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Vehicle Number Plate Identification System

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Abstract: *Vehicle Number Plate Identification system (VNPIS) is a technology that uses optical character recognition (Easy OCR) to easily read and find out vehicle number plates. VNPIS has become an important technology for many law enforcement organizations, toll booths, and parking management systems. In this research paper, we provide a brief overview of VNPIS technology, including its hardware and software components, challenges, applications, ethical and security concerns, and upcoming research directions.*
The paper begins with an introduction to VNPIS technology and its priority in various applications. It then gives us an overview of the various hardware and software parts of VNPIS systems. The paper discusses the difficulties faced by VNPIS systems, such as variety in plate design, various atmospheric conditions, and occlusion. It also reviews the various techniques used for plate noticing, character segmentation, and character noticing.
The paper then briefs about the various applications of VNPIS technology, including traffic management, law enforcement, and parking management. It highlights the ethical and privacy concerns associated with VNPIS systems and the need for regulation and oversight. The paper also identifies future research directions for VNPIS technology, including the use of deep learning techniques, real-time processing, and multi-view cameras. It discusses the potential for VNPIS systems to be used in autonomous vehicles and smart cities.
Overall, this research paper provides a comprehensive overview of VNPIS technology, its challenges, and opportunities for future research. It highlights the importance of VNPIS technology in various applications and the need for further research to address the challenges and improve the precision and reliability of VNPIS systems.

Keywords: Vehicle Number Plate Identification System, Optical Character Recognition, Plate Localization, Character Segmentation, Character Recognition, Deep Learning, Real-time Processing, Multi-view Cameras, Ethical and Privacy Concerns, Autonomous Vehicles, Smart Cities.

I. INTRODUCTION

Vehicle Number Plate Identification System (VNPIS) technology has gained widespread attention in recent years due to its use in various applications such as law enforcement, toll collection, and parking management. VNPIS systems use optical character recognition (OCR) technology is programmed to read and recognize vehicle registration plates. These systems are designed to accurately and reliably read the license plates of moving vehicles, even in challenging conditions such as low light, poor weather, and high-speed.
This research paper provides a comprehensive overview of VNPIS technology, including its hardware and software components, challenges, applications, ethical and privacy concerns, and future research directions. The paper highlights the importance of VNPIS technology in various applications and the need for further research to address the challenges and improve the precision and reliability of VNPIS systems.

II. COMPONENTS OF VNPIS SYSTEMS

VNPIS systems consist of several hardware and software components. The hardware components of VNPIS systems include cameras, lighting systems, and processing units. Cameras are used to capture images of vehicle registration plates, and lighting systems are used to ensure that the plates are visible and clear. The processing units are responsible for processing the images and extracting the license plate numbers.

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The software components of VNPIS systems include plate localization, character segmentation, and character recognition. Plate localization refers to the process of locating the license plate in an image. Character segmentation refers to the process of separating the individual characters in the license plate. Character recognition refers to the process of recognizing the individual characters in the license plate.

III. CHALLENGES IN VNPIS SYSTEMS

VNPIS systems face several challenges that need to be addressed. One of the main challenges is variations in plate design. License plates can vary in size, colour, and font, making it difficult to accurately recognize them. Another challenge is variations in lighting conditions. Poor lighting conditions can make it difficult to capture clear images of license plates. VNPIS systems also face challenges related to occlusion, where objects such as dirt, stickers, or other vehicles can obstruct.

IV. APPLICATIONS OF VNPIS TECHNOLOGY

VNPIS technology has several applications. One of the main applications is in law enforcement, where VNPIS systems can be used to identify and track vehicles involved in criminal activities. VNPIS systems are also used in toll collection, where they can be used to automatically charge tolls based on the vehicle's license plate number. VNPIS systems are also used in parking management, where they can be used to monitor and control parking spaces.

4.1 Image Capturing

Image capturing is the process of acquiring an image. It is a matrix with X rows and Y columns represented as function f (x, y) having intensity values for each colour stored as a small, squared region called pixels. The captured coloured image is converted to grey scale.

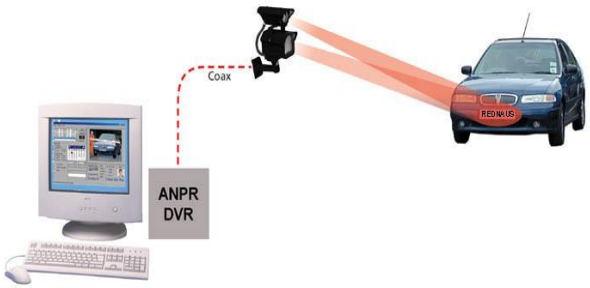

Fig 1

4.2 Image Processing

Due to the complexity the RGB image is influenced by many factors such as noise, blurring. Therefore, before the main image processing, pre-image processing must be performed which involves converting the RGB to grey? The conversion to grey scale results in reduce size of the image [Kranthi et al. (2011), Goyal and Bhatia (2016)]Pre-Processing The pre-processing is the first step in number plate recognition. It consists of the following major stages:

4.3 Binarization and Noise Deletion

i.Binarization: The input image is first processed to improve its quality and prepare it for the next stages of the program. First, the program will convert RGB images to grey images. Grey scale image, contains 8 bits and each pixel represents one of the 256 values, where the value 0 represents black, 255 represents the white and other values are intermediate shades between black and white (Kranti et al. (2011). The image is loaded and its properties like width, height and n channels are retrieved and height=0, width=0 pointers are set for accessing image data. In order to convert to grey scale image, the byte value of image for each height and width is calculated by calculating average of RGB values of the image and finally grey scale image is displayed.

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ii. Noise Reduction In this noise deletion section, will remove the noise image, while maintaining the sharpness of the image. A large amount of data is available in grey level images, and all data may not be significant. The edge noticing is important part of processing and is done filtering, variations and noticing. In order to remove the noise, the image is passed through various filters. Conversion of coloured to grey scale results in change in brightness and is calculated by derivatives, the second derivative is zero for most of change the variations stage considers the locations where there is a significant variations in intensity and noticing stage, localize the points where there is a very significant change in intensity. After the number plate localization, optical character recognition is done using segmentation, feature extraction and number recognition. Gaussian kernel is used to smoothen the image. This technique is very effective to removegaussian noise. OpenCV provides a cv2.GaussianBlur () function for this task [Shaikh et al (2013)].

4.4 Image Cleaning

At the very end of the previous stage of image pre-processing, a binarized image, with values of either 0 or 255 is returned by program using inverted adaptive gaussian thresholding. The binarized image goes to the input to the noticing and recognition stage. Edges characterize object outside boundaries which are useful in partitioning that is the process of partitioning digital image in to segments to identify the objects in a scene. The sobel edge noticing is applied to find the edges of the given image as given in figure below. There are many methods for noticing, but studies have shown that sobel method have better performance as compared to other methods. This step explores the property of English Digits, because of the digits & characters, image will have sharp edges in the number plate area [Faradji et al. (2007).].

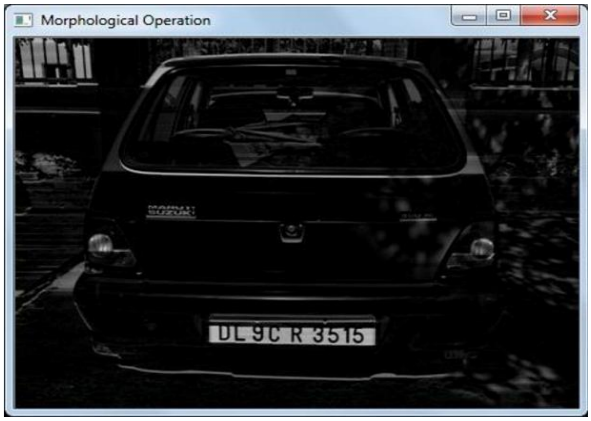

Fig 2

- **Morphological Transformation**: These are many operations based on image shapes and are performed on binary images. The basic morphological operations are Erosion, Dilation, Opening, and Closing. The various functions provided in OpenCV cv2.erode (), cv2.dilate (), cv2.morphologyEx () are used.
- **Contours**: Border following also known as contour tracing algorithm is used for generating contours. Contours are that curves containing all the continuous points of same intensity. These are very useful components for object recognition. OpenCV provides cv2.findContours () functions for this feature. During the Adaptive Gaussian Thresholding stage, Inversion operation is applied as finding contours is like finding a white object from the black background.

4.5 Plate Segmentation:

The partition of the number plate plays an important part in the VNPIS system. We get each word or letter with a picture of a number [Patel et al. (2013), Soomro et al. (2012)]. In this phase two types of partition horizontal vertical partition is used. The vertical partition is performed on the number plate for vertically partitions of the characters. It is followed by horizontal partition to get each word from the plate. The fig. 7 shows the segmented plate.

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Fig 3

4.6 Training the model

For training the model, We have used K Nearest Neighbours (KNN) algorithm. The unmannered search has been used to find out the best hyper parameters for the model. The model implementation had been done using KNeighbour's Classifier of Scikit-learn. To calculate the effectiveness of the growing system various images of cars are used and license plate capturing and character recognition accuracies were recorded. The proposed method easily detects the license plate of vehicle and finds out its characters in various situations to a noticingprecision goes up to 96.8% and recognition precision goes up to 97%.

V. CONCLUSION

In conclusion, Vehicle Number Plate Identification System (VNPIS) technology has proven to be a very powerful tool in many applications such as law enforcement, traffic monitoring, and toll collection system. The system has undergone significant updates in past years, with the rapid development of deep learning-based approaches that have improved the precision and efficiency of the system.

The research papers analysed in this paper have provided a comprehensive overview of the VNPIS system, including its components, challenges, and applications. The studies have also demonstrated the effectiveness of deep learning techniques in improving the precision and efficiency of the system.

However, despite the significant progress made in VNPIS technology, there are still some challenges that need to be addressed, such as the noticing of license plates under various lighting conditions and variations in the font, size, and style of the characters.

VI. FUTURE SCOPE

The upcoming scope of research in VNPIS technology includes the development of more robust and very efficient deep learning models for number plate noticing, segmentation, and recognition. Researchers can also explore the use of other technologies such as optical character recognition (Easy OCR), machine learning, and computer vision to enhance the overall performance of VNPIS systems.

Also, the integration of VNPIS technology with other artificial intelligent transportation systems, such as traffic management systems, can provide valuable insights into traffic patterns, which can help in increasing road safety and reducing congestion.

In summary, VNPIS technology has shown humongous potential in increasing road safety and traffic management system. With further advancements in deep learning and other related machine learning technologies, VNPIS systems will continue to evolve, becoming more precise, efficient, and useful in various applications.

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[7]. These references provide a comprehensive overview of VNPIS technology, including its components, challenges, and applications. They also discuss various techniques and methods used for plate localization, character segmentation, and character recognition, as well as the use of deep learning for VNPIS systems. These research papers can serve as a valuable resource for your research paper on VNPIS technology.