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#### Mini-Project Report on

**Car Parking Detection and Booking System**

Submitted in partial fulfillment of the requirements for the degree of

BACHELOR OF ENGINEERING IN

Computer Science & Engineering

(Artificial Intelligence & Machine Learning)

by

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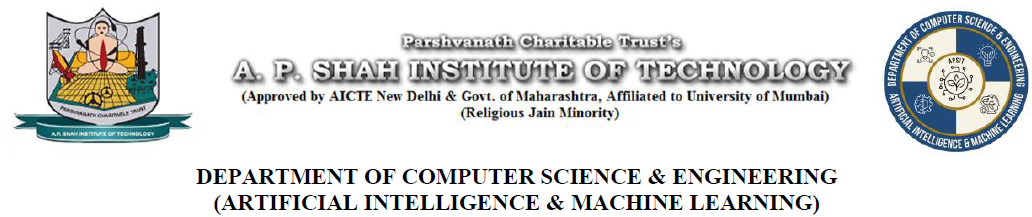
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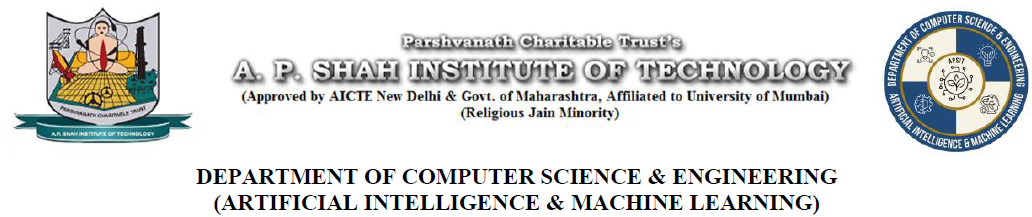
**University of Mumbai 2024-2025**



**CERTIFICATE**

This is to certify that the project entitled “**Parking spot detection using OpenCV”** is a bonafide work of Aditya Sawant (22106084), Aryan Kharat (23206001), Ankit Pawar (22106111), Rohan Patil (22106044) submitted to the University of Mumbai in partial fulfillment of the requirement for the award of **Bachelor of Engineering** in **Computer Science & Engineering (Artificial Intelligence & Machine Learning).**

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**Project Report Approval**

This Mini project report entitled “**Parking spot detection using OpenCV*”*** by **Aditya Sawant, Aryan Kharat, Ankit Pawar and Rohan Patil** is approved for the degree of ***Bachelor of Engineering*** in ***Computer Science &Engineering***, (AIML) ***2024-25***.

#### External Examiner:

Internal Examiner:

Place: APSIT, Thane Date:

**Declaration**

We declare that this written submission represents our ideas in our own words and where other’s ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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### ABSTRACT

Parking spot detection is a crucial component of modern smart parking systems, enhancing efficiency and reducing congestion. This project implements a parking spot detection system using **Python** and **Flask**, leveraging **computer vision** techniques to identify available parking spaces in re al-time. The system processes images or video feeds from surveillance cameras using **OpenCV** and **machine learning models**, detecting empty and occupied spots. Flask serves as the backend, providing a web-based interface for users to check parking availability. The solution is lightweight, scalable, and can be integrated into smart city applications for improved parking management. With increasing urban congestion, efficient parking management has become essential. This project proposes a **parking spot detection system** built with **Python** and **Flask**, integrating **computer vision** techniques to monitor parking spaces. The system processes video feeds using **OpenCV**, detects occupied and vacant spots, and delivers real-time updates via a Flask-powered web interface. This approach enhances urban mobility and reduces unnecessary fuel consumption caused by searching for parking.

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# CHAPTER 1 INTRODUCTION

1. **INTRODUCTION**

Efficient parking management is a growing concern in urban areas due to increasing vehicle ownership and limited parking space availability. Traditional parking systems often lead to congestion, inefficient space utilization, and user frustration due to the lack of real-time availability information. Additionally, static pricing models fail to account for demand fluctuations, resulting in either overpricing or underutilization of parking spaces. To address these issues, an intelligent and dynamic car parking detection system is required.

This project proposes a smart parking system that integrates real-time parking slot detection with a dynamic pricing model. The system identifies vacant and occupied parking slots, preventing double bookings and optimizing space utilization. Pricing is dynamically adjusted based on demand, considering factors such as the number of cars parked and the duration of parking. This approach ensures fair pricing, encourages efficient parking behavior, and maximizes revenue for parking operators.

Unlike traditional systems that rely on databases for data storage, this project stores booking data in memory, allowing for a lightweight and efficient approach. The system tracks available slots and marks them as booked once a reservation is made, preventing multiple users from selecting the same spot. This real-time, database-free design enhances system performance while ensuring reliability in managing parking slots dynamically.

By implementing this system, users benefit from real-time slot availability updates, fair pricing, and reduced congestion. The solution can be applied to public and private parking lots, improving overall parking efficiency while ensuring a seamless user experience. This report explores the development, functionality, and impact of the proposed car parking detection system, highlighting its potential to revolutionize urban parking management.

# CHAPTER 2 LITERATURE SURVEY

1. **LITERATURE SURVEY**

##### 2.1-HISTORY

The history of parking management systems dates back to the early 20th century when urbanization and increased vehicle ownership created a demand for organized parking solutions. Initially, parking was managed manually with attendants guiding vehicles into designated spots, often leading to inefficiencies and congestion in high-traffic areas. The first major advancement came in the 1930s with the invention of the parking meter, which introduced a time-based fee structure to regulate parking durations.

As cities grew and vehicle numbers surged, automated parking solutions emerged in the mid-20th century. Multi-level parking structures, ticket-based systems, and boom barriers were introduced to optimize space utilization and manage traffic flow. By the late 20th century, digital payment systems and electronic parking management became more prevalent, reducing human intervention and streamlining the parking experience.

With the advent of smart technologies in the 21st century, parking management evolved further through sensor-based detection, mobile applications, and real-time slot availability tracking. The introduction of dynamic pricing models, based on demand and duration, helped optimize revenue generation while improving parking space utilization. These advancements have led to the development of AI-driven par king detection systems, which integrate real-time monitoring, user-friendly reservation systems, and adaptive pricing strategies.

Today, smart parking solutions play a crucial role in urban mobility, reducing congestion, minimizing emissions, and improving the overall parking experience. With continuous technological advancements, modern parking systems are becoming more efficient, environmentally friendly, and seamlessly integrated with Internet of Things (IoT) and AI-based analytics, paving the way for the future of intelligent parking management.

### 2.2-LITERATURE REVIEW

1. **"Smart Parking Sensors, Technologies, and Applications for Open Parking Lots: A Review"**  
   Vijay P. Paidi, Hasan Fleyeh, Johan Håkansson, and Roger G. Nyberg present a comprehensive review of various smart parking sensor technologies used for open parking lots. The paper explores different sensing methods, including ultrasonic, infrared, magnetic, and camera-based detection systems, evaluating their accuracy, cost-effectiveness, and integration challenges. The authors emphasize the role of IoT-based real-time parking management and discuss various case studies showcasing successful implementations. The study highlights the importance of **machine learning** algorithms in optimizing parking detection, improving vehicle recognition, and reducing congestion through automated parking solutions.
2. Shruthi B, Raghottam J Kulkarni, Sanath Kumar, and Dilip Kumar propose a **computer vision-based smart parking system** that leverages **image processing techniques** for real-time slot detection. The study presents an approach where **CCTV cameras capture images of parking areas, and algorithms analyze vehicle presence** using edge detection and morphological operations. Their system effectively identifies occupied and vacant slots, enabling users to receive real-time parking availability updates. The research demonstrates the **efficiency of image-based systems over traditional sensor-based methods**, emphasizing their cost-effectiveness and scalability in urban parking spaces.
3. **"An Embedded Real-time Vision System for 24-hour Indoor/Outdoor Car-Counting Applications"**  
   Ming-Yee Chiu, Depommier R., and Spindler T. develop an embedded real-time visionsystem designed for continuous vehicle detection in both indoorand outdoor environments. The study focuses on a high-precision car-counting system that operates 24/7 using **computer vision** algorithms and embedded hardw**are**. Their system efficiently tracks vehicles under varying lighting and weather conditions, improving traffic flow analysis and automated parkingmanagement. The researchers highlight the importance of hardware-software co-design to ensure real-time processing with minimal computational overhead, making the system highly reliable for smart parking applications.

# CHAPTER 3

## Problem Statement

### Problem Statement

Efficient parking management remains a major challenge in urban areas, leading to traffic congestion, fuel wastage, and increased carbon emissions. Traditional parking systems often lack real-time monitoring capabilities, resulting in delays, double reservations, and inefficient space utilization. As urban populations grow, the demand for smart, automated parking solutions becomes essential to optimize available parking spaces and reduce congestion.

To address these challenges, this mini project aims to develop a smart parking detection and booking system using Flask integration for real-time slot management. The system will utilize in**-**memory storage to maintain parking status and avoid double reservations, ensuring efficient space allocation without requiring a database. Additionally, the project will incorporate dynamic pricing, adjusting rates based on the number of occupied slots and duration of parking, thereby optimizing demand distribution.

The primary objective of this project is to:

1] **Develop a real-time parking slot detection and booking system** using Flask to manage parking availability dynamically.

2] **Implement an in-memory storage solution** to track booked and available slots, preventing double reservations without using a database.

3] **Introduce dynamic pricing mechanisms** that adjust parking rates based on demand (number of occupied slots) and duration of parking.

4] **Provide a user-friendly interface** that allows seamless booking and real-time tracking of available parking spaces, enhancing user experience and reducing search time.

By addressing these objectives, this mini project aims to contribute to the efficient management of urban parking spaces, reducing congestion, improving user convenience, and promoting sustainable urban mobility.

# CHAPTER 4

## Experimental Setup

### 4. Experiment Setup

**Hardware Setup**

* + 1. **Computational Resources**

**Laptop or Desktop Computer:**

* A standard laptop or desktop with basic specifications is sufficient.
* Ensure the system has adequate processing power to handle real-time parking slot detection and dynamic pricing calculations.
  + 1. **Memory (RAM)**

**RAM Capacity:**

* Minimum of **8 GB RAM**.
* Necessary for handling real-time slot management, booking requests, and storing parking data in memory.
  + 1. **Storage Space**

**Storage Capacity:**

* Minimum of **256 GB SSD or HDD**.
* Required for storing system files, real-time parking status logs, and Flask application code.

##### 4.1 Software Setup

**4.2.1 Operating System**

* **Windows**
* A stable operating system to support Python, Flask, and other necessary libraries.

**4.2.2 Programming Languages**

* **Python 3.x** (For backend logic and integration)
* **HTML, CSS, JavaScript** (For frontend UI)

**4.2.3 Frameworks and Libraries**

* **Flask** – For web application development and handling parking slot booking requests.
* **OpenCV** – For image processing in parking slot detection
* **NumPy & Pandas** – For data handling and in-memory storage of booking details.

**4.2.4 Database (In-Memory Storage)**

* **JSON**–Data will be stored in memory for real-time tracking of parking slots.

**4.2.5 Development Tools**

* **VS Code** – For writing and testing Python scripts.

# Conclusion

In conclusion, this project demonstrates an efficient and scalable approach to modern parking management. By leveraging **computer vision** techniques with **OpenCV**, the system accurately detects vacant and occupied parking spaces from live video feeds or images. The Flask-based web application ensures seamless access to real-time parking availability, enhancing user experience and reducing traffic congestion. This solution contributes to **smart city infrastructure** by optimizing parking space utilization and minimizing the time spent searching for parking. Future enhancements may include **deep learning-based detection** for improved accuracy, **IoT sensor integration** for real-time data acquisition, and **mobile application development** for broader accessibility. With its modular and adaptable design, the system can be deployed in various urban and commercial environments, paving the way for more intelligent and automated parking solutions.