarity detection on an unknown set of features, so does classification, which detects similarity based on a pre-defined (known) set of features.

Discontinuity Detection (Boundary Approach)

This is a stark opposite of the similarity detection approach where the algorithm rather searches for discontinuity. Image Segmentation Algorithms like Edge Detection, Point Detection, Line Detection follow this approach – where edges get detected based on various metrics of discontinuity like intensity, etc.

The Types of Techniques

Based on the two approaches, there are various forms of techniques that are applied in the design of the Image Segmentation Algorithms. These techniques are

employed based on the type of image that needs to be processed and analyzed and they can be classified into three broader categories as below:

- **Structural Segmentation Techniques**

These sets of algorithms require us to firstly, know the structural information about the image under the scanner. This can include the pixels, pixel density, distributions, histograms, color distribution, etc. Second, we need to have the structural information about the region that we are about to fetch from the image – this section deals with identifying our target area, which is highly specific to the business problem that we are trying to solve. A similarity-based approach will be followed in these sets of algorithms.

- **Stochastic Segmentation Techniques**

In this group of algorithms, the primary information that is required for them is to know the discrete pixel values of the full image, rather than pointing out the structure of the required portion of the image. This proves to be advantageous in the case of a larger group of images, where a high degree of uncertainty exists in terms of the required object within an object. ANN and Machine Learning based algorithms that use k-means etc. make use of this approach.

- **Hybrid Techniques**

As the name suggests, these algorithms for image segmentation make use of a combination of structural method and stochastic methods i.e., use both the structural information of a region as well as the discrete pixel information of the image.

Vehicle recognition:

These sections are part of the image acquisition, section localization or segmentation of no of cars, and in a different form of image conversion.

Identifying No of cars:

The number of cars in the parking area will be identified using Machine Learning algorithm.

Detecting Empty Space:

With the help of Machine learning algorithm, the empty space will be detected and identified by the user.

Algorithm

Region of interest:

In ROI Segmentation, we are selecting a specific region in the frame and providing its dimensions in the rectangle method so that it will draw the rectangle-shaped ROI on the frame.

A region of interest (often abbreviated ROI), samples within a data set identified for a particular purpose.[1] The concept of an ROI is commonly used in many application areas. For example, in medical imaging, the boundaries of a tumor may be defined on an image or in a volume, to measure its size. The endocardial border may be defined on an image, perhaps during different phases of the cardiac cycle, for example, end-systole and end-diastole, to assess cardiac function. In geographical information systems (GIS), an ROI can be taken literally as a polygonal selection from a 2D map. In computer vision and optical character recognition, the ROI defines the borders of an object under consideration. In many applications, symbolic (textual) labels are added to an ROI, to describe its content in a compact manner. Within an ROI may lie individual points of interest (POIs).

Examples of regions of interest

1D dataset: a time or frequency interval on a waveform

2D dataset: the boundaries of an object on an image

3D dataset: the contours or surfaces outlining an object (sometimes known as the Volume of Interest (VOI)) in a volume

4D dataset: the outline of an object at or during a particular time interval in a time-volume

An ROI is a form of Annotation, often associated with categorical or quantitative information (e.g., measurements like volume or mean intensity), expressed as text or in a structured form.

There are three fundamentally different means of encoding an ROI:

As an integral part of the sample data set, with a unique or masking value that may or may not be outside the normal range of normally occurring values and which tags individual data cells. As separate, purely graphic information, such as with vector or bitmap (rasterized) drawing elements, perhaps with some accompanying plain (unstructured) text in the format of the data itself.

As a separate structured semantic information (such as coded value types) with a set of spatial and/or temporal coordinates

Support Vector Machine:

Definition: Support vector machine is a representation of the training data as points in space separated into categories by a clear gap that is as wide as possible. New examples are then mapped into that same space and predicted to belong to a category based on which side of the gap they fall.

Advantages: Effective in high dimensional spaces and uses a subset of training points in the decision function so it is also memory efficient.

Disadvantages: The algorithm does not directly provide probability estimates, these are calculated using an expensive five-fold cross-validation.

Otsu's method:

OTSU method is a global adaptive binarization threshold image segmentation algorithm. This algorithm takes the maximum inter-class variance between the background and the target image as the threshold selection rule.

Create a histogram for the input image

We assume that the input image is grayscale. As for the RGB input image, it should be converted into a grayscale image first.

In Otsu thresholding, statistical data of an image is used. First, we talk about “**Histogram**”. It is a representation of the distribution of the data. And create the histogram for an input image: Very straightforward, take a look at the following example, to calculate the number of every pixel value in one image and this statistical result is the so-called histogram.

Note that the range of the pixel value is from 0 to 255. For convenience, we assume that the pixel value is not greater than 5 and the pixel value is not related to the color shown in the example.

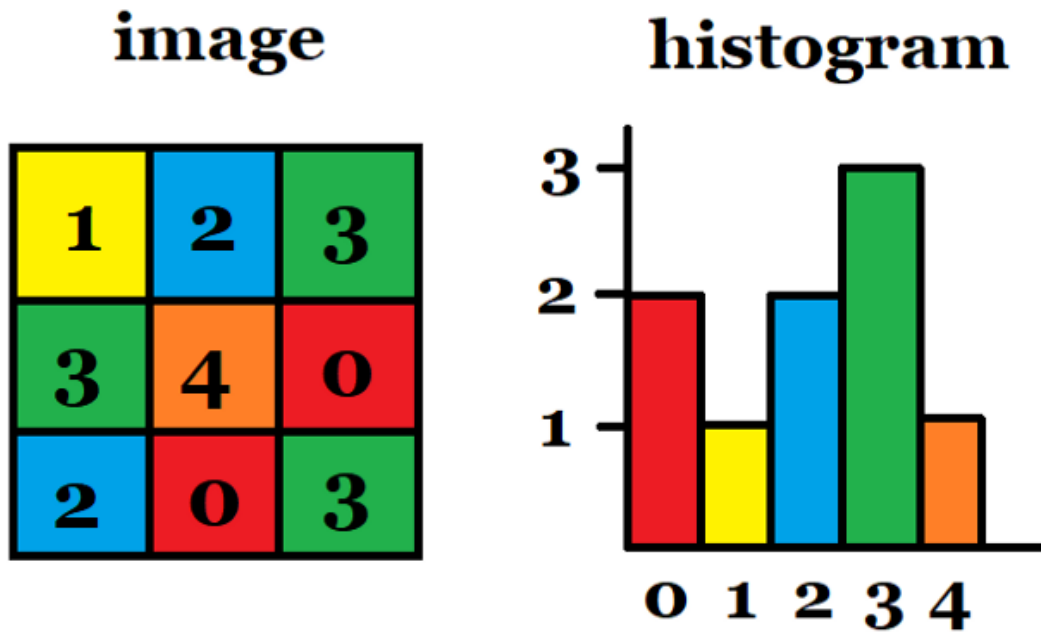


Fig 4.3.3 Histogram

Within-class variance

Use the same histogram as an example. If we choose the threshold value $T=2$, then the image is separated into two classes, which are Class 1 (pixel value ≤ 2) and Class 2 (pixel value > 2). We can say that these two classes represent the background and foreground of the input image respectively. (Class 2 can be the background if the foreground is darker than the background)

Now, let's talk about "Variance". From the following mathematical equation σ^2 , it can be explained as the distribution of the data. The higher the value of "Variance", the more dispersed the data is.

$$\sigma^2 = \frac{\sum_{i=0}^N (X_i - \mu)^2}{N}$$

In terms of the within-class variance (V_w , for short), the lower the value of V_w is, the less dispersed the data in each class is (background and foreground). As the result, to get the optimal threshold value is to find the minimal value of V_w .

Between-class variance

In the previous section, we mentioned "within-class variance". Here, we then talk about "between-class variance" (V_b , for short). V_b is the variance between two classes. And, to get the suitable threshold value is to find the maximal value of V_b . I'll provide two ways to explain.

- Way 1:

There is another technical term "total variance" (V_t , for short), which is the total variance in one image. $V_t - V_w = V_b$ because the variance is either in classes or between classes. In one image, V_t is held fixed, and V_w is minimal so that V_b should be maximal.

- Way 2:

We know that there are two classes, which are the background and foreground of the image. Consider if V_b is minimal. It means that the dispersity between the two classes is the lowest (it is not a good result). As the result, V_b should be maximal.

CHAPTER 5

5 SOFTWARE SPECIFICATION

5.1 Python:

Python is a broadly useful deciphered, intelligent, object-arranged, and undeniable-level programming language. It was made by Guido van Rossum during 1985-1990. This instructional exercise gives sufficient comprehension of the Python programming language.

Python is an undeniable level, deciphered, intelligent, and object-arranged scripting language. Python is intended to be profoundly discernible. It utilizes English catchphrases as often as possible whereas different dialects use accentuation, and it has fewer grammatical developments than different dialects.

Python is a significant level, deciphered, intelligent, and object-arranged scripting language. Python is intended to be profoundly lucid. It utilizes English watchwords now and again whereas different dialects use accentuation, and it has fewer grammatical developments than different dialects.

- Python is Interpreted – Python is prepared at runtime by the translator. You don't have to assemble your program before executing it. This is like PERL and PHP.
- Python is Interactive – We can sit at a Python incite and associate with the translator straightforwardly to compose your projects.
- Python is Object-Oriented – Python upholds an Object-Oriented style or strategy of programming that embodies code inside objects.
- Python is a Beginner's Language – Python is an extraordinary language for the fledgling level software engineers and supports the improvement of a wide scope of uses from basic content preparing to WWW programs to games.

5.2 OpenCV:

OpenCV was begun at Intel in 1999 by Gary Bradsky and the primary delivery turned out in 2000. Vadim Pisarevsky joined Gary Bradsky to affect Intel's Russian programming OpenCV group. In 2005, OpenCV was utilized on Stanley, the vehicle that won the 2005 DARPA Grand Challenge. Later its dynamic advancement proceeded under the help of Willow Garage, with Gary Bradsky and Vadim Pisarevsky driving the undertaking. At present, OpenCV upholds a ton of calculations identified with Computer Vision and Machine Learning and it is extending step by step.

As of now, OpenCV upholds a wide assortment of programming dialects like C++, Python, Java, and so on and is accessible on various stages including Windows, Linux, OS X, Android, iOS, and so on. Additionally, interfaces dependent on CUDA and OpenCL are likewise under dynamic advancement for fast GPU activities.

OpenCV-Python is the Python API of OpenCV. It joins the most desirable characteristics of OpenCV C++ API and Python language.

OpenCV-Python

Python is a comprehensively helpful programming language started by Guido van Rossum, which ended up being amazingly notable in a short period primarily because of its ease and code clarity. However, another critical part of Python is that it might be viably connected with C/C++. This component helps us with making computationally genuine codes in C/C++ and make a Python covering for it so we can use these covers as Python modules. This gives us two advantages: first, our code is just about as fast as exceptional C/C++ code (since it is the real C++ code working in the establishment), and second, it isn't hard to code in Python. This is the way OpenCV-Python works, it is a Python covering around novel C++ execution.

So OpenCV-Python is an appropriate mechanical assembly for fast prototyping of PC vision issues.

5.3 SOURCE CODE OF DETECTING THE SPACE:

```
# importing everything we need
import cv2
import csv
# declaring a static variable
class spots:
    loc = 0
# function to determine if a spot is free/occupied
# params: image source, individual spot coordinates
def drawRectangle(img, a, b, c, d):
    # cutting the image based on the coordinates
    sub_img = img[b:b + d, a:a + c]
    # extracting the edges
    edges = cv2.Canny(sub_img, lowThreshold, highThreshold)
    # counting the white pixels
    pix = cv2.countNonZero(edges)
    # testing if the pixels number is in the given range
    if pix in range(min, max):
        # drawing a green rectangle on the source image using the given coordinates
        # and increasing the number of available spots
        cv2.rectangle(img, (a, b), (a + c, b + d), (0, 255, 0), 3)
        spots.loc += 1
    else:
        # drawing a red rectangle on the source image if the pixels number is not in the
        range
        cv2.rectangle(img, (a, b), (a + c, b + d), (0, 0, 255), 3)
# empty callback function for creating tracker
```

```

def callback(foo):
    pass
# getting the spots coordinates into a list
with open('data/rois.csv', 'r', newline='') as inf:
    csvr = csv.reader(inf)
    rois = list(csvr)
# converting the values to integer
rois = [[int(float(j)) for j in i] for i in rois]
# creating the parameters window with trackbars
cv2.namedWindow('parameters')
cv2.createTrackbar('Threshold1', 'parameters', 186, 700, callback)
cv2.createTrackbar('Threshold2', 'parameters', 122, 700, callback)
cv2.createTrackbar('Min pixels', 'parameters', 100, 1500, callback)
cv2.createTrackbar('Max pixels', 'parameters', 323, 1500, callback)
# select the video source; 0 - integrated webcam; 1 - external webcam;
VIDEO_SOURCE =
'C:\\Users\\Sajith\\Documents\\smart_parking\\smart_parking\\1_27_08_19.mp4'
cap = cv2.VideoCapture(VIDEO_SOURCE)
# start the live feed
while True:
    # set the number of spots to 0
    spots.loc = 0
    # set two frames for the feed
    ret, frame = cap.read()
    ret2, frame2 = cap.read()
    # define the range of pixels and the thresholds for Canny function
    min = cv2.getTrackbarPos('Min pixels', 'parameters')
    max = cv2.getTrackbarPos('Max pixels', 'parameters')
    lowThreshold = cv2.getTrackbarPos('Threshold1', 'parameters')
    highThreshold = cv2.getTrackbarPos('Threshold2', 'parameters')
    # apply the function for every list of coordinates
    for i in range(len(rois)):
        drawRectangle(frame, rois[i][0], rois[i][1], rois[i][2], rois[i][3])
    # adding the number of available spots on the shown image
    font = cv2.FONT_HERSHEY_SIMPLEX
    cv2.putText(frame, 'Available spots: ' + str(spots.loc), (10, 30), font, 1, (0, 255, 0), 3)
    cv2.imshow('frame', frame)
    # displaying the image with Canny function applied for reference
    canny = cv2.Canny(frame2, lowThreshold, highThreshold)
    cv2.imshow('canny', canny)
    # listen for 'Q' key to stop the stream
    if cv2.waitKey(1) & 0xFF == ord('q'):
        break
# when everything is done, release the capture
cap.release()
cv2.destroyAllWindows()

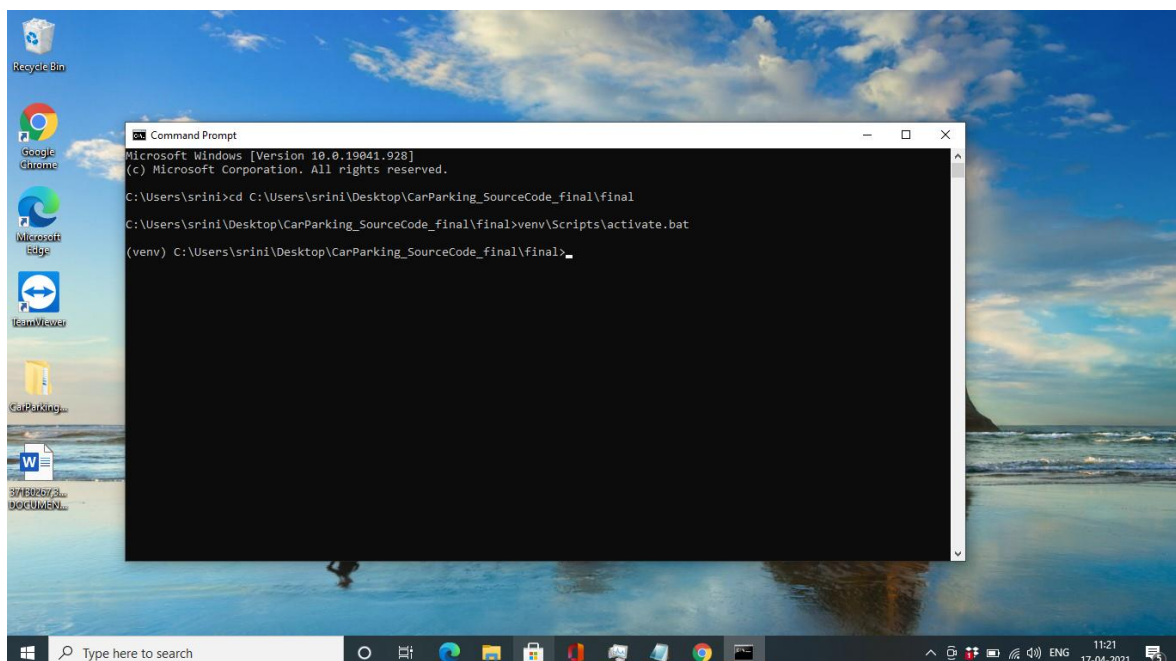
```

SOURCE CODE OF SPOT SELECTOR:

```
# importing everything we need
import cv2
import csv
# select the video source; 0 - integrated webcam; 1 - external webcam;
VIDEO_SOURCE =
'C:\Users\Sajith\Documents\smart_parking\smart_parking\1_27_08_19.mp4'
# start the recording
cap = cv2.VideoCapture(VIDEO_SOURCE)
suc, image = cap.read()
# save first frame as JPEG file
cv2.imwrite("frame0.jpg", image)
img = cv2.imread("frame0.jpg")
# get the regions of interest/parking spots
r = cv2.selectROIs('ROI Selector', img, showCrosshair=False, fromCenter=False)
# convert the result to a list
rlist = r.tolist()
print(rlist)
# write the list into a csv file
with open('data/rois.csv', 'w', newline=") as outf:
    csvw = csv.writer(outf)
    csvw.writerows(rlist)
# when everything is done, release the capture
cap.release()
cv2.destroyAllWindows()
```

RESULT:

INPUT GIVEN





CHAPTER 6

6.SUMMARY AND CONCLUSION

In this paper, the discovery of the space for vehicle leaving framework has been done shrewdly. These days, in a savvy city, the shrewd transportation framework assumes a significant part. A shrewd traffic-stopping framework deals with space for stopping to diminish the gridlock issues by utilizing AI methods. Sensors are set in various stopping territories to get data about free and consumed space utilizing profound learning calculation. It is seen that the proposed framework has the most noteworthy accuracy pace of 94.37% 91.25% and 5.63%, 8.75% during preparing and approval, separately.

6.1 Future Goals

Savvy acknowledgment of vehicles:

We can perceive the vehicles by their number plates with the assistance of picture handling in the ACP framework. By utilizing this kind of innovation clients can straightforwardly pay for their vehicle leaving utilizing cell phone's prepaid equilibrium or vehicle leaving account balance.

Refreshing Users about accessible openings and record balance:

The client can get refreshes about accessible openings of a specific parking spot and record balance by sending a basic SMS to the information base.

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