Intelligent Face Recognition Based Multi-Location Linked IoT Based Car Parking System

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Abstract - The integration of Industrial Internet of Things (IoT) and Artificial Intelligence (AI) hasrevolutionized various industries, particularly in applications like smart traffic management and intelligent parking systems. This paper explores the intersection of IoT technology and AI advancements in addressing urban mobility challenges. Specifically, it focuses on IoTenabled smart parking systems, which offer users features such as locating vacant parkingspots, recommending optimal routes, and providing real-time predictions on parkingavailability while ensuring compliance with privacy regulations. Additionally, the paper discusses the role of the Internet of Vehicles (IoV) in facilitating communication betweenvehicles and infrastructure, along with the use of deep learning models for analyzing big datain industrial IoT settings. Challenges related to privacy concerns and computational demandsare addressed, and solutions such as convolutional neural networks (CNNs) and deep metric learning are proposed. The paper underscores the significance of smart parking solutions in reducing traffic congestion and pollution in metropolitan areas and proposes an intelligent central car parking system integrated into a smart city IoT architecture. Managed by an IoT management centre, the system aims to optimize parking allocation and enhance urban mobility within the smart city framework.

Keywords*—Industrial Internet of Things(IIoT),Artificial Intelligence(AI),Smart traffic management,Intelligent parking systems,Urban mobility.*

I.INTRODUCTION

The integration of Industrial Internet of Things (IoT) and Artificial Intelligence (AI) hassignificantly propelled advancements in intelligent industries. This fusion has notably facilitated progress in applications like smart traffic management and intelligent parking systems. Utilizing IoT technology, these systems offer users various functions to enhance urban mobility experiences. For instance, IoT-enabled smart parking systems provide users with four primary features. Firstly, they assist users in locating vacant parking spots that suit their specific requirements regarding proximity to their destination and parking quality. Secondly, they recommend optimal routes based on factors like travel time and traffic conditions. Thirdly, they enable real-time predictions regarding parking zone availability, all while adhering to privacy regulations such as the General Data Protection Regulation (GDPR) .In the automotive sector, the Internet of Vehicles (IoV) stands out as a notable application of IoT, facilitating communication between vehicles and infrastructure to deliver various services including navigation, entertainment, safety, and parking assistance . Additionally, the analysis of big data enabled by IoT has led to the frequent use of deep learning (DL) models in industrial IoT settings. However, traditional centralized learning approaches face challenges in sensitive industrial contexts due to privacy concerns .Moreover, convolutional neural networks (CNNs) have emerged as crucial technologies for face tracking systems, although their computational demands pose deployment challenges in large-scale systems . Efforts have also been made to employ deep metric learning and facial picture synthesis for recognizing emotions, using synthetic data to complement training sets .Integrating these technological advancements, smart cities aim to enhance the quality of life for their citizens, particularly through convenient public transportation solutions. However, increasing car ownership exacerbates urban traffic congestion, emphasizing the importance of IoT-enabled intelligent parking systems. The parking challenge is particularly acute in metropolitan areas, where a surge in vehicles strains limited parking resources and compromises safety. Consequently, there is growing interest in intelligent parking systems globally, with IoT playing a crucial role in monitoring smart city hotspots The concept of IoT revolves around connecting various devices to enable remote control and monitoring via the Internet, facilitating data exchange and two-way communication between devices. The parking challenge not only contributes to congestion but also worsens pollution, underscoring the importance of smart parking solutions in reducing fuel wastage and

II. LITERATURE SURVEY

The expansion of the automotive sector has raised consumer demand for automobiles, making parking problems in cities worse. By automating parking place distribution, smart parking systems lower traffic, waste time, and emit less pollution. They do this by utilizing technologies like Wireless Senso Networking (WSN), Cloud Technology (CT), Fog Computing (FC), a nd the Internet of Things (IoT). By

moving processing power to the network edge, fog computing solves latency problems.Deep learning-based smartphone apps for real-time parking place prediction, duallensmillimeterwave (MMW) radar antennas for precise parking identification, and solar-poweredautonomous sensing nodes for vehicle recognition are a few examples of innovations. More and moreInternet of Things (IoT) applications are incorporating facial recognition technologies for emotionalanalysis and identification verification. Limited data from IoT devices and a wide range of facialexpressions present issues for deep learning models. Realtime face expression recognition is made possible by edge computing, which lowersnetwork overhead by processing data locally. Users can securely train models on local devices with federated learning, maintaining privacy and increasing accuracy at the same time. Gaussian mixture models and feature dictionaries have made it possible to analyze various facial expressions in order to gain insight into people's perceptions and emotional states.or precise and effective face matching, multi-scale face detectors, face association methods, and unsupervised subspace learning are used in video-based face identification systems. Decentralized authentication systems based on blockchain improve security and dependability in edge and Internetof Things environments.

III..OBJECTIVES

The suggested smart parking system aims to enhance urban parking management in many significant Tplaces. First off, by using facial recognition technology, the system seeks to improve security and access control by making sure that only drivers with permission can enter parking lots. Second, the system aims to automate license plate reading through the use of optical character recognition, which will enable effective vehicle identification and streamline entry and leave processes. Furthermore, real-time monitoring of parking availability is made possible by t he integration of IoT devices, which cuts down on the amount of time spent looking for a spot and permits dynamic modifications to parking allocation. Additionally, by giving drivers precise and current parking information, the system seeks to ease traffic congestion and eventually cutfuel consumption and CO2 emissions. In addition, the system enhances the overall sustainability and efficiency of urban environments by pushing the development of smart city technologies and IoT applications inparking management. In general, the smart parking system's goals include raising the Inintegration of smart technologies into urban infrastructure, decreasing traffic, increasing security, andsimplifying procedures.

IV.METHEDOLOGY

Novel approaches to improve parking systems and traffic monitoring are being developed, employing cutting-edge technologies like Kalman filters and Convolutional Neural Networks (CNNs). By enabling the segmentation and classification of vehicles for intelligent traffic monitoring, these technologies enhance the effectiveness of large-scale traffic flow management.Ingnition technology is essential. In order to improve user experience and vehicle security, models are made to precisely identify facial features and validate identities.order to provide security and identification in smart parking systems,facial recoRecurrent deep neural networks (RDNNs) and the Deep Extreme Learning Machine(DELM) are two examples of deep learning algorithms that are used to optimize parking trajectories and forecast t he availability of parking spaces. These models can be implemented in smart city contexts since they use neural networks to increase accuracy while consuming less resources. order to provide security and identification in smart parking systems, facial recoConvolutiona l Neural Networks (CNNs) are used in traffic monitoring to process aerial data and segment cars. Kalman filter-based approaches are then used for vehicle tracking and classification i n order to efficiently control traffic flows. Then, in order to improve detection accuracy, filtering techniques are used to minimize noise in traffic video frames. By creating a Multi-Location Linked IoT based Car Parking System with Intelligent Face Recognition, the suggested methodology seeks to address issues related to urban mobility. This system makes use of cutting-edge technologies including edge computing, face recognition, and the Internet of Things (IoT) to improve the security and efficiency of parking lot operations. When a car first arrives in the city, the system registers it with a central parking managementcentre. Vehicles can select parking spaces in the area that best suit their needs by registering. However, the technology optimizes the parking process by recommending appropriate slots in high-traffic locations, avoiding potential delays in selecting parking slots. The capacity of the suggested system to carry out multi-location linking for parking spots forms its fundamental component. This feature makes sure that the system provides customers with alternate parking slots in case the requested slot isn't accessible. Through the application of this multi-location connecting strategy, the system lowers parking delays and boosts overall performance. The approach also highlights how crucial face recognition technology is to car security. Every passenger in the car has their facial characteristics taken at the entrance, and these faces are compared when they get out to ensure security. The technology makes use of sophisticated face recognition algorithms to guarantee safe parking operations a nd validate the identity of occupants. All things considered, the suggested methodology blends cutting-edge technologies to produce a smart parking system that boosts urban mobility, lessens traffic, and raises city dwellers' quality of life. The system's goal is to minimize the negative effects of traditional parking systems on the environment and the economy while offering users a smooth and convenient parking experience through sophisticated security measures and effective parkingmanagement.

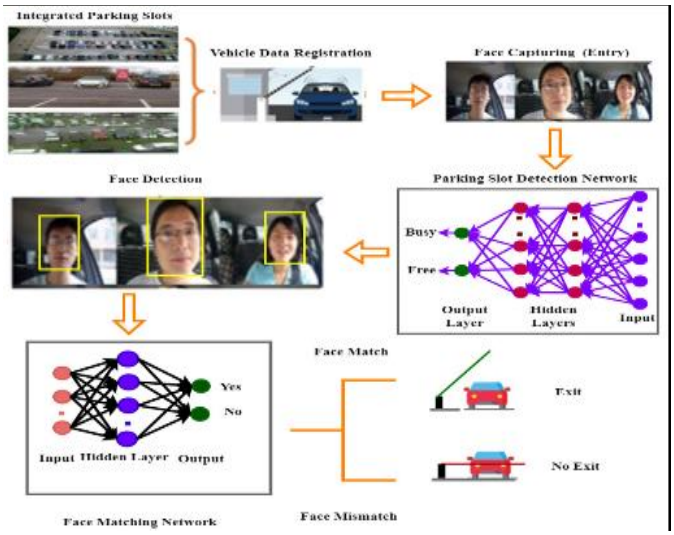

FIGURE 1: Proposed model framework

V.RESULTS AND DISCUSSION

By making parking easier to find and less expensive overall, the smart parking solution that is being shown here significantly improves the user experience. The integration of many parking spaces into a single, centrally managed system offers users the advantage of greater convenience. In order to save customers time, lessen traffic congestion, and save fuel, our research suggests a smart parking system that reduces data transmission and energy usage. Facial recognition technology also improves vehicle security by confirming the identity of the driver when they enter and exit the car. Utilizing Google Colab and Python for implementation and testing, the system examines four datasets that correspond to parking spots that can hold up to 200 cars, demonstrating its efficacy in contrast to conventional methods. When a car enters the central parking area, it is registered with the car's information and the driver's picture is taken for security. When compared to conventional approaches, the suggested solution simplifies the car registration process. In addition, parking spaces are dynamically assigned according to arrival time, guaranteeingeffective use of available space and lessening traffic jams. A comparative analysis shows that the suggested approach is more accurate and efficient at detecting parking spaces and allocating alternate parking spaces in a timely manner when needed. Furthermore, the accuracy levels of facial feature extraction validate the dependability of the system for driver verification at exit. All things considered, the suggested smart parking system provides a thorough answer to the problems associated with urban parking, improving user convenience while reducing environmental effects.

VI. CONCLUSIONS

The swift progression of facial recognition and Optical Character Recognition (OCR) technologies presents opportunities to improve accuracy and convenience across a range of applications. Researchers are working to tackle the obstacles these technologies confront despite their increasing popularity and integration into other systems. Simplifying procedures and cutting down on scan times are the main goals, along with guaranteeing data integrity by cross referencing with databases. Researchers are working to tackle the obstacles these technologies confront despite their increasing popularity and integration into other systems. Simplifying procedures and cutting down on scan times are the main goals, along with guaranteeing data integrity by crossreferencing with databases. Furthermore, the Internet of Things (IoT), which transforms modern life by automating chores and processes, is strongly related to the future of automation. IoT offers a chance to optimize parking place distribution in the context of parking systems, saving drivers time and effort. By offering easy transit options, IoT enabled smart parking systems improve t he quality of life for inhabitants and aid in the development of smart cities.

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