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A DEEP LEARNING POWERED SMART PARKING SYSTEM BASED ON FACIAL RECOGNITION AND LICENSE PLATE ANALYSI

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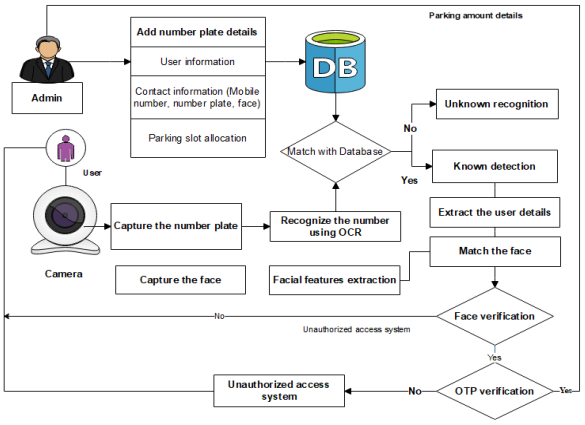
Abstract – In today's urban landscapes, parking congestion has become a pervasive challenge, leading to wasted time, increased emissions, and driver frustration. The ever-growing urban population, coupled with the increasing number of vehicles, has led to a severe shortage of parking spaces in metropolitan areas. This scarcity has not only made finding a parking spot a time-consuming and frustrating experience but has also contributed to traffic congestion and environmental pollution. Traditional parking management systems, which often rely on manual ticketing or physical barriers, are becoming inadequate in addressing these challenges. To address this issue, innovative solutions that combine technology and automation are on the rise. Traditional parking management systems often rely on physical infrastructure and human intervention, resulting in inefficiencies and limited scalability. In contrast, the integration of deep learning techniques and advanced computer vision technology into parking management opens up new possibilities for a smarter, more efficient, and user-friendly experience. This system leverages two key components: facial recognition technology to identify vehicle occupants and automatic recognition of license plate numbers for vehicle identification. By seamlessly integrating these technologies, the system not only facilitates effortless parking but also enhances security and optimizes parking space utilization.we will explore the fundamental components, benefits, and potential impact of the Face and Number Plate-Based Smart Parking System. Experimental results shows that improved efficiency in smart parking system using face and number plate verification system.

1. INTRODUCTION.

In our increasingly urbanized world, the efficient management of parking spaces has become a critical aspect of urban planning and daily life. Parking is not only a matter of convenience for drivers but also an essential component of traffic management, environmental sustainability, and revenue generation for municipalities and businesses. To address the challenges of parking in crowded urban areas and streamline the parking experience, advanced parking systems have emerged. These systems leverage technology, data, and automation to optimize the use of available parking spaces, enhance user convenience, and improve the overall management of parking facilities. This introduction provides an overview of parking systems, outlining their significance, components, and the benefits they offer to both drivers and parking operators. As urban centres continue to grow, the role of parking systems in creating more efficient and sustainable cities becomes increasingly crucial. Security is a paramount consideration in parking systems, ensuring the safety of vehicles, individuals, and the overall operation of the facility

2. SYSTEM ARCHITECTURE

System architecture involves the high-level structure of software system abstraction, by using decomposition and composition, with architectural style and quality attributes. A software architecture design must conform to the major functionality and performance requirements of the system, as well as satisfy the non-functional requirements such as reliability, scalability, portability, and availability. Software architecture must describe its group of components, their connections, interactions among them and deployment configuration of all components. The system concludes with the classification. Each section was separately assessed for the likelihood of true positives once the structure had been examined. In this architecture, admin can add the number plate details with contact information. After data saving, user can be verified through camera for capture the number plate. And extract number plate details using Optical character recognition algorithm. Then match the number plate with facial points using Grassmann algorithm. Finally send OTP to user for further verification



FRAMEWORK CONSTRUCTION

Nowadays in many public places such as malls, multiplex systems, hospitals, offices, market areas there is a crucial problem of car parking. The car-parking area has many lanes/slots for car parking. So, to park a car one has to look for all the lanes. Moreover, this involves a lot of manual labor and investment. So, there is a need to develop an automated parking system that indicates directly the availability of vacant parking slots in any lane right at the entrance. It involves a system including infrared transmitter- receiver pair in each lane and a display outside the car parking gate. So, the person desirous to park his vehicle is well informed about the status of availability of parking slot. Conventional parking systems do not have any intelligent monitoring system and the parking lots are monitored by security guards. In this module, admin can login to the system to view the parking information and user details. Constructing a framework for a smart parking system involves the integration of various technologies to efficiently manage parking spaces. At its core, the framework incorporates sensors and Internet of Things (IoT) devices, such as in-ground sensors or cameras, to monitor parking space occupancy in real-time. Edge computing devices play a crucial role by processing data locally, reducing latency, and enhancing system responsiveness

MEMBER REGISTRATION

Due to the large amount of time people spend on parking their car, there is a need for a better system which reduces the time taken to park vehicles, the current system which exists involves the client(user) to wait in a queue where each car has to wait for a token to be generated, this token is kept by the client till he is done with his work and on the time of exit has to return the token, which then calculates the time spent and the bill is generated. But the

problem with this current system is the queue, each person is unique in their own way, so it depends from person to person, some people might quickly take the token and park their car, while some might take a longer time, leading to delay. Member registration is the formal process through which individuals or entities express their intention to join and participate in a specific organization, platform, service, or community. This involves the systematic collection of user information, encompassing personal details like names, contact information, addresses. Account creation is a fundamental aspect, with users selecting unique usernames and passwords that will grant them secure access to the associated platform or services. Verification mechanisms are typically implemented to ensure the accuracy and authenticity of the registration details; this can involve email verification, SMS confirmation, or other validation methods. Additionally, during the registration process, individuals often agree to the terms and conditions set forth by the organization or platform, outlining the rules, responsibilities, and expectations associated with membership. Overall, member registration is a crucial initial step in fostering a sense of belonging and engagement within a particular community or organization. In this module, user registers their details such as number plate details, user type, id, name, father name, gender, age, mobile, email, address, vehicle type, face.

Optical Character Recognition (OCR) has been a topic of interest for many years. It is defined as the process of digitizing a document image into its constituent characters. Despite decades of intense research, developing OCR with capabilities comparable to that of human still remains an open challenge. Due to this challenging nature, researchers from industry and academic circles have directed their attentions towards Optical Character Recognition. Over the last few years, the number of academic laboratories and companies involved in research on Character Recognition has increased dramatically. This research aims at summarizing the research so far done in the field of OCR. Optical Character Recognition (OCR) is a piece of software that converts printed text and images into digitized form such that it can be manipulated by machine. Unlike human brain which has the capability to very easily recognize the text/ characters from an image, machines are not intelligent enough to perceive the information available in image. Therefore, a large number of research efforts have been put forward that attempts to transform a document image to format understandable for machine. OCR is a complex problem because of the variety of languages, fonts and styles in which text can be written, and the complex rules of languages etc. Hence, techniques from different disciplines of computer science (i.e. image processing, pattern classification and natural language processing etc. are employed to address different challenges. An OCR is not an atomic process but comprises various phases such as acquisition, pre- processing, segmentation, feature extraction, classification and post-processing. Each of the steps is discussed in detail in this paper. Using a combination of

these techniques, an efficient OCR system can be developed as a future work. The OCR system can also be used in different practical applications such as number-plate recognition, smart libraries and various other real-time applications.

FACIAL FEATURES EXTRACTION

Facial features extraction using the Grassmann algorithm entails a sophisticated application of mathematical principles from Grassmannian geometry to analyze and derive meaningful information from facial images. The process initiates with the detection of faces within an image, employing techniques like deep learning-based methods. Subsequently, facial landmark detection is crucial for identifying key points on the face, such as eyes, nose, and mouth. The next step involves transforming facial images into a mathematical representation on the Grassmannian, a space that characterizes subspaces within a vector space. This representation encapsulates essential facial features. The Grassmann algorithm is then applied to examine the geometric properties of these facial subspaces, allowing for a comprehensive analysis of the spatial relationships and structural characteristics of facial features. This intricate approach to facial features extraction holds significance in computer vision applications, particularly in the realms of face recognition and understanding facial geometry. This module, facial features are extracted. And constructed as feature vectors. Facial features include nose part, eye parts and lip part. These values are stored is in the form of matrix. Grassmann algorithm is used in this process. Face registration is the process of transforming different sets of data into the coordinate system. Facial features are stored with labels. Labelling the faces using their names.

GRASSMAN ALGORITHM:

For each frame in a video sequence, we first detect and crop the face regions. We then partition all the cropped face images into K different partitions. We partition the cropped faces by a Grassman algorithm type of algorithm that is inspired by video face matching algorithm. Sampling and characterizing a registration manifold is the key step in our proposed approach. The proposed algorithm presents a novel perspective towards frame selection by utilizing feature richness as the criteria. It is our assertion that quantifying the feature richness of an image helps in extracting the frames that have higher possibility of containing discriminatory features. In order to compute feature-richness, first the input (detected face) image I is preprocessed to a standard size and converted to grayscale. By performing face detection first and considering only the facial region, we ensure that other non-face content of the frame does not interfere with the proposed algorithm. Given a pair of face coordinates, we determine a set of affine parameters for geometric normalization. The affine transformation maps the (x, y) coordinate from a source image to the (u,v) coordinate of a normalized image.

TOKEN INFORMATION

Necessary precautions have been taken programmatically just in case of a parking-lot's running out of parking space problem during the process of this application. That way vehicles

that are about to check-in will not be let in, thus, there will not be any time-loss to look for parking space. Another problem is the application's disconnection to the central database during its operation. This is basically the result of the internet infrastructure breakdown. To avoid such a problem, necessary precautions were taken to run the database on both a local and a remote server simultaneously. In this module admin can be provide the slot to the users with number plate and time of parking. Slot details can be verified at the time leaving from parking.

VERIFICATION SYSTEM

In this module, verification done with help of number plate verification with facial data recognition. if user can leave from parking means, camera can be capturing the vehicle number using Optical character recognition algorithm. Then match the number plate with face recognition using Grassmann algorithm. After successful verification, OTP can be sent to registered mobile number. If OTP number not verified means, send alert to admin about theft access. Finally parking amount collected based on in and out time calculation.

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