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IMPLEMENTATION PAPER ON PARKING MANAGEMENT USING OPENCV AND IMAGE PROCESSING

Narayan K Krishna [1], Sree Hari Thejus Pachipulusu [2], Prajwal B P Barlaya [3], O Bhuvan [4], Mrs. Vinutha G K[5]
[1]Student ,[2]Student, [3]Student, [4]Student,
[5]Assistant Professor

ABSTRACT - Parking management system using OpenCV, image processing, and the SSD algorithm offers a novel method to parking management. Real-time accurate detection and counting of available parking spaces by the system improves operator productivity and patron satisfaction. OpenCV performs image preprocessing, feature extraction, and object identification by analysing live video feeds from strategically placed cameras; SSD improves speed and accuracy in finding empty spaces, cutting down on consumers' search times. Furthermore, the system effectively manages billing when a car exits, producing detailed bills depending on how long a customer parks, which enhances operator revenue management and consumer convenience. "The Parking Management System using OpenCV and Image Processing" validate key features such as accurate slot detection, real-time occupancy monitoring, and quick payment integration, which ultimately improve parking management effectiveness and customer happiness.

INTRODUCTION

Urban infrastructure cannot function well without parking management systems, which solve the growing problems of a shortage of parking spaces and rising vehicle density. This study offers a novel solution to these problems by utilizing state-of-the-art tools like the Object Tracking and Single Shot De algorithm, OpenCV, and image processing techniques to completely transform parking lot management. An increasing number of smart cities and Internet of Things devices mean that effective and automatic parking space optimization solutions that improve user experience are urgently needed. The needs of contemporary urban areas can no longer be satisfied by manual parking management techniques that are outdated. In order to provide parking operators and consumers with useful information, this paper presents a comprehensive system that uses computer vision to properly detect and count available parking slots in real-time. The system uses OpenCV to conduct object detection, feature extraction, and image preprocessing on live video feeds from carefully placed cameras inside parking facilities. The system effortlessly incorporates billing features, automating the process of producing detailed bills based on the amount of time parked when a car exits. This improves customer comfort and simplifies operator revenue management. This study presents experimental data to evaluate the efficacy and dependability of the proposed system in a variety of parking settings, and it discusses the essential characteristics and functionalities of the system.

OBJECTIVES

The objectives of this project are to reduce wait times and hassles for users, improve security, automate car detection, enable real-time monitoring of parking occupancy, and

leverage data analytics for better decision-making and cost savings using object tracking and image processing techniques.

EXISTING SYSTEM

Beyond manual procedures, the current parking management systems frequently encounter difficulties such as possible security officer fraud in ticketing charges and cases where consumers are not given the correct invoices. These problems have the potential to damage the system's integrity and trust while also costing parking operators and users money. Furthermore, restricted surveillance capabilities could jeopardize parking facility security, raising worries about illegal entry and car safety. Long wait times and busy parking lots may degrade customer experience, and a lack of data analytics integration impairs decision-making and resource optimization.

Given these difficulties, an innovative parking management system that not only automates crucial procedures but also increases efficiency and general trust by strengthening security measures, enhancing real-time monitoring, addressing fraudulent activity, and guaranteeing billing process transparency.

LIMITATIONS OF EXISTING SYSTEM

Traditional manual methods for parking management system have several limitations:

1) **Manual Processes:**
For functions like vehicle detection, ticketing, and billing, a lot of the current systems mostly rely on human processes. The manual process is prone to mistakes, hold-ups, and irregularities, which results in ineffective parking operations.

2) **Limited Surveillance:**
Inadequate surveillance capabilities in certain parking lots can jeopardize safety and security. It becomes difficult to properly detect and handle vehicle theft, unauthorized access, and other security breaches without adequate monitoring.

3) **Lack of Integration:**
Many modern systems, such as payment systems, parking sensors, and data analytics platforms, operate in separate silos with little to no interaction between different components.

PROPOSED SYSTEM

The suggested parking management system greatly reduces the requirement for human supervision by utilizing cutting-edge technology like Object Tracking, OpenCV and image processing. Real-time autonomous car detection and identification is achieved by the system by the strategic placement of cameras across the parking facility. The system employs OpenCV's robust object detection and image preprocessing features to precisely track parking occupancy and identify open spots, hence eliminating the necessity for continuous human supervision. This reduces the possibility of human error while also streamlining parking procedures, allocating resources optimally, and raising overall effectiveness.

Object Tracking

The suggested system's automation of these crucial processes lowers operating expenses while simultaneously enhancing parking management's precision creating a more fluid and user-friendly parking experience.

Simulation and analysis

ADVANTAGES OF PROPOSED SYSTEM

The suggested system's technology, which includes image processing and OpenCV, automates procedures, improving accuracy, lowering costs, and boosting security in operations.

1) **Enhanced Efficiency and Security**: Automation improves accuracy when determining parking availability, and producing billing information. A safer environment for cars and customers is ensured by the system including real-time monitoring and precise vehicle tracking more feasible than manually crafting features.

2) **Cost Reduction**: Parking owners can save a lot of money by automating operations like occupancy monitoring, vehicle detection, and billing, which drastically lowers operational costs.

3)**Improved User Experience**: By automating parking procedures, the system minimizes the need for human intervention and lowers the possibility of mistakes or delays.

RESULTS

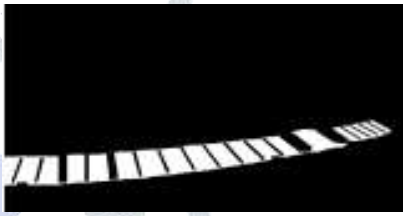
The testing process's outcomes, emphasizing any flaws found and their seriousness, shall be recorded. In addition, suggestions for enhancement or any required remedial action will be given.

Test cases: Finding flaws in requirements, design, documentation, and code as early as possible is the main goal of testing for the parking management system. The goal of the testing procedure is to guarantee that the customer receives a flawless software product. Every test should be able to be linked back to the specifications provided by the client and cover both expected and valid input situations as well as unexpected and invalid ones.

Test Case ID	Test Scenario	Input	Expected Output	Actual Output	Result
001	Vehicle Detection	Vehicle enters the parking facility	System detects the vehicle	System successfully detects the vehicle	Pass
002	Integration of payment processing	Vehicle exits the parking facility	System generates bill based on duration	System generates accurate bill	Pass
003	System's response time during peak hours	Simulated peak parking hours with high vehicle volume	System maintains quick response times in peak hours	System maintained quick response times in peak hours	Pass
004	Occupancy Monitoring	Vehicle occupies a parking space	System updates occupancy status	System updates occupancy status	Pass
005	Security Features	Unauthorized access attempt	System triggers security alert	System triggers security alert	Pass

Accuracy of Intrusion Model:

Using OpenCV and image processing, the "Accuracy of Intrusion Model" part evaluates the intrusion detection system's (IDS) efficacy within the parking management system. The precision, recall, F1-Score, True Positive Rate, False Positive Rate, and other standard metrics are used to assess how well the IDS can detect and categorize illegal access attempts and security breaches. The relevant dataset, which is specific to parking facility security and includes information on its attributes and any preparation methods used, is used for this study.



Parking lot's binary mask

he configuration of the IDS, including feature selection strategies and parameter tweaking tailored to parking security, is included in the trial setup.

Drawn key points from detector

The section offers a thorough evaluation of the IDS's functionality, stressing both possible areas for development to increase the system's performance and its accuracy in identifying intrusion events.

Parking lot area shown in green rectangle

CONCLUSION

The parking management system's combination of OpenCV and image processing shows notable improvements in efficiency and security. The system's capacity to precisely identify and react to intrusion attempts improves user experience and overall safety. Its position as a reliable option for parking facilities will be further cemented with continuous improvement and optimization.

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