Park Pro

Computer Vision based Parking Management System

Efforts By-
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Background

- Parking management is a significant challenge for public and private organizations, particularly in congested areas with scarce parking spots.

- Locating empty parking spaces manually is a time-consuming and frustrating task, leading to inefficient use of parking space especially in crowded lots.

- Therefore, there is a need for a reliable and automated parking management system that can quickly detect vacant parking spaces and assist drivers in locating them efficiently.

Scope of Project

- **Urban Planning and Smart Cities:**
  - Integration with smart city initiatives for efficient traffic management and optimized use of urban spaces including shopping malls, airports, office complexes.

- **Security and Surveillance:**
  - Beyond parking, the number plate identification module can be extended for broader security and surveillance applications.

- **Integration with IoT Devices:**
  - Scope for integration with Internet of Things (IoT) devices for real-time communication and control.

- **Scalability:**
  - Designed to be scalable, allowing for adaptation to various parking sizes and types.

Utility

- **Improved User Experience:**
  - Drivers can easily find parking spaces, reducing the time spent searching for spots.

- **Data-Driven Decision Making:**
  - Provides valuable data on parking patterns, peak hours, and average parking durations for informed decision-making.

- **Efficient Resource Management:**
  - Enables administrators to manage parking resources more effectively based on real-time information.

- **Integration with Other Technologies:**
  - Potential integration with other smart city technologies for a comprehensive urban management system.

Objectives

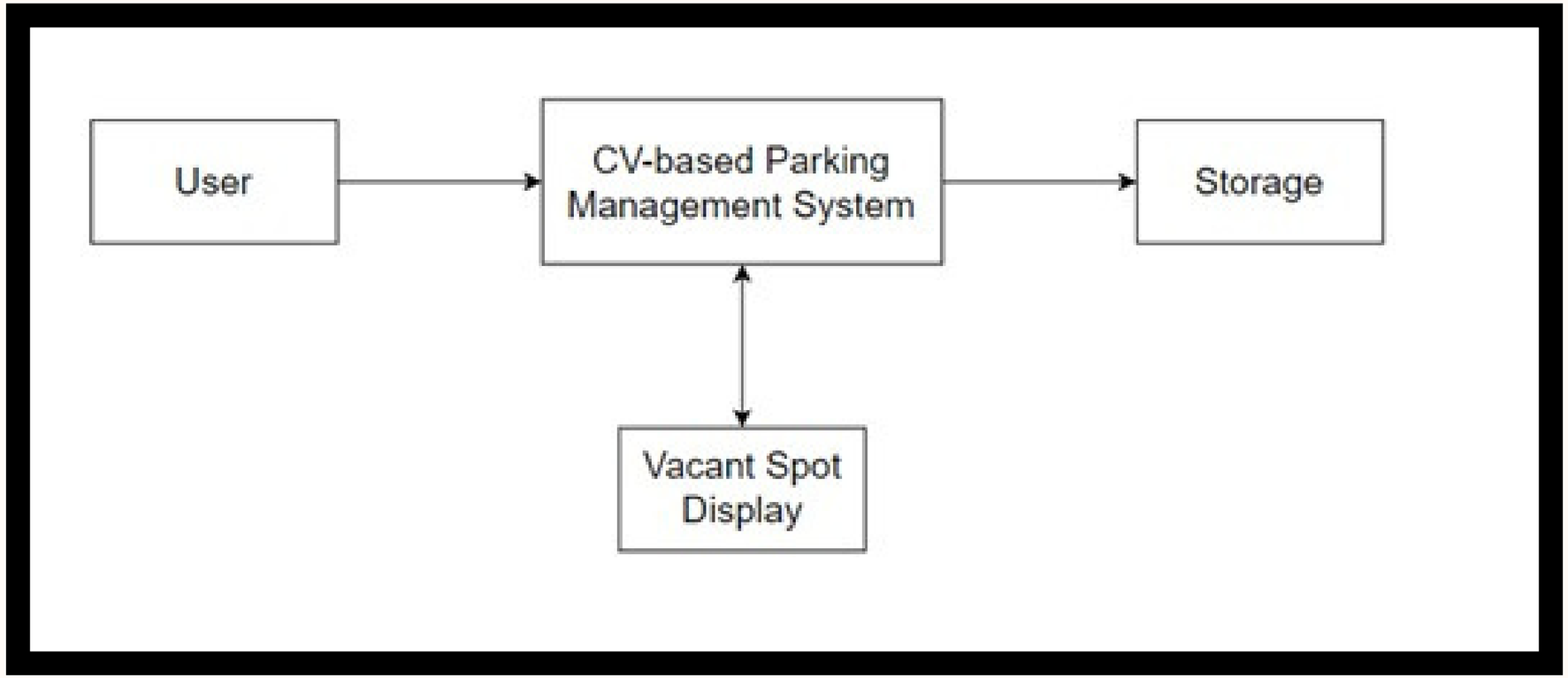
- To identify the number plate of the vehicle entering the parking space.
- To identify the vacant spots in the parking area using live video feed.
- To record the timestamp and authorization status of the vehicle as it enters and exits a parking spot.
- To design and validate the proposed system.

Literature Survey

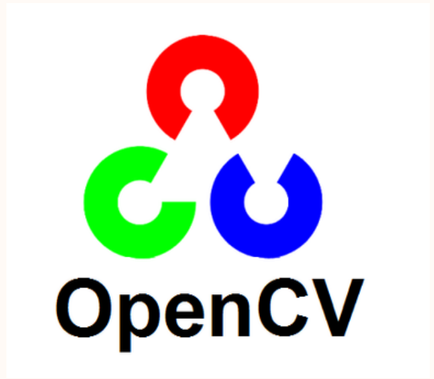
1.	Computer Vision based Parking Optimization System (2022) by S Chandrasekaran, J. M. Reginald, W. Wang, and T. Zhu.	The authors suggested a system that used cameras to detect parking spots in a pre fixed and hard coded manner, not in real time but as per class schedule of user using Django. Highlighted the difficulties encountered in implementing the suggested system, such as poor illumination and occlusion
2.	Computer Vision on a Parking Management and Vehicle Inventory System (2020) by A. D. M. Africa, A. M. S. Alejo, G. M. Bulaong, S. R. Santos and J. K. Uy.	Presented a Computer Vision system to capture license plates using CV techniques and thus keep track of entering and exiting vehicles. The system captured photos in real time using cameras positioned in the parking lot, which were then processed to extract license plate.
3.	Automatic Number Plate Recognition System for Vehicle Identification Using Optical Character Recognition (2009) by M.T. Qadri and M. Asif.	Proposed an Automated Number Plate Recognition system that employs OCR to identify vehicles. The technology is intended to be implemented in real-time and can identify and recognize license plates from camera photos
4.	Computer Vision in Automated Parking Systems: Design, Implementation and Challenges (2017) by M. Heimberger, J. Horgan, C. Hughes, J. McDonald and S. Yogamani.	The paper presented various image processing techniques, such as object detection, segmentation, and recognition, that extracted parking-relevant information from images. The authors also discussed challenges faced in implementing computer vision-based automated parking systems, including lighting conditions, and the need for high accuracy and robustness

5.	Smart Vehicle Parking System Using Computer Vision and Internet of Things (IoT) (2021) by O. Taylor et al.	The authors put forth a system based on IOT and CV. The system's computer vision component used cameras to detect and track cars while the IoT component employed sensors to monitor parking spot occupancy and transfer the data to a central server.
6.	Research Review on Parking Space Detection Method (2021) by Yong Ma et al.	Several methods for parking space identification were reviewed by the authors in this paper. These methods included computer vision-based, magnetic field sensors, and ultrasonic sensors based implementations
7.	A Computer Vision-Based Roadside Occupation Surveillance System for Intelligent Transport in Smart Cities (2019) by George To Sum et al.	The authors discussed a system that analysed video streams from roadside cameras to identify and categorise various forms of roadside occurrences, such as roadwork and parked cars
8.	The Smart Parking Management System (2020) by Amira. A. Elsonbaty et al.	The proposed system employed sensors and cameras to identify available parking spaces and transmit the data to a centralized server.

Architecture

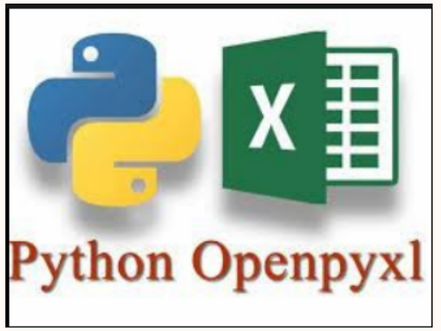


Techniques and Tools used



- Countouring
- Gaussian Blur
- Median Filtering
- Image dilate

Vacant Parking Spot Detection Module



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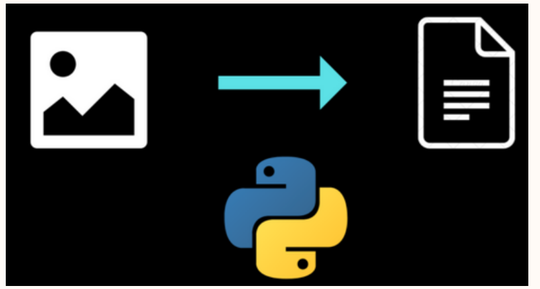
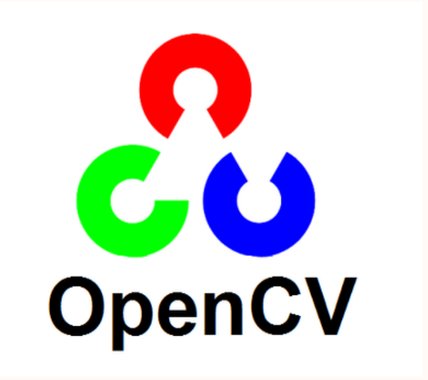
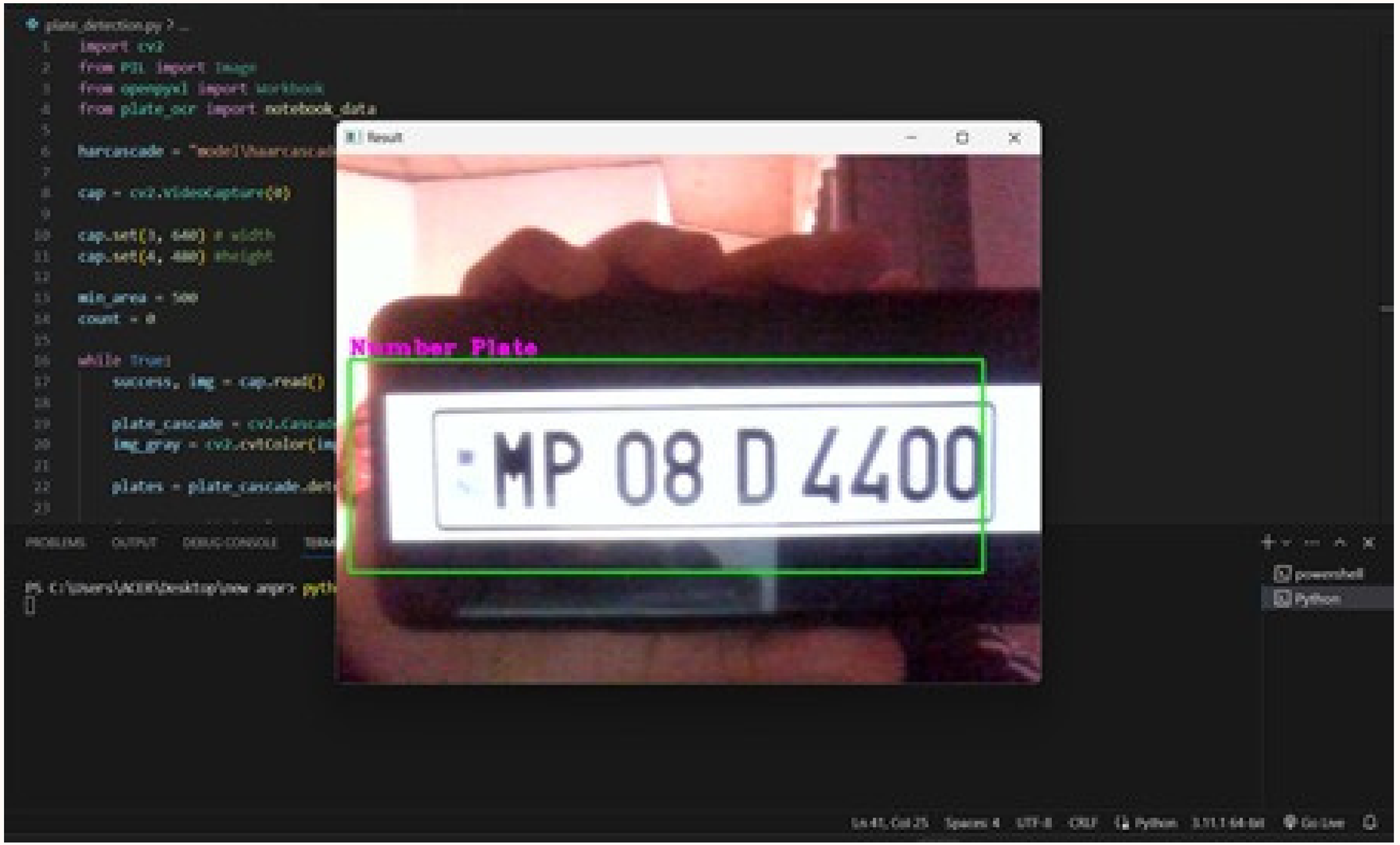


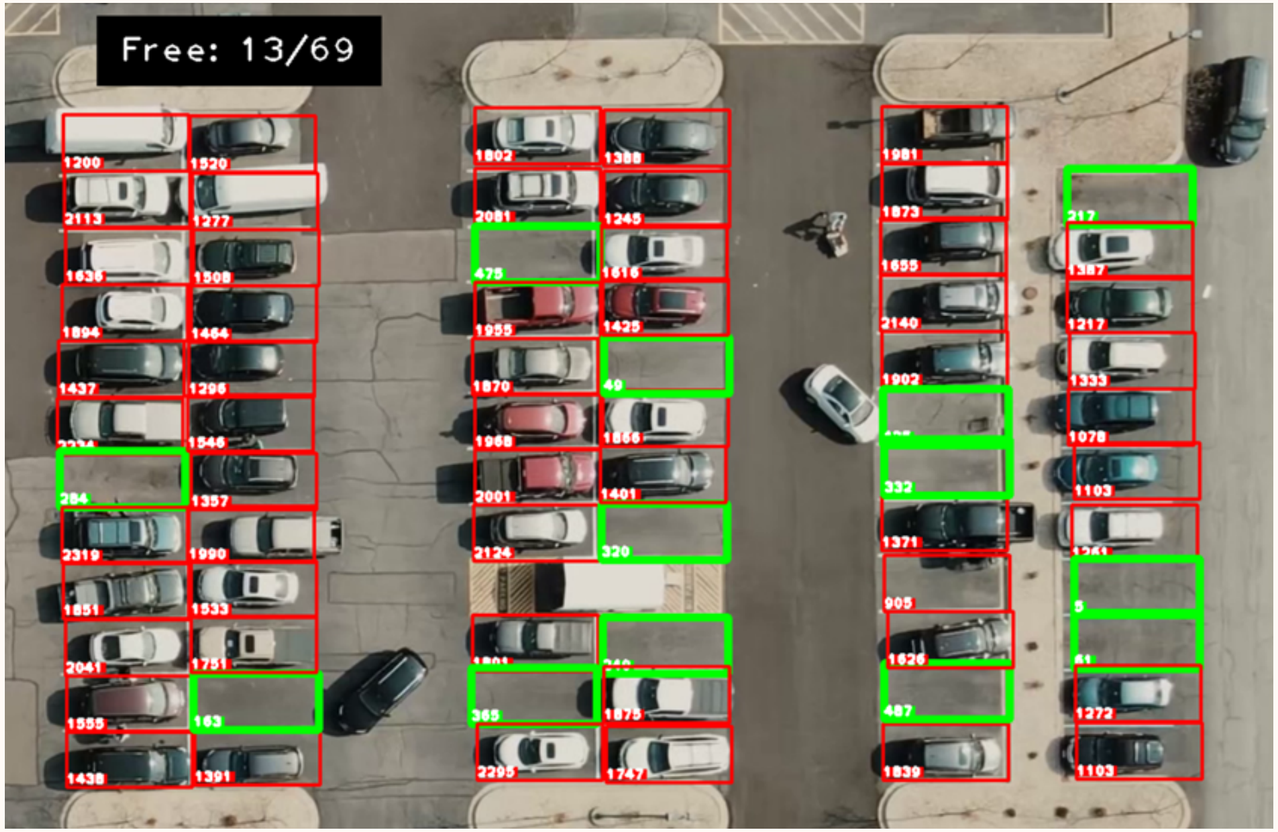


OCR module

In Action - Relevant Snapshots



OCR Module



Vacant Parking Spot Detection Module

Methodology

- **Designing the System architecture**: Based on the requirements, design the system architecture. This involves selecting the appropriate hardware, such as cameras and sensors, and software, such as a database to store information about parked vehicles.

- **Develop the parking spot detection algorithm:** The next step is to develop a CV algorithm that can detect parking spots. This algorithm should be able to identify whether a spot is occupied or available in real-time. The algorithm will be based on OpenCV and CVzone that can be used to classify the parking spots or simpler image processing techniques, such as edge detection and thresholding.

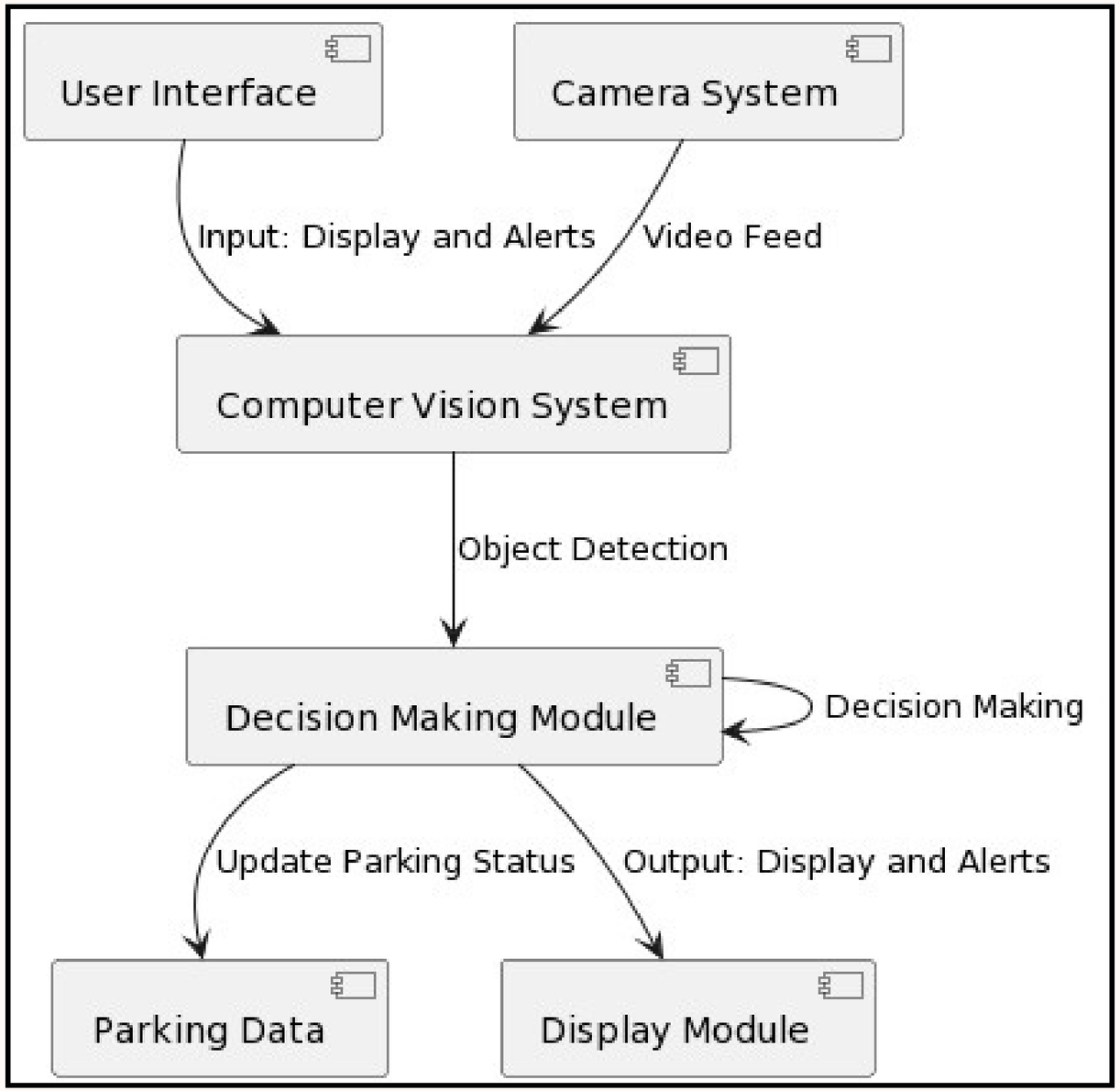
- **Develop the OCR algorithm**: The OCR algorithm should be able to read the license plate number and compare it with a database of authorized vehicles. The OCR algorithm can based on machine learning techniques that are capable of processing sequential data, like characters in a license plate

- **Implement the user interface**: Develop a user interface that can display the status of parking spots, the time stamp information, and the authorization status of vehicles.

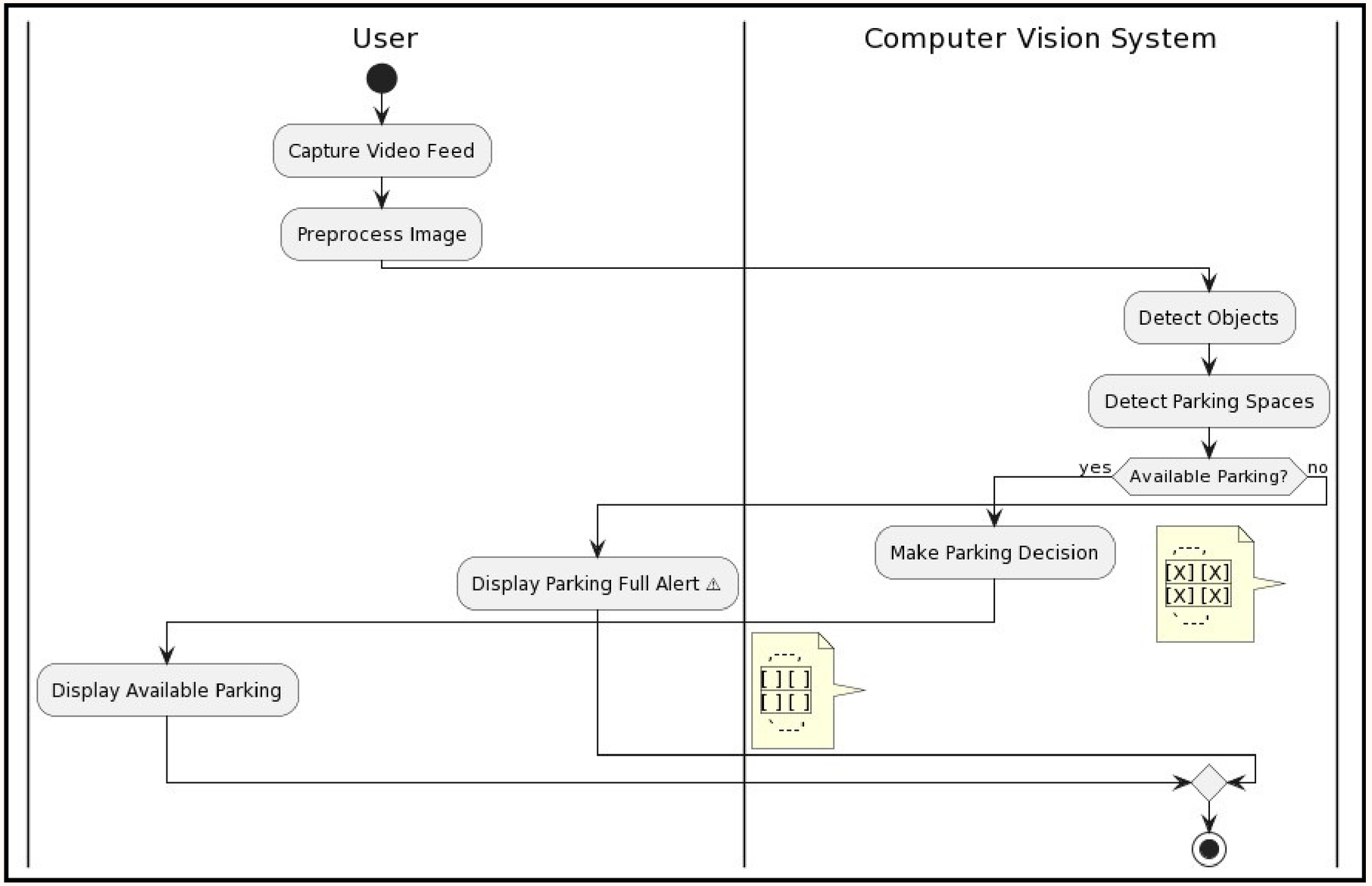
- **Develop the time stamp check algorithm**: The time-stamp algorithm should be able to record the time a vehicle enters and exits a parking spot. This can be done by using a camera to capture an image of the license plate as the vehicle enters and exits the parking spot. The algorithm can then use image processing techniques to extract the license plate number and record the time.

- **Test and Deployment of System**: Finally, test the system to ensure it meets the requirements and deploy it in the parking area. Monitor the system to identify any issues and make necessary adjustments

Deployment Diagram



Procedural Workflow



Deliverables

- **System Documentation:**
  - Requirements Specification: Detailed document outlining the functional and non-functional requirements of the system.
  - Design Documents: Detailed design documents for each module, explaining the architecture, algorithms, and data flow.

- **Software Components:**
  - Executable Software: The actual software application implementing the parking management system with all modules integrated.
  - Database Schema
  - User Interfaces

- **Hardware Components** (when project is to be implemented in real world):
  - Camera Systems
  - Display Systems

Professional Learning:

- **Improved Efficiency:**

Streamlined entry and exit processes lead to faster parking operations.
Reduced manual efforts in managing parking spaces.

- **Enhanced Security:**

Better control over access to the parking area with automatic number plate recognition.
Improved monitoring of vehicles entering and leaving the premises.

- **Revenue Generation:**

Efficient billing and payment systems based on accurate vehicle identification.
Potential for implementing tiered pricing or special services for different types of vehicles.

- **Customer Satisfaction:**

Improved user experience with quicker and hassle-free parking procedures.
Reduced wait times and congestion in parking areas.

- **Data Insights:**

Access to valuable data on parking patterns, peak hours, and popular parking spots.
Informed decision-making for optimizing parking space allocation.

Technical Learning:

- **OCR Accuracy:**
  - High accuracy in reading and interpreting license plates through OCR technology.
  - Continuous improvement in OCR algorithms for better recognition rates.
- **Integration with Existing Systems:**
  - Seamless integration with other systems such as payment gateways, surveillance, and management software.
  - Compatibility with various hardware components like cameras and sensors.
- **Real-time Processing:**
  - Efficient real-time processing of license plate data for immediate actions, such as opening gates or sending alerts.
  - Minimization of latency in the detection and recognition processes.
- **Scalability:**
  - Ability to scale the system to accommodate a growing number of users and vehicles.
  - Scalable architecture to handle increased data and transaction volumes.

- **Robust Security Measures:**
  - Implementation of security measures to protect against unauthorized access and potential breaches.
  - Encryption of sensitive data to ensure privacy and compliance with data protection regulations.
- **Reliability and Redundancy:**
  - Implementation of redundant systems to ensure continuous operation even in the case of hardware or software failures.
  - Regular maintenance and updates to keep the system reliable and secure.
- **User-friendly Interfaces:**
  - Intuitive interfaces for administrators and end-users to monitor and manage the parking system.
  - Mobile applications or web portals for users to check availability, make reservations, or pay for parking.

Individual Roles and Responsibilities

Ankur Garg	Vacant Parking Spot Detection module, Documentation
Kunal Ranjan	OCR Module,Documentation
Prisha Kwatra	OCR module, Documentation
Mandeep Kaur	Documentation, Software Design Diagrams
Jayesh Mohan Saxena	Documentation

Thank You