SMART PARKING USING THRESHOLDING

A PROJECT REPORT

Submitted by

SUNIL SELVENDRAN M 312321106171

SANTHOSH R 312321106152

in partial fulfilment for the award of degree

of

BACHELOR OF ENGINEERING

in

ELECTRONICS AND COMMUNICATION ENGINEERING

ST.JOSEPH'S COLLEGE OF ENGINEERING

(An AUTONOMOUS INSTITUTION)

CHENNAI 600 119

April-2024

St. JOSEPH'S COLLEGE OF ENGINEERING

CHENNAI-600119

BONAFIDE CERTIFICATE

Certified that this project report **"SMART PARKING USING THRESHOLDING"** is the bonafide work of "**SANTHOSH R (312321106152), SUNIL SELVENDRAN M(312321106171)"** who carried out the project work under my supervision.

SIGNATURE
Dr. S. RAJESH KANNAN. M.E., Ph.D

HEAD OF THE DEPARTMENT
Associate Professor
Electronics and Communication Engineering
St. Joseph's College of Engineering

SIGNATURE
Dr.P.EZHILARASI B.E., M.E., Ph.D

SUPERVISOR
Professor
Electronics and Communication Engineering
St. Joseph's College of Engineering

CERTIFICATE OF EVALUATION

COLLEGE NAME St. JOSEPH'S COLLEGE OF ENGINEERING

BRANCH ELECTRONICS AND COMMUNICATION ENGINEERING

SEMESTER VI

S. NO	Name of the students who have done the project	Title of the Project	Name of the Supervisor with Designation
1. 2.	SANTHOSH R (312321106152) SUNIL SELVENDRAN M (312321106171)	SMART PARKING USING THRESHOLDING	Dr.P.EZHILARASI M.E,Ph.D PROFESSOR

This report of project work submitted by the above students in partial fulfillment for the award of Bachelor of Engineering in Electronics and Communication Engineering degree in Anna University was evaluated and confirmed to be reports of the work doneby the above students

Submitted for UNIVERSITY VIVA VOICE Examination held on .....

INTERNAL EXAMINER **EXTERNAL EXAMINER**

ACKNOWLEDGMENT

The contentment and elation that accompany the successful completion of any work would be incomplete without mentioning the people who made it possible.

Words are inadequate in offering our sincere thanks and gratitude to our respected Chairman **Dr. B. Babu Manoharan, M.A., M.B.A., Ph.D. for** his outstanding leadership, unwavering dedication, and invaluable contributions to our organization. His vision, guidance, and commitment have been instrumental in shaping our success and driving us towards excellence.

We express our sincere gratitude to our beloved **Managing Director Mr. B. Shashi Sekar, M.Sc., (Intl. Business) and Executive Director Mrs. B. Jessie Priya, M.Com., (Commerce)** for their support and encouragement.

We also thank our beloved principal **Dr. Vaddi Seshagiri Rao, M.E, MBA, Ph.D,** for having encouraged us to do our under graduation in Electronics and Communication Engineering in this esteemed institution.

We also express our sincere thanks and most heartfelt sense of gratitude to our eminent Head of the Department, **Dr. S.Rajesh Kannan, M.E., Ph.D** for having extended his helping hand at all times.

We humbly express our profound gratitude for the invaluable guidance and expert suggestions generously shared by our supervisor,Dr**.P.Ezhilarasi, M.E.,Ph.D**

We thank all staff members of our department, our family members, and friends who have been the greatest source of support to us.

ABSTRACT

Urban parking congestion prompts the development of a smart parking system using MATLAB's image processing. The system detects and categorizes parking spaces as occupied or vacant, offering real-time availability updates via a GUI. Methodology encompasses image acquisition, preprocessing, segmentation, feature extraction, SVM classification, and GUI development. Preprocessing enhances image quality, while thresholding and edge detection segment parking spaces. Relevant features like color and texture are extracted for SVM classification. A GUI provides real-time parking availability, improving user experience. The system shows promise in accurately detecting occupancy and reducing search time, addressing challenges like lighting variations. This project demonstrates MATLAB's efficacy in parking management and user satisfaction enhancement. Future directions include algorithm refinement and real-world deployment with additional sensors.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ABBREVATIONS

CCTV: Closed Circuit Television

DA: Data Analytics

GSM: Global System for Mobile Communications

ITT: Input Tracking Technology

MATLAB: Matrix Laboratory

PMS: Parking Management system

RGB: Red Green Blue

CHAPTER 1

1.1 INTRODUCTION

Nowadays, cars has become a necessity; it is no more a luxury especially for the working people. People even purchase car on installments. When talking about metropolitan, then traffic jams have become quite common recently during large number of vehicles. Also, we cannot deny the existence of the cars in our daily life. Whenever we go out by car, we face problems to find an available parking space.

When driver enters a certain parking lot, the first thing that he does is to look for some sign which tells whether the parking lot is fully occupied, partly occupied or vacant. . He also does not know how many parking slots are there and where to find a parking division for his car. Some of the parking divisions may remain unoccupied even when the total occupancy is high. This causes ineffective use of parking divisions as well as traffics jams around the entrance of parking lot. Therefore, by offering drivers with relevant information about the parking lot while entering the parking lot becomes an important issue. When driver enters a certain parking lot, the driver takes a long time just to find an available parking space.

Counting Available Parking Space using Image Processing helps to solve the problem that the driver faces at low cost. The system uses image processing to detect the existence of the car and also provides information such as number of available parking space. The system captures image using CCTV cameras and processes the image to count the available parking space. The system basically is implement to plan, analyze, design, development and testing. The development of this system will use techniques of image processing that will be implemented in each phase of the methodology. This system gives information about the number of available parking space. It will provide benefit to all the drivers when they enter the parking lot. The system uses image processing, since the whole area in the parking lot can be observed with relatively few cameras. Other than that, the system is compact and the

cost is not high. The image of a parking lot is taken by a surveillance camera set at some height in the parking lot. MATLAB is used as software platform in this project.

1.2 PROBLEM DESCRIPTION

In response to the perennial issue of drivers circling parking lots in search of available spaces, automated car parking systems have emerged as a promising solution. These systems leverage assistive technology to offer convenience and efficiency to users, particularly through smartphone applications. By registering for the service, users gain access to valuable parking information tailored to their needs. Upon booking, users specify their destination and estimated time of arrival, allowing the system to streamline the parking process. Booking details are swiftly dispatched to the user, ensuring a seamless experience from start to finish. With automated car parking systems, the hassle of searching for parking spaces is significantly reduced, enabling drivers to navigate parking regions with ease and confidence. This innovative approach not only enhances convenience for users but also contributes to the optimization of parking resources and the alleviation of traffic congestion. As technology continues to advance, automated car parking systems promise to play an increasingly pivotal role in modern transportation infrastructure, revolutionizing the way we park and travel.

1.2 OBJECTIVE

- ✓ Identify the widespread issue of parking congestion in urban settings. Highlight the negative impacts, including time wastage, increased fuel usage, and environmental harm.
- ✓ Propose the adoption of smart parking systems as a remedy for these issues.
- ✓ Outline the aim of the mini project: to devise and implement a smart

parking system employing MATLAB's image processing capabilities.

- ✓ Emphasize the goal of creating a system proficient in discerning occupied and vacant parking spaces.

1.4 EXISTING SYSTEM

- Camera-Based Systems,
- Mobile Applications,
- Data Analytics and Optimization.

1.5 PROPOSED SYSTEM

Image Acquisition and Preprocessing:

Capture images of the parking lot using cameras positioned strategically. Apply preprocessing techniques to enhance image quality and reduce noise.Parking Space Detection: Utilize image segmentation algorithms to identify and isolate parking spaces. Extract relevant features such as color, texture, and shape to characterize each parking space.

Occupancy Classification:

Employ machine learning algorithms, particularly support vector machines (SVM), to classify parking spaces as occupied or vacant based on extracted features.

Graphical User Interface (GUI) Development:

Develop a GUI to display real-time parking availability information to users. Provide a visual representation of the parking lot layout with color-coded indications of available and occupied parking spaces.

Real-Time Updates and User Interaction:

Continuously monitor the parking lot and provide real-time updates on parking space availability through GUI. Allow users to interact with the GUI to search for available parking spaces, reserve spots, and receive instructions to the nearest vacant space.

1.6 ORGANIZATION OF THE REPORT

The proposed work is divided into various chapters as mentioned below:

Chapter 1 is the introduction that explains the objective and scope of the proposed system. Chapter 2 is the literature survey that elaborates on the research works on the existing system and their issues. It also proposes a new system which makes an attempt on improving the existing system. Chapter 3 describes the system design and the roles played by various modules and gives details about the modulesdescription. Chapter 4 provides the conclusion and timeline chart for PHASE II which summarizes the efforts undertaken in the proposed system and states the findings and various shortcomings in the proposed system.

CHAPTER 2
LITERATURE REVIEW

[1] Y. Bengio "Learning deep architectures for AI". in IEEE Transactions on Pattern Analysis and Machine Intelligence,

In this project, we propose a method for the recognition of car parking occupancy based on Deep Learning. Deep Learning (DL) is a branch of Artificial Intelligence that aims at developing methods that allow computers to learn complex perception tasks, such as seeing and hearing, at human level of accuracy. It gives approximate to human level accuracy in image classification, object detection, speech recognition, natural language processing, vehicle and pedestrian detection, and more.

[2] N. Dan "Parking management system and method".in Google patents on 2003

Lately, several methods relying on to determine video cameras have been planned to observe the occupancy of parking lots. But, in spite of these fine efforts, empty parking space recognition using only visual information is yet an open challenge. Most of these methods rely on particular visual techniques personalized to the particular scenario, and absence of simplification when applied to various parking lots. In this paper, we provide a allocated, operative, competent and mountable solution for real-time parking occupancy recognition, based on deep Convolution Neural Networks (CNN).

[3] R. Girshick, J. Donahue, T. Darrell, and J. Malik "Rich feature hierarchies for accurate object detection and semantic segmentation".

A Deep Learning methodology mostly operative for vision tasks exploit Convolution Neural Networks (CNN). A CNN is comprised of a feasibly huge hidden layers, each of which performs mathematical calculations on the input and gives an output that is given in input to the succeeding layer

[4] S. Toklu &H. Canli" Deep Learning-Based Mobile Application Design for Smart Parking".

A new mobile smart parking app was created using deep learning and cloud tech to tackle urban parking challenges. It employs LSTM networks to predict space availability, accessible in real-time on mobile devices. Tested extensively with Istanbul's data, it outperformed Support Vector Machine, Random Forest, and ARIMA, confirming its accuracy. This innovation optimizes energy and time usage, reducing environmental impact and parking stress.

[5] Muhamed Alarbi &Anwar Haque&Abdelkareem Jaradat "Smart Cooperative Parking Environment"

SCOPE is a cooperative system addressing urban parking shortages, utilizing a distributed architecture and interaction model. It optimizes traffic and communication among facilities through an overlay network and hierarchical nodes. By integrating a sharing economy model, it maximizes resource use and benefits private parking owners economically. Evaluation results demonstrate notable reductions in search time, traffic, cost, and pollution, improving driver satisfaction. SCOPE offers a holistic solution for smart parking, enhancing efficiency, sustainability, and economic viability in cities.

[6] JIAZAO LIN & SHI-YONG CHEN & CHIH-YUNG CHANG & GUILIN CHEN" Smart Parking Algorithm Based on Driver Behavior and Parking Traffic Predictions"

SPA is a smart parking allocation algorithm prioritizing benefits and service quality. It predicts driver behavior and parking traffic from historical data to efficiently allocate resources. Using worst-fit, best-fit, and behavior forecast policies, SPA outperforms in parking rate and service quality. Its predictive analytics-based grid allocation enhances overall benefits for parking lots. SPA presents a promising solution for boosting smart parking systems' efficiency and effectiveness**.**

CHAPTER 3

SYSTEM DESIGN

3.1 ALGORITHM OF THE PROPOSED SYSTEM

1. **Image Preprocessing**:
    1. Convert the input image and background image to grayscale.
    2. Compute the size (height and width) of the input image.
2. **Foreground Detection**:
    1. Compute the absolute difference between the input image and the background image.
    2. Threshold the absolute difference to identify foreground objects (cars).
3. **Image Enhancement**:
    1. Adjust the intensity values of the foreground-detected image.
    2. Apply Gaussian noise to the adjusted image.
    3. Filter the noisy image using a Weiner filter.
    4. Convert the filtered image to binary using a threshold.
    5. Fill holes in the binary image.
    6. Remove small objects (noise) from the binary image.
    7. Label connected components in the binary image.
4. **Counting Cars**:
    1. Utilize region properties to measure properties of connected components (blobs).
    2. Count the number of cars present in the parking area.
5. **Lane Division and Analysis**:
    1. If there are vacant parking spaces:
        1. Divide the parking area into lanes (six lanes in this case).

2. For each lane, repeat steps 3 and 4 to detect cars and count vacant spaces.
3. If a lane has vacant spaces, display information about that lane.
4. Exit the loop if a lane with vacant spaces is found.

6. **Output**:
    1. If there are vacant spaces, output the lane number with available space.
    2. Display the total number of cars and vacant spaces in the parking area.
    3. Visualize the results using plots and images.
7. **Exit Condition**:
    1. If there are no vacant spaces in any lane, indicate that the parking area is full and exit

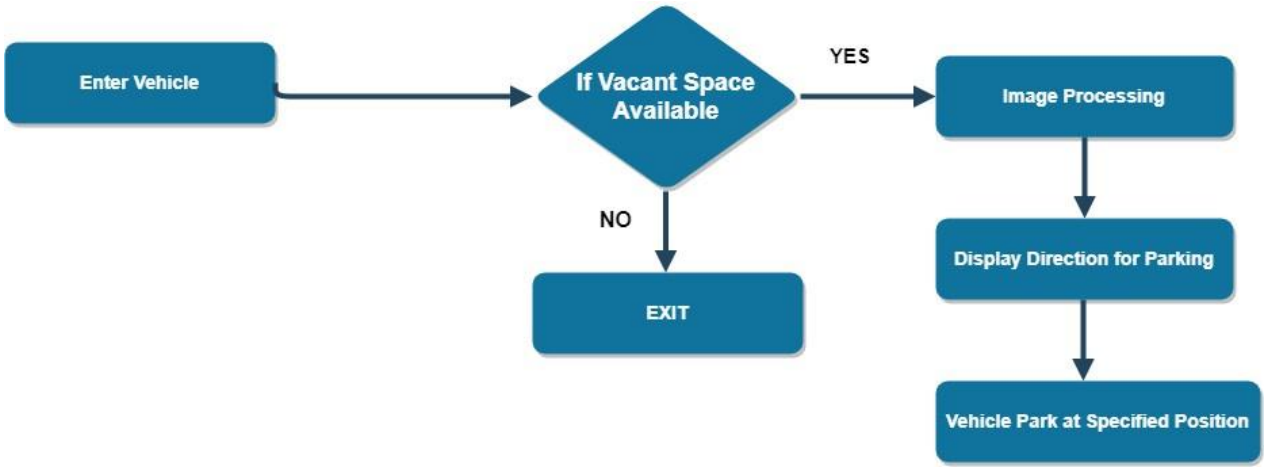


Fig 3.1 Activity diagram for the system

3.2 SYSTEM FLOW DIAGRAM

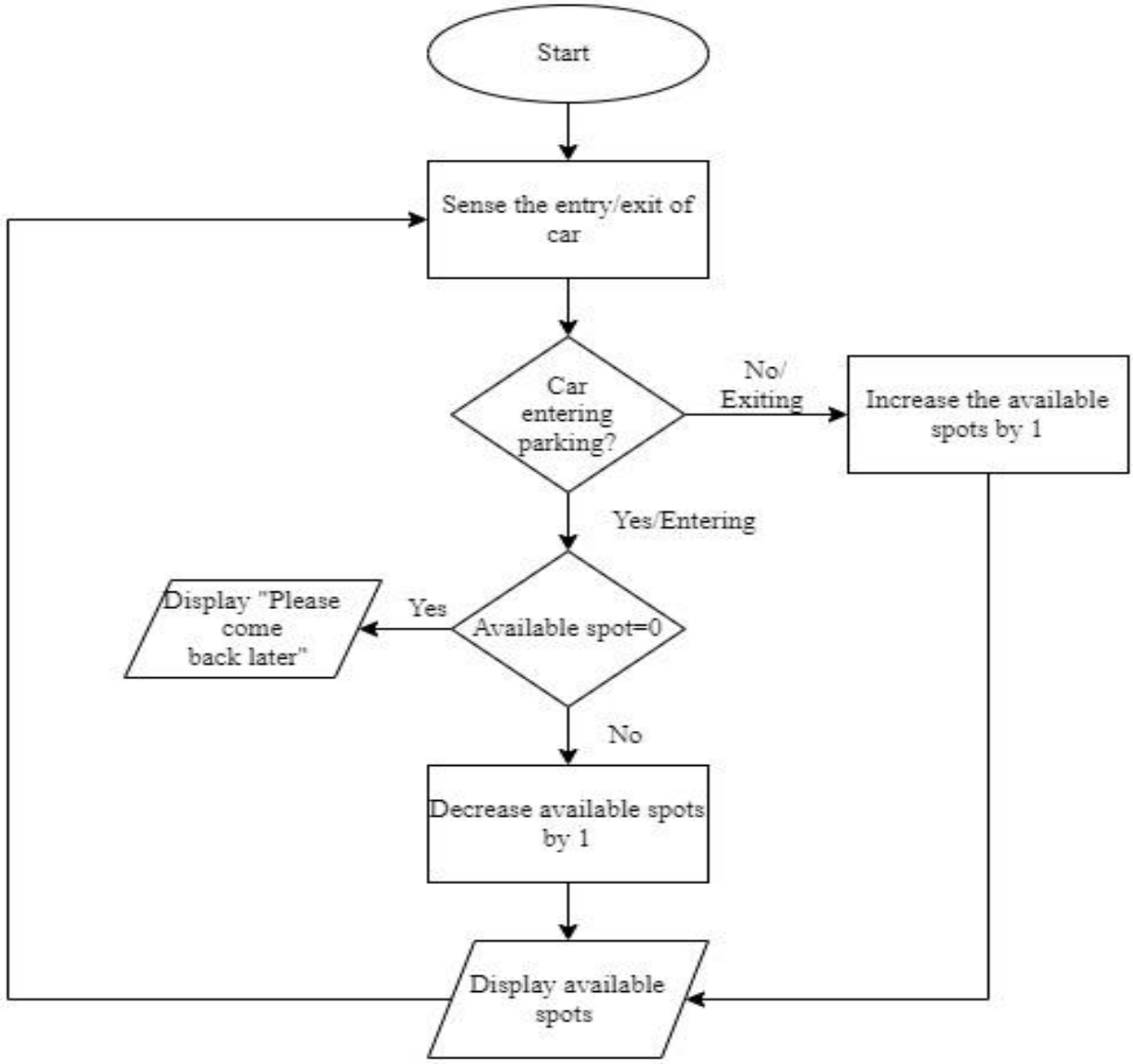


Fig 3.2 Flow diagram of the system

3.3 COMPONENT

In MATLAB image processing projects, you typically need several components, including software tools and toolboxes. Here's a list of some essential components with their latest versions as of my last update:

1. **MATLAB Software**: The latest version of MATLAB as of my last update is MATLAB R2021b.

2. **Image Processing Toolbox**: This toolbox provides a comprehensive set of algorithms and tools for image processing, analysis, visualization, and algorithm development. The latest version of the Image Processing Toolbox is included with MATLAB R2021b.

3.3 METHODOLOGIES

The main flow of the framework is shown in the Fig-3.3. Videos are acquired from the top view of the parking arena with the help of a fixed camera. Video is segmented into frames. Then from each segment a key frame is extracted and further processing is applied on this key frame, to reduce the computational complexity.

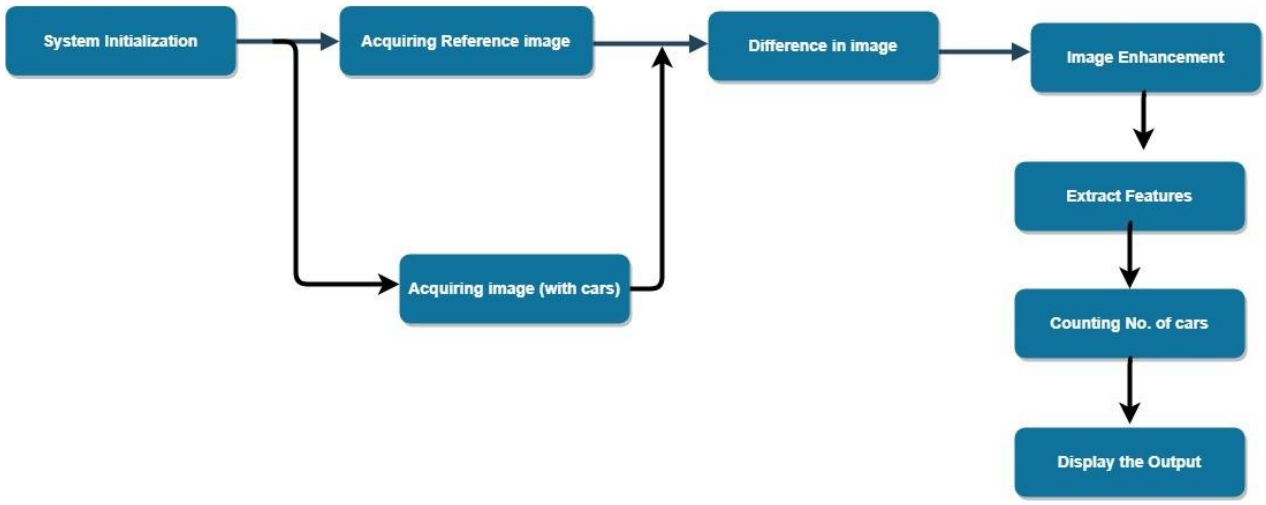


Fig 3.3 main flow of the framework

3.3.1 SYSTEM INITIALIZATION

This reference image does not contain any cars. The main purpose is to identify the parking slots in the image. The camera which is used to take the images is fixed at a certain position and it faces a fixed direction all the time.

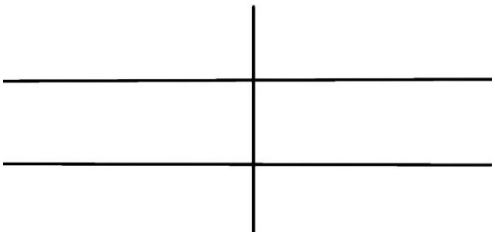


Fig 3.4 background image

3.3.2 IMAGE ACQUISITION

In this step, the picture of parking space containing cars is taken with the help of a high-definition camera.

The image frame containing six lane image is divided lane-wise.

The image data is then supplied to the MATLAB software for further processing.

Fig 3.5 occupied parking spot

3.3.3 THRESHOLDING OF IMAGE

The RGB image acquired is then converted to gray-scale image and then binary image is created in the Image segmentation module. The equation used for the conversion to gray-scale image is **Gray= 0.229R+0.587G+0.11B**. The gray scale image of the parking space with cars. From the resulting gray-scale image, binary image is obtained using thresholding technique. The binary image contains all the information about the position and shape of interest. The threshold level is set in such a way that the objects of interest are made into white and the rest of the image black.

3.3.4 IMAGE ENHANCEMENT

The binary image contains a lot of noise which is removed using morphological operations and filters such as the Weiner filter. The holes are removed with the help of imfill and bwareaopen function.

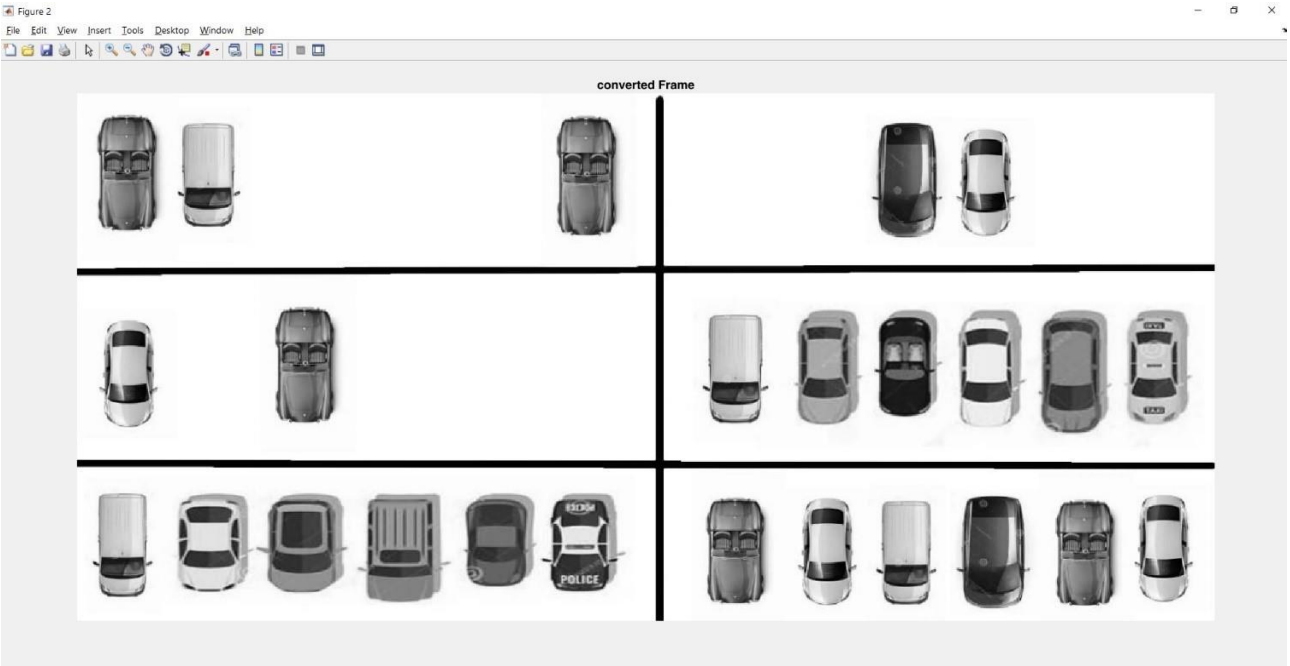


Figure 3.6 Image enhancement

3.3.5 IMAGE DETECTION

In order to detect the cars, blob analysis is done using predefined functions in MATLAB and the number of cars is counted.

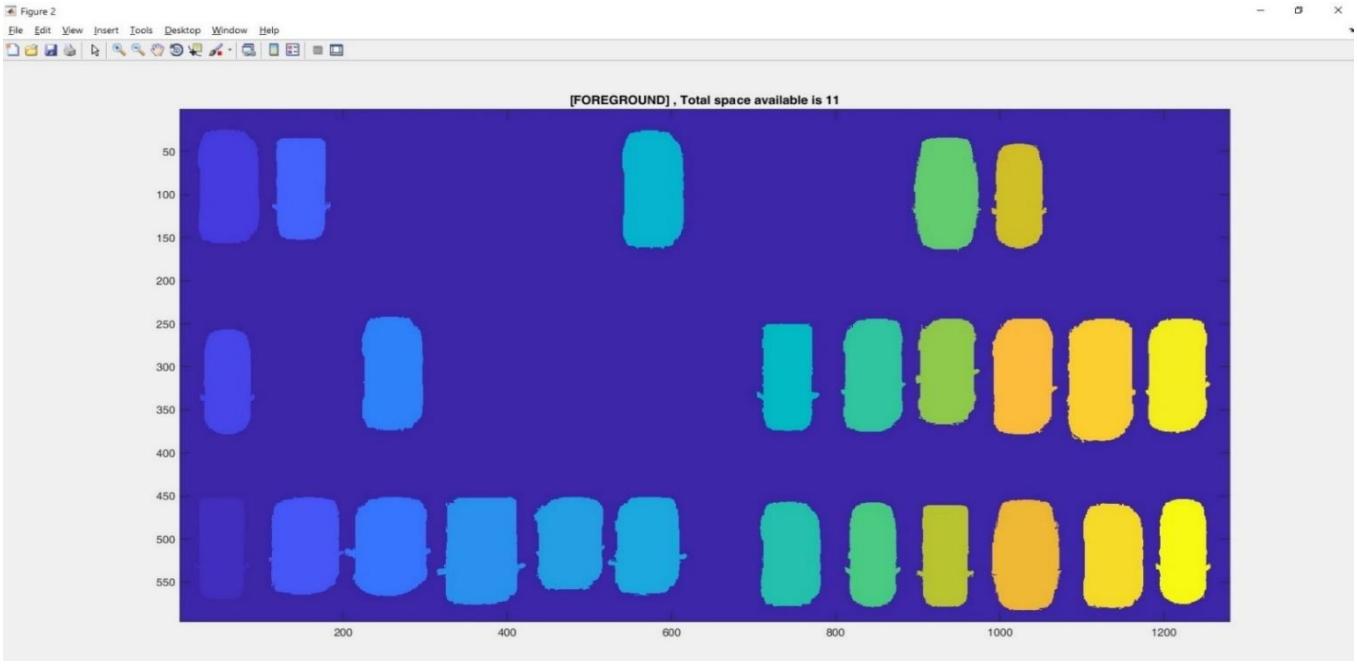
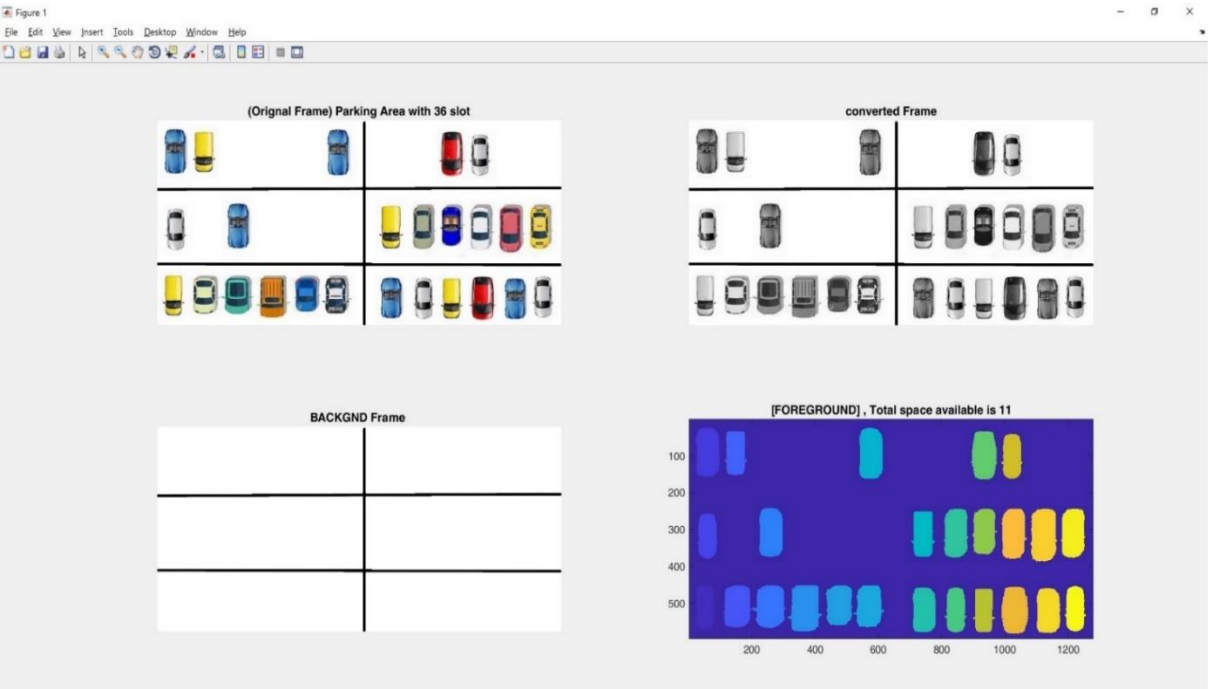
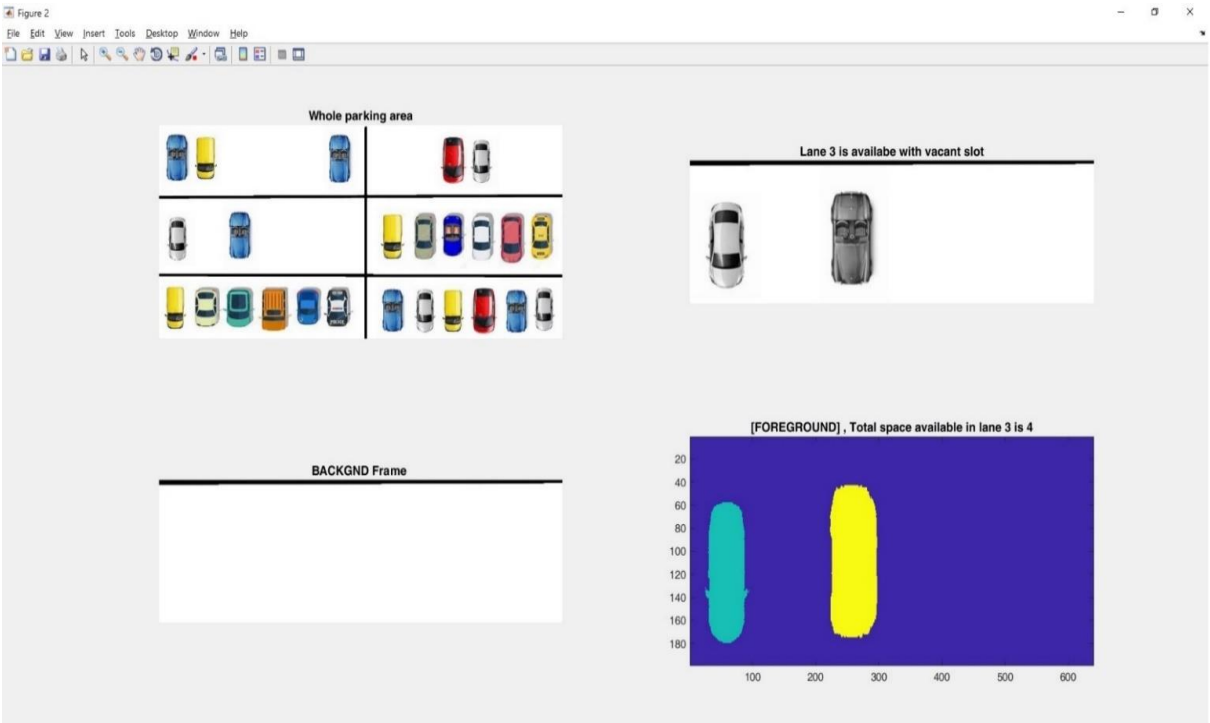


Fig 3.7 image detection of the system

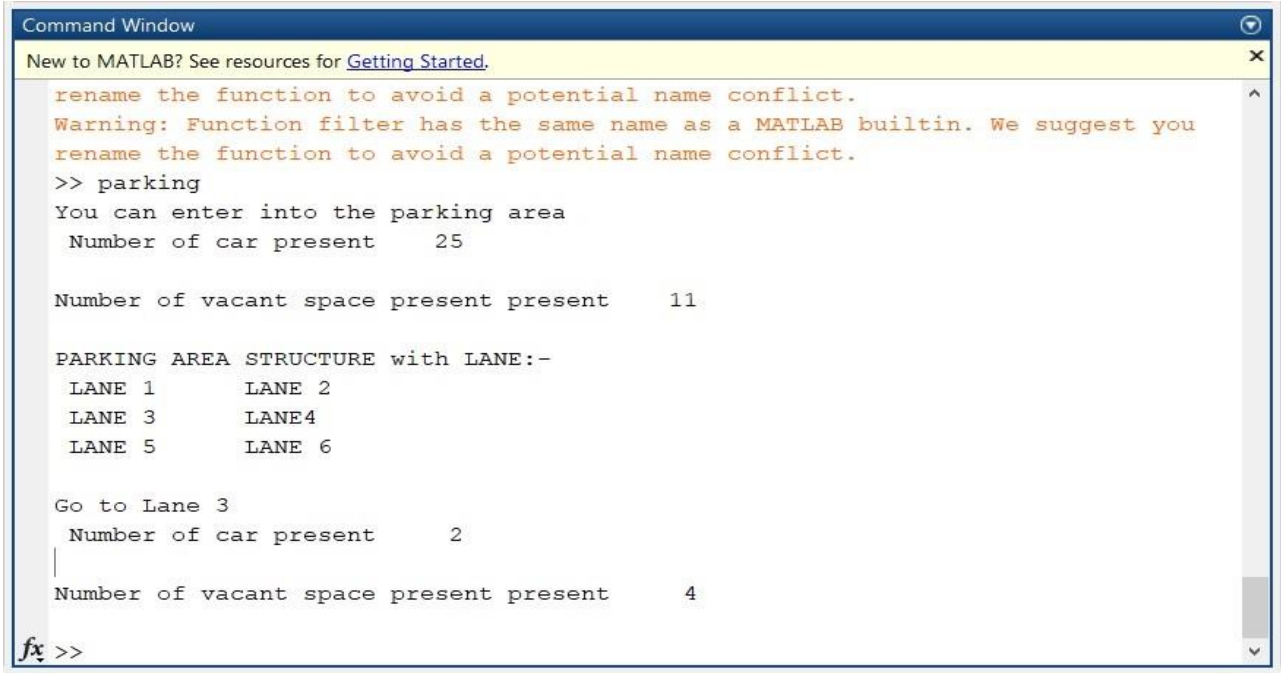
3.4 OUTPUT



Detection of cars in the parking spot



Detection of vacant lane in the parking area



Direction to vacant lane in the parking area

CONCLUSION

There are many automated car parking systems already available using technologies such as GSM, wireless transmitter, etc. This project was especially chosen for the purpose of learning more about image processing, as it is one of the most relevant technologies of our times and used in numerous other applications. The parking space detection system based on image processing in MATLAB was designed and tested. It is possible to manage large area by just using several CCTV. It is consistent in detecting incoming cars because it uses actual car images. It is cheap and easy-installed because of the simple equipment. Drivers can get useful real-time parking lot information from this system by the guidance information display. Future researchers can focus on allocation specific location to customers already registered from online parking management system

REFERENCES

1.Abhirup Khanna, Rishi Anand, “IoT based Smart Parking System”, Proc., In 2016 International Conference on Internet of Things and Applications (IOTA), 22 Jan - 24 Jan 2016.

2.Anusha, Arshitha M, S, Anushri, Geetanjali Bishtannavar “Review Paper on Smart Parking System,” International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181, Volume 7, Issue 08, Special Issue – 2019. Tuticorin District Using Landsat Images”, IJIEST ISSN (2455-8494), Vol.03, No. 01, Jan 2018.

3.Juhi Seth, Pola Ashritha, R Namith, “Smart Parking System using IoT ElakyaR”, International Journal of Engineering and Advanced Technology (IJEAT), ISSN: 2249 – 8958, Volume-9 Issue-1, October 2019.

4.Mimbela, L.Y. and L.A. Klein, “A summary of vehicle detection and surveillance technologies used in intelligent transportation systems”, New Mexico State University, Tech. The report, 2007.

5.M. Y. I. Idris, Y. Y. Leon, E. M. Tamil, N. M. Noor, and Z. Razak, “Car parking system: A review of the smart parking system and its technology,” Information Technology Journal, pp. 101-113.], 2009.

6.Mechkul Jayakshei Dadaji Bachhava, "Smart Car Parking System", International Research Journal of Engineering *and Technology (IRJET*, vol. 04, no. 06, June 2017.

7.Sagar Rane, Aman Dubey and Tejisman Parida, "Design of IoT Based Intelligent Parking System Using Image Processing Algorithms", *2017* International Conference on Computing Methodologies and Communication.

8.Abhirup Khanna and Rishi Anand, "IoT based smart parking system", *2016* international conference of IoT and applications.

9.Chungsan Lee, Youngtak Han, Soobin Jeon, Dongmahn Seo and Inbum Jung, "Smart Parking System for Internet of Things", *2016 IEEE International* Conference on Consumer Electronics.

10.SR Basavaraju, "Automatic Smart Parking System using Internet of Things (IoT)", *International Journal of Scientific and Research Publications*, vol. 5, no. 12, December 2015.