Vehicle Number Plate Recognition System for Theft Detection

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Abstract— **Large number of vehicles around us in daily life creates disturbances such as heavy traffic, stealing of vehicles at the places like toll plazas, parking areas, heavy traffic roads. Management of vehicles transportation is tedious and time consuming task if it is completely done manually and which results in huge errors and faults. Therefore it is necessary to develop automatic license plate recognition system to solve the problems discussed above which will automatically recognize number from front side image of vehicle. The detection number plate goes through following steps: finding plate location in image, segmenting and recognizing characters. Number of license plate is displayed on graphical user interface and stored in database with time and date for further use and alarm will ring of stolen vehicle is detected. The system can be used for purpose of security as well as automatic highway speed detection, traffic violation cases, toll plazas, parking areas**

Keywords—Automatic vehicle license recognition system, Character segmentation, Character recognition, stolen vehicle, Theft detection.

I. INTRODUCTION

Vehicles are increasing in enormously as they are necessary to travel from one place to another place in little time. We see number of vehicles around us in our daily life and everyone needs it but with population increase, vehicles increased last decades in large quantity. But it created disturbances to human life such as huge traffic, large sound, crime cases such as stealing of vehicles, accidents, etc. and therefore management of vehicle is very necessary. As a result, there is a lot of work going on to improve the transportation of vehicles. Out of these, vehicle Plate Recognition System is the most attractive research issue and this manuscripts discusses some practical aspect of recognizing number written on vehicle number plate. A Vehicle Plate Recognition System is a tracking system that identifies the vehicle so that the car is tracked down through the existing database. Normally the recognition system will be installed at the gate of the residential area, factory entrances, parking space, toll gates, university entrance or other high-secured building such as defense institute, nuclear factories as given in [1].

Above Fig.1 describes the more details of Vehicle Plate Recognition system systematically. The presence of vehicle is detected using IR sensor after camera will capture image of vehicle which will be used for further processing. Basically,

vehicle registration plate is a plate which is made by either metal or plastic and is usually will be attached to the front or back of a vehicle. Vehicle plate number contains of numbers and alphabetical letter which can be used to represent an identity of respective vehicle as described in [2].
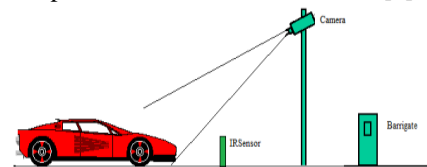

Fig. 1. Automatic Vehicle License Recognition System

The first two letter of the vehicle serves as the state location prefix and followed by two numerical digits which represents district from where vehicle belongs to. Number plate format of Indian vehicle is LLNN LLNNNN where L is letter and N is the number. If vehicles are recognized manually then will be more mistakes with less efficiency and slow. If the described system will be implemented artificially by using machines described in next chapter, it will be more efficient and Less Costly.

Paper is organized as follows. Section I is the introduction to the paper. Section II describes the literature survey of the systems and methods implemented so far. Section III is the details of implementations where three different steps are of the system i.e. Number plate extraction, Character segmentation and Character recognition described in detail. Section IV describes the Experimental results obtained in MATLAB. Section V deals with conclusion and acknowledgements of the project. Paper ends with references

II. LITERATURE SURVEY

Huge work is done on Vehicle License plate Recognition System in various industries; large numbers of papers are published by various authors in IEEE journals, non IEEE journal and Dissertation reports. Some basic references which are referred by authors are discussed in following section.

1. Christos Nikolaos E. Vassili Loumos ,Anagnostopoulos, Ioannis E. Anagnostopoulos, ,and Eleftherios Kayafas-'A License Plate Recognition. Algorithm for Intelligent Transportation System Applications' IEEE transaction on Intelligent Transportation System, Vol. 8, No. 3, Sept 2006

In this paper, a new algorithm for vehicle license plate identification is proposed, using segmentation technique and connected component analysis in conjunction with a character recognition. The algorithm was verified with different gray-level vehicle images of different backgrounds and ambient illumination. The camera towards the plate, while the angle and the distance from the vehicle varied according to the experimental setup.

2. Choudhury A. Rahman, Wael Badawy,Ahmad Radmanesh 'A Real Time Vehicle's License Plate Recognition System 'Proceedings of the IEEE Conference on Advanced Video and Signal Based Surveillance,0-7695-1971.June 2010.

A smart and simple algorithm is presented in this paper for vehicle's license plate recognition system. Depend on pattern comparison; this algorithm can be applied for real time detection of license plates for collecting data for surveying or for some application specific purposes. The system has been designed using C++ and the experimental results have been shown for recognition of Alberta license plates.

3. Banshidhar Majhi'Heuristics for license plate localization and hardware implementation of Automatic License Plate Recognition (ALPR) system'Department of Computer Science and Engg, National Institute of Technology Rourkela, 2012.

The project "Heuristics for license plate localization and hardware implementation of Automatic License Plate Recognition (ALPR) system" deals with detection and recognition of license plate from a captured front view of any car. The work obeys all the steps in an ALPR system like pre-processing, segmentation, and license plate localization, extraction of characters and finally recognition of each character to form a string to match with the registered License plate numbers.

Automatic Vehicle License Plate Recognition System consists of following 3 main processing steps as shown in Fig.2 License Plate Extraction from whole image, Character Segmentation form number plate and Character Recognition comparing with database images [3].

Methods	Pros	Cons
Using pixel connectivity	Simple and straightforward,	May not to extract all the characters when there are joined or broken characters
Using projection profiles	Independent of character positions	Noise may increase.
Using basic knowledge of characters	Simple Limited by the prior knowledge	Any change may result in errors.

There are various methods to detect License Number Plate from total image and segment the characters from number plate. Some methods are described in Table 1 with their comparative advantages and disadvantage [4]. Number plate localization is important step in developing VLPR system. If system fails to detect the location of License plate then VLPR system will not able to recognize the number plate.

Methods	Pros	Cons
Using boundary features	Simplest, fast and Straight forward.	Hardly be applied to complex images since they are too sensitive to Unwanted edges.
Using global image features	Straightforward, independent of the license plate position.	May generate broken objects.
Using texture features	Be able to detect even if the boundary is deformed.	Computationally complex when there are many edges.

Segmentation process is used to find the individual characters on the number plate considering character properties. It is segmented by finding the characters inside the image and bounded each character with the rectangle to separate them. Table 2 describes methods of characters segmentation [5].

III. DETAILS OF IMPLEMENTATION

A. After Plate Extraction Detection

The crucial and initial step in ALPR system is to extract the characters of number plate from the vehicle image. The procedure for detecting is done in several stages. The number plate extraction is started with the horizontal and vertical edge detection techniques that are based on the characteristics of the edge displayed by the edges of the character on the vehicle's number plate. The procedure used to for number plate extraction out of total image is discussed as follows.

1. Read Photo of vehicle as Input Image (I) and Crop the Image with Proper Dimensions(IC).
2. Use Morphological Operation like Closing with Proper Structuring Element.
3. Obtain Difference between I-Ic and Find all candidates for Number Plates by Labelling Connected Component in it. Measure Properties in above Image like Area, Major Axial Length Area>70
4. Select Candidates who's Major Axis Length is greater than and Remove Objects that will be never Number Plate using Closing and Dilation Process.
5. Select Largest connected Component as Number Plate and Crop it and display it.

B. Character Segmentation

Segmentation process is used to find the individual characters on the number plate. In this work, characters are segmented using the thresholding technique. It is segmented by obtaining the characters inside the image and bounded each character with the rectangle to separate. Process used to for character segmentation is as follows.

1. Take Extracted Image Plate as Input and Use Thresholding to Binarize Image.
2. Measure Properties of Individual Patterns like Area, Angle, Length of Major Axis, etc.
3. Considering Largest Area as Character and detect other Characters according to it and Turn Characters according to Angles.
4. Use Morphological Operations to Regain Shape of Characters and Remove Noise from it.
5. Crop Individual Characters and Display them as Separate Images in Standard size for Further Recognition Process.

C. Character Recognition

It is employed for the purpose of conversion of images of text into characters. The objective of Optical Character Recognition is to classify optical pattern corresponding to alphanumeric or other characters. The process of character recognition involves several steps like feature extraction and classification. Before recognition algorithm, the characters are normalized.

Normalization is to refine the characters into a block containing no extra white spaces (pixels) in all the four sides of characters. Then each character is fit to equal size. Fitting technique is necessary for template matching. For comparing the characters with the database, input images must be same-sized with the database characters Template matching is a proper algorithm for recognition of characters. The character image is matched with the ones in the database and the best similarity is calculated. To measure the similarity and find the best match, a correlation function is used.

1. Load database of letters, numbers as templates (0-9, A-Z) and Take segmented characters image as input from previous step.
2. Check segmented characters and template characters similarity and Compare it with all the loaded templates using correlation function
3. Output of above function will be correlation coefficients and Find maximum value correlation coefficient for corresponding template.
4. Give unique identity to all the templates for easy process and corresponding template is detected as recognized character
5. Repeat all above steps for other characters and display recognized character to GUI as number plate.

D. Creating GUI''s for user friendly and Theft detection

For proper user friendly environments various graphical user interfaces are created so that user can process step by step. Various buttons are provided for interfacing with main

code and some of the GUI's are discussed in this section. Fig.3 indicates user interface for Front Page and reading image already stored or by camera which shows systematic flow of working of system.
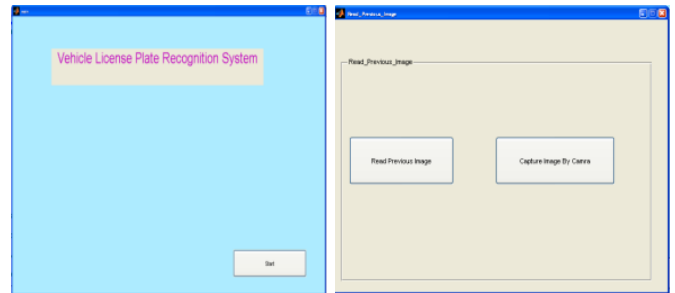

Fig. 3.Graphical user interface for (a) Front Page (b) reading image already stored or by camera.

Every recognized number plate is compared with database of stolen vehicle if math founds then that vehicle is declared as stolen vehicle. The data base of such vehicle maintained for security purpose so that stolen vehicle will be detected easily. After detecting stolen vehicle system will generate alarm and it will close door so that vehicle will not pass from that place. After message will be send to the traffic police for detecting theft.
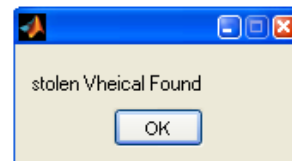

Fig. 4.Displaying message for stolen vehicle.

IV. EXPERIMENTAL RESULTS

We have taken number photos of cars from camera of 8 Megapixel and done survey to know what be the exact position of number plate in total image. Out of them few images are as shown in Fig.5.We considered all types of number plate like titled and corrupted.

Fig. 5.Various Photo Images taken for Survey

It is concluded that average size of number plate in total image is 17×6.We can also conclude that size of number plate varies between 14 to 27 ×4 to 9 percent of total image as shown in fig 10.

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A. *Number Plate Extraction*

Fig. 6. Number Plate Extraction and Captured Number Plate

Fig.6 shows extraction of number plate from total front side image of vehicle taken by webcamera, and it also indicate captured number plate as seprate image. Fig.7 (a) and Fig.7 (b) are some errors obtained during number plate extraction process.Fig.7 (a) shows extracted number plate contains additional area other than number plate. Sometime results shows corrupted number plate as shown in fig.7 (b).
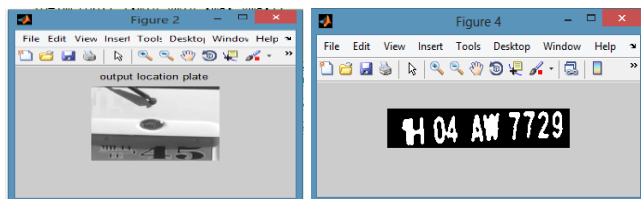

Fig. 7(a). Extracted number plate contains additional area Fig.7 (b) .When plate is corrupted

B. *Character Segmentation*
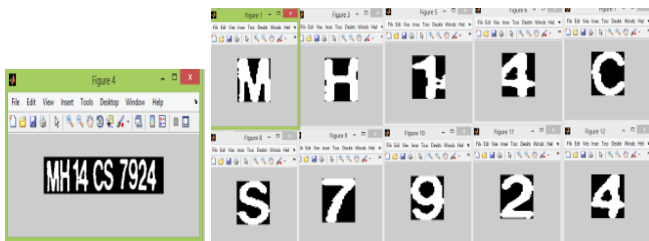
Fig. 8.Captured Number Plate and Segmented Characters from Number Plate

Segmentation of character can be easily understood from Fig.no.8.In few cases characters are not considered for segmentation as shown in Fig.9 because of their size comparatively very less from other characters. Two different characters are considered as one after segmentation because they are connected to each other as described in Fig.10.Some cases shows Single character is segmented into two characters because character is having very high size which is shown in Fig.11.
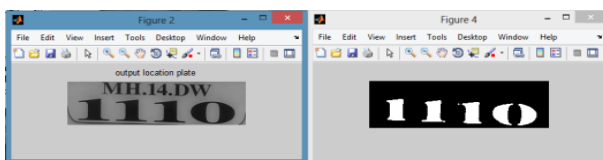

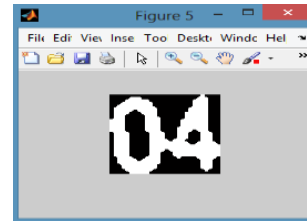
Fig. 9.Some characters are not considered for segmentation

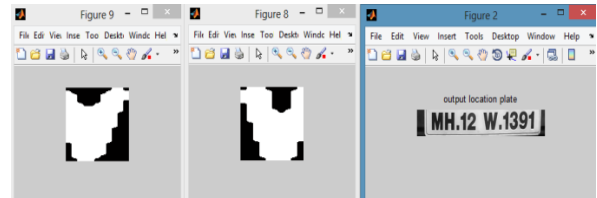Fig. 10.Two different character are considered as one after segmentation

Fig. 11.Single character is segmented into two characters

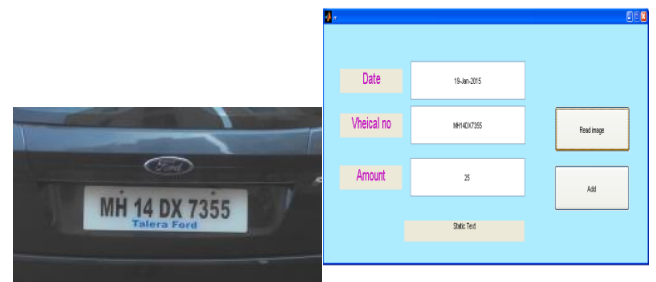Fig. 12.1.Number plate and its recognized characters are shown in GUI

Fig. 12.2.Number Plate and Recognized Character

Character recognized in segmentation step goes through recognition process by comparing with templates characters.Fig.12.1 to Fig.12.3 shows recognizes number from concerned image with details like date, amount. In some cases characters are not properly recognized due to some problems like improper size of segmented character and templates, damaged characters and it is shown in Fig 13
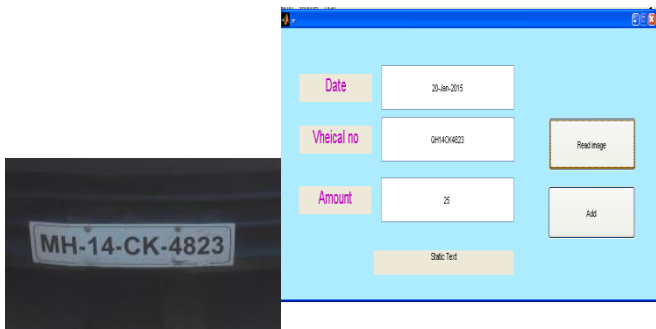
Fig. 12.3.Recognized Number plate

Fig. 13.Partially Recognized Number plate

Parameter	Input Images	Output Image	Efficiency
Number plate Extraction	50	45	90%
Character Segmentation	45	40	90%
Character Recognition	40	30	75%

V. CONCLUSION

The proposed system of Automatic Vehicle License Plate Recognition can be implemented using above discussed method which involves fundamental Image processing steps using MATLAB. We can detect and recognize license number from a captured front view image of any vehicle from camera. It contains main three processes: plate extraction, character detection and character recognition. Every process has its own different efficiencies as per procedure used and its complexity as shown in Table no.2. Further we can detect stolen by comparing it with database of stolen vehicles and ring an alarm which increases security of system. It can be used in many security purposes like speed detection, detection of traffic violation, toll collection, parking system as well as can be installed at secure areas like at the gate of the residential area, factory gates, parking space, toll plazas, university entrance or other high-secured building such as defense institutes, nuclear factories.

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