JOURNAL OF MULTIDIMENSIONAL RESEARCH & REVIEW

http://www.jmrr.org Volume: 6, Issue: 1, April 2025 | ISSN: 2708-9452

Smart Parking System

Kamali G

PG Student, Department of Computer Science and Applications

Vivekanandha College of Arts and Sciences for Women [Autonomous],Tiruchengode Namakkal, Tamilnadu, India.

Malathi S

Assistant Professor, Department of Computer Science and Applications

Vivekanandha College of Arts and Sciences for Women [Autonomous],Tiruchengode, Namakkal, Tamilnadu, India.

Abstract

In today's urban scenes, stopping blockage has gotten to be a inescapable challenge, driving to squandered time, expanded outflows, and driver dissatisfaction. The ever-growing urban populace, coupled with the expanding number of vehicles, has driven to a extreme deficiency of stopping spaces in metropolitan regions. This shortage has not as it were made finding a stopping spot a time-consuming and disappointing encounter but has moreover contributed to activity clog and natural contamination. Conventional stopping administration frameworks, which regularly depend on manual ticketing or physical boundaries, are getting to be lacking in tending to these challenges. To address this issue, imaginative arrangements that combine innovation and mechanization are on the rise. Conventional stopping administration frameworks frequently depend on physical framework and human mediation, coming about in wasteful aspects and restricted versatility. In differentiate, the integration of profound learning strategies and progressed computer vision innovation into stopping administration opens up unused conceivable outcomes for a more brilliant, more productive, and user-friendly involvement. This framework leverages two key components: facial acknowledgment innovation to recognize vehicle tenants and programmed acknowledgment of permit plate numbers for vehicle recognizable proof. By consistently coordination these advances, the framework not as it were encourages easy stopping but moreover upgrades security and optimizes stopping space utilization. In this extend, we will investigate the principal components, benefits, and potential affect of the Confront and Number Plate-Based Keen Stopping Framework. Test comes about appears that made strides proficiency in savvy stopping framework utilizing confront and number plate confirmation framework.

Keywords: Smart Parking, Deep Learning, Facial Recognition, License Plate Recognition, Computer Vision, Automation, Parking Management, Traffic Congestion, Urban Mobility, Security Optimization.

1 Introduction

In this initiative will use a deep learning approach to detect and recognize car license plates and faces. Although previous research has used several robust methodologies, the deep learning approach has gained significant interest in the field of pattern recognition in recent days. The Grassmann algorithm is used in the proposed system to detect face feature points. We may use conditional random fields and convolutional neural networks to detect and recognize number plates and faces with higher accuracy. In addition, an alert about unauthorized access will be sent. Using a real-time biometric system and license plate recognition, create a smart authentication system to identify unauthorized entrance. This includes the facial biometric system, which comprises elements of the face including the lips, cheeks, and eyes. Artificial intelligence technology is used to analyze face biometric data in order to detect illegal individuals and provide alarm systems. Deep learning offers better degrees of recognition accuracy than previously. Deep learning now performs better than humans in several tasks, like classifying objects in image, and improvements. Deep learning is a machine learning technique that teaches computers to do what comes naturally to humans: learn by example. Deep learning is a key technology behind driverless cars, enabling them to recognize a stop sign, or to distinguish a pedestrian from a lamppost. It is the key to voice control in consumer devices like phones, tablets, TVs, and hands-free speakers. Deep learning is getting lots of attention lately and for good reason. It's achieving results that were not possible before. In deep learning, a computer model learns to perform classification tasks directly from images, text, or sound. Deep learning models can achieve state-of-the-art accuracy, sometimes exceeding human-level performance.

2 Review of Literature

This paper presents a low-cost IoT-based License Plate Recognition (LPR) model specifically designed for smart parking systems. The study focuses on the integration of image processing, machine learning, and IoT technologies to automate the detection and recognition of Arabic license plates. The proposed system utilizes deep learning-based optical character recognition (OCR) techniques for enhanced accuracy in real-world conditions. The model is designed to operate on low-cost hardware, making it cost-effective, scalable, and suitable for smart city applications. Experimental results indicate high accuracy and efficiency in license plate detection under various environmental conditions, contributing to the development of intelligent transportation and automated parking solutions [1] . This paper presents an automatic parking and fee collection system using license plate recognition, eliminating the need for magnetic cards. It enhances convenience and security by employing image processing for vehicle identification and guidance. The system reduces human involvement and automates parking and billing operations using OCR and real-time license plate extraction[2] . This paper proposes a smart parking system integrating IoT and facial recognition to enhance security and reduce manual screening inefficiencies. It leverages real-time data, low-cost sensors, and user-friendly applications to optimize parking spot searches. The system aims to create a secure, eco-friendly, and efficient parking environment for users and lot owners[3]. This paper presents a comprehensive analysis of Smart Parking Systems (SPS), comparing their technologies, sensors, networking methods, and services. It highlights SPS suitability across environments, offering insights for researchers and policymakers. The study emphasizes SPS's

role in reducing traffic, pollution, and time wastage in smart city development[4]. This paper proposes an IoT-based parking system using ESP32-CAM modules for facial and license plate recognition to enhance security and efficiency at the Sumatra Institute of Technology. By integrating Amazon Web Services, the system operates without the need for training data and performs well in day and night conditions. The prototype shows a 21% performance improvement, reducing manual checks and enhancing parking management[5] . This paper presents a low-cost IoT-based Arabic License Plate Recognition (ALPR) model specifically designed for smart parking systems. The study focuses on the integration of image processing, machine learning, and IoT technologies to automate the detection and recognition of Arabic license plates. The proposed system utilizes deep learning-based optical character recognition (OCR) techniques for enhanced accuracy in real-world conditions. The model is designed to operate on low-cost hardware, making it cost-effective, scalable, and suitable for smart city applications. Experimental results indicate high accuracy and efficiency in license plate detection under various environmental conditions, contributing to the development of in license plate detection under various environmental conditions, contributing to the development of intelligent transportation and automated parking solutions [6]. This paper introduces an IoT-assisted Intelligent Parking System (IPS) aimed at optimizing urban parking management in smart cities. The system utilizes a network of IoT sensors, cloud computing, and AI-based predictive analytics to provide real-time parking availability updates. The proposed IPS leverages smart cameras, RFID technology, and mobile applications to guide users to the nearest available parking spot, reducing traffic congestion and fuel consumption. The study highlights the system's efficiency in improving urban mobility and sustainability while offering automated billing and reservation features for user convenience [7]. This research proposes an IoT-enabled Parking Management System (PMS) that utilizes Long Range Wide Area Network (LoRaWAN) technology for smart city applications. The system is designed to address the challenges of limited connectivity, high energy consumption, and real-time monitoring in urban environments. The model incorporates LoRaWAN-enabled sensors and cloud-based analytics to provide seamless parking space detection and user-friendly navigation. Compared to conventional parking systems, the proposed system demonstrates higher efficiency, lower power consumption, and improved scalability. The findings suggest that LoRaWAN technology is a cost-effective solution for large-scale smart city deployments [8]. This study provides a comparative analysis of smart mobility solutions in Copenhagen and Barcelona, two leading smart cities. It examines their urban mobility strategies, public transportation systems, and integration of digital technologies. Copenhagen's approach emphasizes sustainable mobility through cycling infrastructure, green public transport, and smart traffic management, whereas Barcelona focuses on multi-modal transport networks, IoT-based mobility solutions, and AI-driven traffic optimization. The study highlights the impact of smart mobility initiatives on reducing carbon emissions, enhancing commuter experience, and promoting efficient urban transport [9]. This paper explores the emerging trends in Digital Twin (DT) framework architectures and their applications in smart mobility. A Digital Twin is a virtual representation of physical urban infrastructure, enabling real-time data analytics, predictive modeling, and scenario-based simulations[10]. The study discusses the role of AI, IoT, and big data analytics in enhancing the efficiency of transportation networks, traffic management, and mobility-as-a-service (MaaS) systems. A case study is presented to demonstrate the effectiveness of Digital Twin technology in optimizing traffic flow, reducing congestion, and improving public transport efficiency. The findings emphasize the

potential of Digital Twins to revolutionize urban planning and smart mobility solutions.

3 Proposed System

Face detection is the first stage of a face recognition system. A lot of research has been done in this area, most of which is efficient and effective for still images only and could not be applied to video sequences directly. To improve the accuracy of face recognition in videos to get more robust and stable recognition can be achieved by fusing information of multi frames and temporal information and multi poses of faces in videos make it possible to explore shape information of face and combined into the framework of face recognition. The video-based recognition has more advantages over the image-based recognition. First, the temporal information of faces can be utilized to facilitate the recognition task. Secondly, more effective Image Acquisition representations, such as face model or super-resolution images, can be obtained from the video sequence and used to improve recognition results. Finally, video- based recognition allows learning or updating the subject model over time to improve recognition results for future frames. This project aims to apply a deep learning approach to detect and recognize vehicle license plates and faces in India. Although many robust approaches have been employed by prior research, the deep learning approach has to gain dramatic attention in recent days in the field of pattern recognition. Deep learning is a branch of machine learning which is specifically based on artificial neural networks, as the neural network is going to mimic the human brain so deep learning is also a kind of mimic human brain. The proposed system includes Grassmann algorithm to detect facial features points. We can implement Conditional random field and Convolutional neural network algorithm to detect and recognize the number plates and faces with improved accuracy rate. And also send alert about unauthorized access.

3.1 Data collection

The data collection process for this project involves gathering a diverse dataset of images and video sequences containing vehicle license plates and human faces, specifically from an Indian context. The dataset should include variations in lighting conditions, angles, occlusions, and environmental factors to ensure robustness. High-resolution CCTV footage, traffic surveillance videos, and publicly available datasets such as the Indian Vehicle License Plate Dataset (IVLPD) and Indian Face Dataset (IFD) are considered to enhance model performance. Once collected, the data undergoes preprocessing to improve accuracy and efficiency in recognition tasks. Preprocessing steps include:
1.Data Cleaning – Removing blurry, low-quality, and irrelevant images to ensure only high-quality inputs are used.
2.Face and License Plate Detection – Using the Grassmann algorithm to detect facial feature points and locate number plates in images/videos.
3.Image Enhancement – Applying histogram equalization, noise reduction, and super-resolution techniques to improve image clarity.

4 Result and Discussion

The proposed Face and Number Plate-Based Smart Parking System was evaluated using a combination of real-time video input and labelled datasets. The system's performance was assessed based on accuracy, efficiency, security, and user experience. The facial recognition component, which uses the Grassmann algorithm for feature extraction and convolutional neural networks for classification, achieved an average accuracy of 96.3% across varied lighting conditions and facial angles. Similarly, the license plate recognition system, trained on a dataset of vehicle plates with different backgrounds and angles, achieved a recognition accuracy of 94.8%. The system also demonstrated strong performance in detecting unauthorized access. During testing, out of 150 simulated attempts by unauthorized individuals, the system correctly identified and triggered alerts in 98% of the cases, showcasing the robustness of its security mechanisms. In terms of efficiency, the proposed system significantly outperformed traditional manual and RFID-based parking systems. While conventional ticket-based systems took 12 to 15 seconds per vehicle to process, the smart system reduced this time to under 4 seconds by enabling seamless authentication through facial and license plate recognition. Compared to RFID systems, which averaged 6–8 seconds and showed around 80% recognition accuracy, the deep learning-based approach offered both faster processing and higher reliability. Overall, the integration of deep learning techniques has led to improvements in both recognition performance and user satisfaction. Further analysis suggests that real-world deployment of the system would require addressing challenges such as low lighting, harsh weather conditions, and potential camera obstructions. Solutions like the use of infrared or thermal cameras and advanced image enhancement techniques can help mitigate these issues. Additionally, given that facial and vehicle data are sensitive, compliance with data protection laws and implementation of strong encryption protocols are essential. Feedback from a user study involving 50 participants revealed that 92% of users found the system to be convenient, fast, and secure. However, some users noted difficulties in recognition under low-light conditions, indicating a possible area for future enhancement. These results highlight the potential of deep learning-powered smart parking systems to revolutionize urban mobility and parking management through automation, accuracy, and enhanced security.

5 Conclusion and Future Work

Finally, a convolutional neural network (CNN) is used to extract alternatives for each character that identifies the vehicle town, kind, and number in order torecognize the characters on the number plate. For assistance with character identification from the quantity plate, the CNN includes a wide range of choices. This study used super resolution techniques to recognize characters with high resolution. In future work, extend the framework to implement various algorithms to provide still to video face matching with improved accuracy rate. Videos provide an automatic and efficient way for feature extraction. Data redundancy renders the recognition algorithm more robust. The similarity between feature sets from different videos.

References

[1] M. M. Rashid, A. Musa, M. A. Rahman, N. Farahana, and A. Farhana, "Automatic parking management system and parking fee collection based on number plate recognition," International Journal of Machine Learning and Computing, vol. 2, no. 2, pp. 94, 2012.

[2] M. Deenakonda, V. V. Inti, B. C. V. Chakravarthi, C. Rajyalakshmi, Y. T. R. Palleswari, A. Siva, and M. K. S. Pranay, "Sustainable Parking Innovations: Enhancing Security with IoT and Facial Image Recognition," in IOP Conference Series: Earth and Environmental Science, vol. 1375, no. 1, p. 012031, IOP Publishing, July 2024.

[3] A. Fahim, M. Hasan, and M. A. Chowdhury, "Smart parking systems: comprehensive review based on various aspects," Heliyon, vol. 7, no. 5, e07050, 2021.

[4] I. F. Ashari, "Parking system optimization based on IoT using face and vehicle plate recognition via Amazon web service and ESP-32 CAM," Computer Engineering and Applications Journal, vol. 11, no. 2, pp. 137–153, 2022.

[5] M. M. Abdellatif, M. F. Hossain, M. I. M. Mohd, and M. S. Islam, "Low-Cost IoT-Based Arabic License Plate Recognition Model for Smart Parking Systems," in 2022 IEEE International Conference on Smart Electronics and Communication (ICOSEC), pp. 1937–1942, 2022.

[6] A. Aditya, D. N. R. Lakshmi, R. K. S. Reddy, and A. S. Kumar, "An IoT Assisted Intelligent Parking System (IPS) for Smart Cities," in 2021 IEEE International Conference on Distributed Computing, VLSI, Electrical Circuits and Robotics (DISCOVER), pp. 285–290, 2021.

[7] W. A. Jabbar, L. Y. Tiew, and N. Y. A. Shah, "Internet of Things Enabled Parking Management System Using Long Range Wide Area Network for Smart City," IEEE Internet of Things Journal, vol. 7, no. 5, pp. 4471–4482, May 2020.

[8] R. Wolniak, "Smart Mobility in Smart City – Copenhagen and Barcelona Comparison," Transportation Research Procedia, vol. 58, pp. 112–119, 2021.

[9] E. Faliagka, K. Votis, and D. Tzovaras, "Trends in Digital Twin Framework Architectures for Smart Cities: A Case Study in Smart Mobility," in 2022 International Conference on Smart Cities and Green ICT Systems (SMARTGREENS), pp. 195–202, 2022.

Cite this article:

Kamali G & Malathi S., "Smart Parking System", Journal of Multidimensional Research and Review (JMRR), Vol.6, Iss.2, pp.92-96, 2025