ALL REFERENCES REGARDING PROJECT :-

1. Slow Motion
https://www.codespeedy.com/creating-a-slow-motion-video-using-opencv-in-python/

2. Changing frame perspective

https://www.tutscode.net/2
020/04/how-to-change-perspective-image-with.html

3. Object Recognition
https://www.geeksforgeeks.org/detect-an-object-with-opencv-python/

4. Increasing pixel
https://github.com/abhishek305/Opencv-HDR-demo/blob/master/hdr.py

5. Blur
https://github.com/maponti/imageprocessing_course_icmc/blob/master/05b_restoration_deconvolution.ipynb

6. Text recognition

https://www.geeksforgeeks.org/text-detection-and-extraction-using-opencv-and-ocr/

Articles:

Article-1:

1.2 The Benefits of OCR technique: It increases the efficiency and effectiveness of office work. The ability to instantly search content is immensely useful, especially in an office setting that has to deal with high volume scanning or high document inflow. You can now use the copy and paste tools on the document as well, instead of rewriting everything to correct it. OCR is quick and accurate, ensuring the document's content remains intact while saving time as well

When combined with other technologies such as scanning and file compression, the advantages of OCR truly shine. Workflow is increased since employees no longer have to waste time on manual labor and can work quicker and more efficiently.

Radio frequency identification (RFID) technology has proven its usage diverse tracking and localization applications such as asset management, passports, transportation payments and inventory taking, etc. The RFID basic concept depends on storing data and retrieving it using tags, which are either embedded into the objects or attached on them. The main components of RFID tags are: an integrated circuit for storing and processing information and an antenna for receiving and transmitting signals.

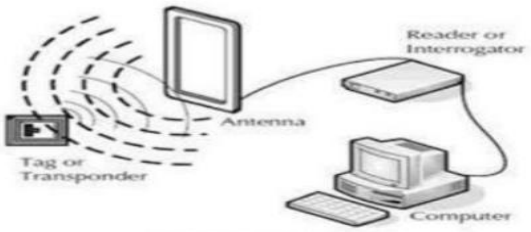

Fig.1.2. RFID system

Article-2:

Research Article

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A Review Paper on License Plate Recognition System

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Abstract

ANPR provides solution in which the steps to run an efficient intelligent transport network might be taken. Owing to the rapid increase in vehicles it has become a requirement for traffic control management. ANPR's main goal is to track traffic and for the purpose of defense. Number plate recognition uses image processing techniques or OCR techniques and edge detection technology to detect characters on license plates. The model comprises of three modules which are module for car detection, module for license plate segmentation and module for recognition. Starting from auto robberies, violating traffic laws, to law enforcement administration, Image processing gave us a determination to put a stop to these violations. This review paper provided an examination of the different license plate recognition design implemented so far.

Keywords: Automatic Number Plate Recognition (ANPR), Optical Character Recognition (OCR), License Plate (LP)

Introduction

The identification of license plate is a very good source of knowledge for record detection and recognition. But the conventional license plate recognition process is a boring one. The manual way of identifying the vehicle and its owner is not that applicable in detecting license plates to retrieve the hidden treasures of information. Automatic recognition of license plate is an important stage in the intelligent traffic network, and several ways for the construction of ANPR architecture have been developed [1]. Although the proportion of the license plate in the image is greatly correlated with shooting distance, therefore the ANPR architecture [7] is not easy to balance in. Vehicles in motion, however, are too tiny to capture in the huge open space and clear recognizable license plate images. Identifying a license plate from tiny and distorted pictures will reveal a lot of effort. One answer is to use a CCD camera with panning, tilting, and zooming (PTZ) capturing functions [2].

The various researchers have proposed various techniques for every step and an individual technique has its own pros and cons. The method for recognizing license plate includes the three main steps. That is the region of extraction of interest, extraction of plate numbers and recognition of character. Below is the block diagram for the license plate system:-

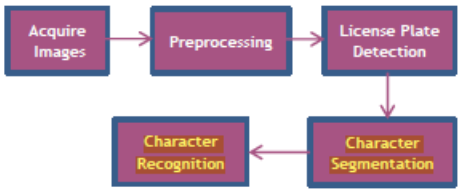

Figure 1: License Plate System Block Diagram

License plate recognition is achieved through device program ANPR. Images taken by using cameras displays the output of vehicle plate. ANPR's basic work is reading and unfolding license plate. ANPR are also called by the name of ALPR (Automatic License Plate Recognition). The software of this system forms a record of all number plates that interpret with all the related data such as date, time and GPS location. It utilizes the OCR technology for recognizing characters of number plates.

LPR is an important process of automatic parking. It will be a feature anticipated by industry demand for higher commercial parking management projects across the smart city areas. It has also been utilized for security purposes in toll collection systems, traffic control, also in gas stations, and many other opportunities for exploration [8]. ITS plays a leading role in facilitating smart cities due to its many applications such as highway surveillance, urban logistics and enforcement of traffic laws and much more [6].

The layout of the rest of the paper is as follows: section II is a summary of the literature showing the research conducted by other researchers in the field of license plate recognition, section III is an overview of the conclusion and future work.

Article-3:

AUTHOR NAME AND YEAR	DESCRIPTION	TECHNIQUES USED	OUTCOMES
Hanit Karwal et al. **(IEEE 2015) [1]**	The proposed technique shows the necessity of use of automated systems to maintain vehicle information. In the proposed algorithm an efficient method for recognition for Indian vehicle number plate has been devised.	Paper presents VNPD system based on template matching with Normalized cross correlation. It also uses modified Otsu's method for threshold partitioning.	It obtained the accuracy of 98.07 %.
S. Ramalingam et al. **(IEEE 2014) [2]**	In this paper the author has determined the impact on ANPR performance caused by illegal spacing between characters of number plate. The causes of inaccurate ANPR read data are examined in detail and recommendations made as to how improvements could be introduced to minimize the risk of misreads.	In this key data sets are generated through a simulation process that will generate car number plate images. In this Optical Character Recognition (OCR) is used.	Variable spacing does appear to have an adverse impact on ANPR engines. They were not able to predict the impact of illegal spacing or syntax rules that cause a complete fail to capture or misreads. Therefore more work has to b done.
Abd Kadir Mahamad et al. **(SPRINGER 2014) [3]**	Automatic inspection and recognition system has been proposed for Malaysian vehicles using optical character recognition (OCR). This system is tested for various implementations to ensure that that proposed method can be applied for real implementation	System is based on Digital Image Processing and Optical Character Recognition (OCR). An intelligent OCR Training Interface has been used as a library and the system has been developed using LabVIEW Software.	The proposed system shows good performance for inspection and can recognize an alphabets and numbers of vehicle Number plate.
Mr.G.T.Sutar et al. **(IJIRSET 2014) [4]**	They implement Number Plate Recognition (NPR). This system is designed keeping in mind automation of number plate detection for the security reason that could replace the current system of manual entry.	In this vehicle number plate region is extracted using the image segmentation in an Image. Optical Character Recognition (OCR) technique is used for character recognition.	The result shows that the system works against different lightening conditions and can be implemented on the entrance of a highly restricted areas. System successfully detects and recognizes the vehicle number plate on real images with an accuracy of 93%
Kuldeepak et al. **(IJECCT 2012) [5]**	They introduced that high degree of accuracy has been required by the number plate recognition when roads are busy and number of vehicles are passing through. For this there is a need of automatic number plate recognition. It also gives us warning for the stolen vehicle which cannot be possible for man handling services.	Character segmentation is used to separate each image from the background. The proposed system has been implemented using vision assistant 8.2.1 & labview 11.0.	By optimizing various parameters, they have achieved an accuracy of 98%. But for the tracking stolen vehicles and monitoring of vehicles an accuracy of 100% cannot be compromised with. Therefore to achieve better accuracy optimization is required.
Quraishi et al. **(RAIT 2012) [6]**	The purpose of the author to present this work is to provide a new approach for image recognition using Artificial Neural Network (ANN).	In this alternative solution for Object Recognition using Artificial Neural Networks (ANN) is used.	If the avg. error is less than 45% ANN can be applied for training & testing for the purpose of recognition. Therefore the test image is recognized & matched successfully with original image.

Article-4:

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22nd EURO Working Group on Transportation Meeting, EWGT 2019, 18-20 September 2019, Barcelona, Spain

A dynamic OD prediction approach for urban networks based on automatic number plate recognition data

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Abstract

OD flows provide important information for traffic management and planning. The prediction of dynamic OD matrices gives the possibility to apply anticipatory traffic management measures. In this paper, we propose an OD prediction approach based on the data obtained by Automated Number Plate Recognition (ANPR) cameras. The principal component analysis (PCA) is applied to reduce the dimension of the original OD matrices and to separate the main structure patterns from the noisier components. A state-space model is established for the main structure patterns and the structure deviations, and is incorporated in the Kalman filter framework to make predictions. We further propose three K-Nearest Neighbour (K-NN) based long-term pattern recognition approaches. The proposed approaches are validated with field ANPR data from Changsha city, P.R. China. The results show that the observed OD flows can be accurately predicted by our proposed approaches. Which prediction method performs best depends on the quality of the available data: for regular, periodic OD matrices the Kalman filter is better, for irregular OD matrices the pattern recognition that looks at different time periods in the historical data, gives better results.

Keywords: OD matrix prediction; principal component analysis; state-space kalman filter model; pattern recognition

1. Introduction

Traditionally, a dynamic origin-destination was not directly observable from traffic data. Several methods have been developed to derive origin-destination from traffic counts, historical data and partial actual data, such as origin

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- We establish a state-space model for significant structure patterns and structure deviations, and make a prediction basis from a historical data set using a Kalman filter predictor. In the meantime,
- We further develop K-Nearest Neighbours based pattern recognition methods to identify and predict structure patterns, and structure deviations.

In other words, we make a prediction under both shorter-term and longer-term, considering both the random trend as well as the latent pattern, in order to get a better prediction performance, also for the case that the historical observations are not applicable to the present and the future traffic state.

3. Data acquisition

The traffic data used in this study has been obtained from ANPR cameras in the city of Changsha, the capital of Hunan province in the P.R. China. Many intersections in Changsha are provided with ANPR cameras. Each camera can observe one lane and register the number plates of vehicles that pass the stop line of the intersection. The number plates of taxis can be separated from ordinary vehicles and OD matrices for taxis and other traffic can be separated (Sbai et al. 2017). The moments of the passing number plates are registered in seconds. The Number plates of three days were collected for further analysis: 20, 21 and 22 April 2015. From the available ANPR data a selection was made of 22 intersections.

Figure 1 The road network of the CBD of Changsha. The intersections with bold numbers have ANPR

4. Prediction models for the OD matrix

4.1. Data reduction

In order to reduce the data of the OD matrix a principal component analysis was executed. That is shown in the upper right part of Figure 2. First of all, the original OD matrix is centralized by column to derive the average value for each column and the covariance matrix of the centralized matrix. Secondly, we calculate the eigenvalue and the eigenvector of the covariance matrix and determine the number of principal component k. We select the first k column of the eigenvector as the principle components. In this way, we have transformed the high-dimensional OD matrix to the low-dimensional coordinate. Finally, we can calculate the score of each principal component by multiplying the centralized OD matrix with k principal components (first k column of the eigenvector).

Each whole OD matrix contains many elements but there are regularities in the data: correlations exist and it is possible to reduce the whole matrix to a few components that can represent the whole matrix in such a way that the matrix can be reproduced from a limited number of components. It appeared in our OD matrices that only 3 principal components were needed to explain 76% of the variation in the OD matrix over the whole day, 9 components explain 85%. In this paper we use 5 components for the prediction procedure, explaining 83%. The temporal behaviour of the score values of the principal components is rather regular for the first 3 and noisier for the higher components (see Figure 3).

Article-5:

the car and motorcycle in the UK (United Kingdom) is shown in the form of Table 1.

Table 1: Dimension of the vehicle's number plate in UK standard.

Dimension		
Properties	Car	Motorcycle
Character Height	79 mm	64 mm
Character Width	50 mm	44 mm
Character stroke	14 mm	10 mm
Space between characters	11 mm	10 mm
Space between groups	33 mm	30 mm
Space between vertical lines	19 mm	13 mm

For nearly half a century, vehicle number plate detection, as well as recognition, has been a topic of interest. This technique in the field has opened new challenges. In terms of consistency, color, number plate shape, and type of vehicle, the major challenges of vehicle number plate detection as well as recognition are focused on the various categories of features and are related to changing illumination level, the geometry of visualization, and background [9,10]. In Figure 2, typical samples of vehicle number plates [11] are shown.

Figure 2: Samples of vehicle number plate [11]

Number plate recognition procedure is divided into three key functions: Identification of Plate Area, Segmentation of Plate Character, and Recognition of Character [12-16]. In terms of traffic management, traffic optimization, traffic law enforcement, vehicle access control, automated collection of tolls, traffic speed control, automatic parking, monitoring of stolen cars, and tracking of possible acts of terrorism, each of these aspects plays a crucial role [6, 7, 14, 17, 18].

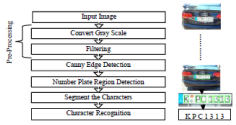

Figure 3: Flow diagram of common number plate detection and recognition method

Figure 3 shows common vehicle number plate detection and recognition method based on the edge detection method. At first, the vehicle registration plate detection as well as the recognition system capture the image using the camera and then apply some image processing techniques for pre-processing the image such as input image to grayscale image conversion, filtering technique to eliminate noise. Next, to extract the license plate area, apply the canny edge detection technique. After that, apply the appropriate detection method to detect the vehicle registration plate effectively, and apply the segmentation technique to segment the characters of the registration plate. Finally, the appropriate character recognition method is used to recognize each of the characters separately.

Due to the lighting conditions, the noisy image captured, fast-moving vehicles, are always a difficult task in vehicle number plate identification as well as recognition. Several researchers have been working on vehicle number plate recognition and are still working in this field. They have adopted several image processing techniques and presented some of their development strategies for vehicle number plate detection. As much research has been done so far in this paper on vehicle number plate detection as well as recognition and their success behind their proposed method and exactly what caused their proposed method to fail is discussed here. And this paper explores how to resolve their limitations or what more can be achieved in this area in the future.

Vehicle number plate detection studies, as well as recognition techniques, have been categorized into three sections in this review paper: (1) Related Works on Vehicle Number Plate Detection Techniques (2) Related Works on Vehicle Number Plate Recognition Techniques (3) Related Works on Vehicle Number Plate Detection as well as Recognition Techniques.

The residual of the paper is arranged in a structured way. The number plate detection strategies are demonstrated in section 2. Techniques for number plate recognition are discussed in section 3. In section 4, techniques of vehicle number plate detection, as well as recognition, are illustrated. Finally, section 5 states the conclusions.

2. Related Works on Vehicle Number Plate Detection Techniques

Number plate detection (NPD) is a technology that uses certain image features to understand vehicle registration plates to assess location data for vehicles [14,19]. To determine a location going to the next frame, NPD identifies a region of the vehicle number plate with similar structures. The consecutive frame fixes the area of detection in the prior frames with the observed area of the vehicle [20]. During the identification of the registration plate of the vehicle, various difficulties of the surrounding environment were observed. In addition to these, several vehicle number plate considerations are concise in Table 2.

Table 2: Some factors of vehicle number plates [14,21]

Variants of the number plates	Variants of the environment
Plate size Plate background Plate location Quantity Font Angle Screw	Brightness Similarity in background

The existing methods for the identification and recognition of vehicle license plates have been classified based on accuracy that is shown in Figure 12.

5. Conclusion

This study paper presents a concise description of the vehicle number plate detection as well as recognition techniques used for effective traffic monitoring and observation of the reliability of the methods. In the construction of a smart transport network, vehicle number plate detection, as well as a recognition system, plays an important role. Although identification of vehicle number plates has always been a difficult proposition for certain reasons including changes in lighting, glare, non-uniform type of license plate, different styles, and color effects in the environment. Recognitions may also use some image processing techniques in conjunction with neural networks to identify the number plate characters, moving distance images, numbering schemes, angled or side-view images. In this study, the methods of vehicle number plate detection and recognition have been classified based on accuracy. In the future, the preference is to use high-resolution cameras with an improved number of frames for better performance and effective license plate recognition. The classification section can be further improved with the complexity, speed, and chronological order. This study includes a comprehensive evaluation of the progress and future patterns in the identification and recognition of recent vehicle number plates which could be of value to researchers interested in such development.

Conflict of Interest

There is no conflict of interest reported between the authors.

Acknowledgment

We are thankful to the Department of Computer Science and Engineering, Jahangirnagar University.

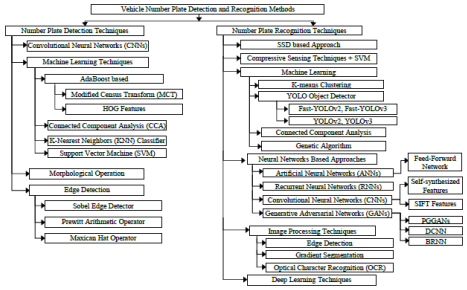

Figure 12: Existing frameworks for previous research.

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