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Smart Vehicle Identification And Surveillance System Using OCR

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Abstract

Objective: **- Our main objective is to identify unauthorized vehicles in a parking place. With the help of this system we can manage to get the vehicle number directly into the database.**

Method: **- In existing vehicle surveillance system, maintaining record of incoming and outgoing vehicles is inconvenient. To accomplish this goal, number of technologies can be used, out of which Optical Character Recognition (OCR) is most favored technology.**

Findings: **- Vehicle identification is indispensable to control any abnormal activity in organizations and industries. According to recent survey on vehicle tracking and parking mechanism, it is concluded that appreciation of unidentified vehicles is unavoidable. In our system we are going to implement OCR technology to park the vehicles in smart way and also going to keep track of vehicles entering and leaving at boom barrier. It will capture images of vehicle arriving at entry-point then determining the number plate using OCR process and immediately data will be update in the database. At the time of exit, the same procedure will be performed again. In our article the deficiencies of preceding systems such as inefficient to process on poor quality documents, multiple fonts, isolating between similar types of characters are downsized to the assertive degree.**

Applications: **- This system can be implemented in different organizations like colleges, hospitals, malls and industries. This will reduce manual effort to store the vehicle number into the database.**

***Keywords*: OCR, Unauthorized Vehicles, Vehicle Surveillance, Vehicle Identification.**

I. INTRODUCTION

License Plate Recognition is a technique used for capturing images of vehicle's number plate. Generally, these systems are implemented to recognize the region of license plate from the images of a vehicle, captured through a camera, and that image will be retrieved through OCR. The heat arising from the car due to hot engine won't affect the image of the number plate because the camera will not be infrared cameras. Secondarily, we can use infrared light source in which the first image is taken when light source is activated and another image is taken when light source is deactivated then initial image is subtracted from second image which eliminates IR signals from the image.

Optical Character Recognition (OCR), is a technique that converts different types of documents, such as, PDF files, scanned paper documents or images captured by a camera in editable format. It also converts examined images of printed text, handwritten text characters into machine encoded text information. The final output must be in the form of string of characters.

Number plate norms vary from country to country as per the principles of government. Nowadays in many countries the characteristics of the number plates are strictly maintained. However, the number plates in India are not uniformed across different states, making localization and consecutive recognition of number plates are extremely difficult. Moreover, in India number plates are mostly written in multiple scripts.

Two categories of number plates have been used in India. For trading vehicles, the number plate has a yellow color background and for black numbering. For private vehicles a white background with black numbering is used. Indian vehicle registration scheme comprises of a two-letter recognition code for the state, in which the vehicle is registered. It is succeeded by a two-digit numeric code to analyze the district. Recently many states are get used to the two letter series code system, for example car series' are CA, CB, CC; motorbike series' are MA, MB and so on. Finally a four-digit numbers are used to separately identify the vehicle.

Number plate recognition is a form of automatic vehicle identification. Each vehicles are unique from each other by its number. In image processing, vehicles are classified by their own number plates. It has wide applications areas such as toll plaza, parking area, highly security areas, border areas etc.

Automatic license plate recognition has three important parts i.e. Character segmentation, Number plate extraction, and Character Recognition. In OCR system, number plate is captured and converted into text format which act as input to database for future references. OCR works on images to read the vehicle license plate. The number gets detected and pre-processed where noise is removed and then the outcome is passed to the segmentation part, to divide the individual characters from the obtained license plate. Those divided characters are passed to an OCR technique.

Authors have proposed a system which works on RFID in [1]. In which each vehicle is assigned a specific RFID tag which will be unique for different vehicles. Without this RFID tag vehicles cannot access parking area as identification of vehicle is compulsory. RFID scanner will scan the RFID tag and after the identification of vehicle the boom-barrier will be opened and the vehicle will be allowed park. This system will work for authorized vehicles as the data of authorized vehicle will be already saved in the database but for unauthorized vehicles it will be difficult to store data as it will for the daily parking. OCR will be used to store the data of authorized as well as unauthorized vehicles. In RFID technology there are some problems like collision. For this purpose anti-collision protocols are used so reader can read multiple tags at a time.

Authors have shown that how image is passed to OCR and text regions are extracted and skew is corrected in [2]. Then these regions

are finalized and divided into lines and characters. This system works more accurately for handheld devices like PDA, Smart Phones, iPhone, iPads etc. having built-in Digital cameras, but processing speed and memory size of handheld devices are not yet sufficient enough so as to run desktop based OCR algorithms that are computationally expensive and require high amount of memory. Floating point operations can be performed on such devices by using floating point emulators that results in slower operation. Therefore, need of efficient and light-weight OCR algorithms for handheld mobile devices. These study reflect the feasibility and make a strong indication that OCR system can be designed for handheld devices.

The study of Automatic Number Plate Recognition (ANPR) which is a surveillance system in which the images of vehicles are captured and their license number are recognized is shown in [3]. This will be used for detection of stolen vehicles efficiently. This paper mainly focuses on two methods: Edge Finding Method and Window Filtering Method. Performance of this system is not much good, they are still working for better performance. The car image must be captured in a way that the environment is excluded as possible and the size of the number plate is as big as possible. It is difficult to capture the photograph of fast vehicles, since the optimum moment of exposure can hardly be guaranteed.

Authors have discussed that how characters are directly identified from the image of a vehicle plate in [4]. Given system supports digital images and easily applied to park system for utilization of documenting access of parking services, secure usage of parking spaces and to stop automotive robbery problems. To segment plate characters area professionals perform in MATLAB, labelling and fill whole approach is used. For recognizing the characters accomplished method of template matching is used. The system recognizes vehicle using vehicle plate against different lightning conditions and might be implemented on doorway of highly restricted areas. This strategy supports the morphological algorithmic program, digital image labelling and region props technique. The accuracy of given system is very high for segmenting and recognizing characters.

Authors have described the recognition of Qatari Number plates are presented and compared in [7]. Four algorithms are applied to these number plates. These ANPR systems are essential to monitor and detect traffic, control access and improve site security, trace suspect or stolen vehicle, and prevent crime and terror acts. The proposed algorithms are based on feature extraction (vector crossing, zoning, combined zoning and vector crossing) and template matching techniques. All these four algorithms have been implemented and tested using MATLAB.

Authors have state that a vehicle is not just identified by its number plate but the model of the vehicle also possesses many information so that it could be identified from the distance or remote location as the number plate can only be identified when camera is focused on it in [8]. Generally vehicle identification consist three fundamental stages, identification of vehicle through motion, location the number plate and accurately identifying the characters in the number plate. The drawback of the system is that it is not much accurate as the keeping the model and structure of every vehicle is difficult to store.

Authors have given brief review about some knowledge of Support Vector Machines (SVM) in [9]. Experimental outcome based on SVM's are given in this paper. SVM is better than other techniques such as inductive learning-based number recognition. However, there are still some fundamental problems in SVM that need to be investigated in the future. They have listed three trends for further research on SVM in the following: Feature variables selection for SVM, Support Vector Selection, and Selection of Parameters.

Authors have proposed a shared hidden-layer deep convolution neural network (SHL-CNN) for image character recognition in [11]. The hidden layers are made common across characters from different languages. This aims at learning common characters existed in different languages. This paper attempts to introduce the SHL-CNN framework to image character recognition. The overall RER of our study reaches 9.03% compared to 14.04% of the best method and it ranges from 32.14% for seriously distorted images to 5.03% for clear images. They have also shown that the learned shared hidden layers are also fruitful for undetected image character recognition tasks.

II. PROPOSED SYSTEM

In consideration with flaws in current system, we propose an OCR system which provides efficient and reliable output. OCR is a character recognition system though which we can store the character of a vehicle's number plate into the database. Camera is used to capture an image of a vehicle and will be passed to OCR. Then the image will be processed and the number plate portion will be detected. After number plate is detected the OCR will recognize the characters and it will be stored into Database.

The working for OCR and steps involved in it are mentioned below:

1 .Input Image
2. Preprocessing
3. Number Plate Localization
4. Character Segmentation
5. Character Recognition
6. Output Characters

All these steps will work independently and the result of each step will be forwarded to the next step.

1. Input Image:-

In this stage the Camera will take the picture of a vehicle. All the captured image of vehicle arriving at parking spot will be stored in 'T' set. T= {I1, I2, I3……It}. The number plate can be of White or Yellow color. So, it is required to find the region in the image which contains the intensity of three colors i.e. R (Red), G (Green) and B (Blue). Number plate is converted into binaries on the basis of RGB colors.

Algorithm:

Step1: Capture image using the camera. Consider 'T' be a set of images. T= {I1, I2, I3……It}.

Step2: Images will be captured in RGB format and processed for the number plate extraction.

Step3: Pre-processing is performed as noise filtering, RGB to gray scale conversion, Conversion to Binary process.

2. Preprocessing:-

After image has been captured it sent to preprocessing stage where the image will modified. Consider the image 'I' which is being captured by camera will be further proceed to processing. Preprocessing is mainly done to improve contrast in an image. It involves two steps

a. RGB to Grayscale conversion:-

Here input image (RGB) is converted into grayscale image.

b. Contrast enhancement using histogram equalization:-

Image are enhanced using histogram equalization on grayscale image, to reduce the problem of low contrast and low quality in vehicle input image.

3. Number Plate Localization:-

In this the grayscale is converted into binary image. Consider 'E' be the set of number plates in the database, E = {E1, E2, E3… En}. Along with checking vehicle a parking space will be allotted to each vehicle. Suppose 'A' be the parking space So, E = {A1, A2, A3… An}. Then the number plate of the vehicle will be processed. The black pixels are converted into white pixels and white pixel are converted into black pixels. So, now the background of the image becomes black and characters become white.

Algorithm:

Step1: Detect vertical edges in the input image using Sobel mask. Consider 'E' be the set of number plates in the database, E = {E1, E2, E3… Et}.

Step2: Perform Wavelet decomposition for better analysis.

Step3: Convert result into a binary.

Step4: Use Morphological operations like erosion, dilation to find the location of the license plate.

Step5: Suppose 'A' be the parking space So, E = {A1, A2, A3… An}. So every license plate will be allocated a parking space.

4. Character Segmentation:-

Characters are divided into blocks by discovering maximal area of each block by using Sobel Edge Detection. The vehicle number plate can be divided based on vertical or horizontal projection. Segmentation is the most important process in the automatic vehicle number plate identification system; because all further steps rely on the output of this process. If segmentation is not done properly, the character recognition from the segmented plate will be difficult. It is necessary to identify the exact area of the license plate to be segmented for the identification of characters.

Algorithm:

Step1: Image contrast can be stretch over the range of grey levels (0-255).

Step2: Threshold the plate image.

Step3: Search the linked components in the image; each linked component will be assigned a special label to distinguish different connected components in image.

Step4: Each character is resized in standard height and space for recognition process.

5. Character Recognition:-

The segmentation algorithm sometimes detect unnecessary elements, which do not correlate to proper character. The structure of these characters after normalization is often similar to the shape of characters, these elements are not separable by traditional OCR methods, as they differentiate in size as well as in contrast or brightness. Since the feature extraction methods do not consider these properties, there is a need to use additional heuristics properties. Elements with different properties are treated as invalid and removed from the recognition process.

Algorithm:

Step1: Create templates (A-Z), (0-9) of size 42 x 24 (binary image) of same window size.

Step2: Correlation coefficient for each template with the character is found.

Step3: Two-dimensional correlation operation is used which gives a value of the similarity between two matrices (images).

Step4: The index of the best match is stored as a recognized character. After recognizing the first character the next character is taken and thus after recognizing the first line, the next line is taken, and procedure from step 3 is repeated unless and until last line detected is empty.

6. Output Characters:-

After the characters have been recognized it will be arranged in sequence and will be stored in database for security purpose and further reference.

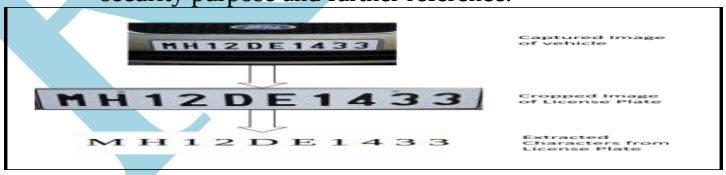

Figure 1: Character Recognition

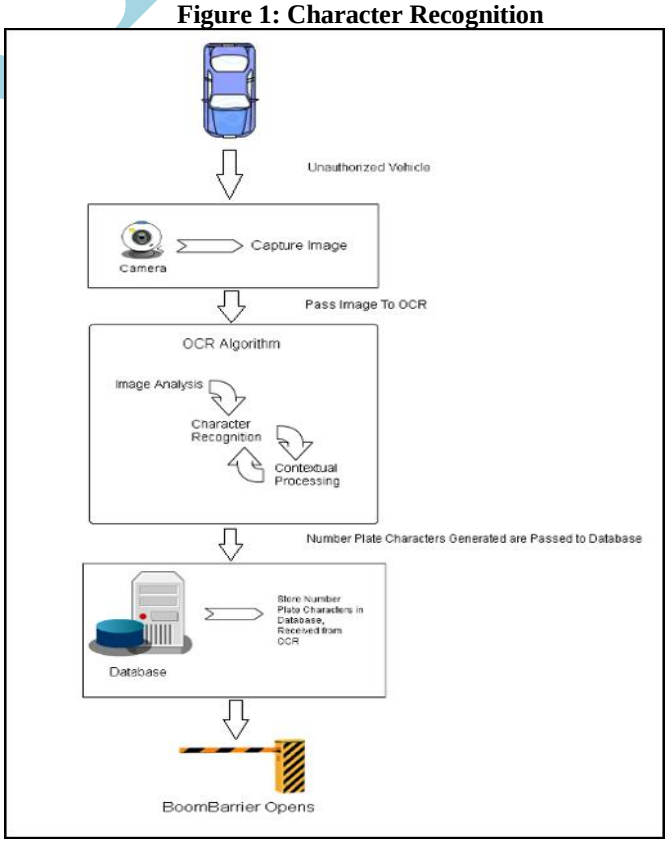

Figure 2: System Architecture

III. METHODOLOGY

The working of this system is based on Optical Character Recognition (OCR). Here, an image of unauthorized vehicle will be captured from front side and will be passed to OCR module. OCR module will then convert that image into grayscale image for better performance. From next step, the actual working of OCR begins where each character in license plate will be identified and separated. In final stage of OCR, the total characters in license plate will be extracted and stored in database. After success, that unauthorized vehicle will be allowed to access parking area.

Captured image is initially Pre-processed for more accuracy and better working of system. It involves Noise Removal and Conversion to Binary values from captured images. In Noise Removal, we are going to remove the noise of the image i.e. while preserving after image is sharpened.

After Pre-processing image is move ahead for segmentation. In this, we will use two types of segmentation: 1. Vertical segmentation 2. Horizontal segmentation. Initially we have performed vertical segmentation on the number plate then the characters are vertically segmented. After vertical segmentation is performed we have to perform horizontal segmentation. Then we get characters from the plate. For this we calculate vertical and horizontal projections for intensity, and find the local minima for horizontal projection. According to the threshold calculation from the given local minima's, we find x locations of the segmented regions. To point the left and right edges of number plate from region, the vertical projection are changed into binary image.

After isolating the characters from number plate, elements with unusual properties are ignored for the recognition process. Specific template will be created to recognize each character uniquely. Following operation will be done to create the template for each character. For every white pixel, we insert the value 1 and for every black pixel 0 will be inserted. This is done for all the 10 training samples and calculate the weights to get the template. In some situations when the recognition mechanism fails, there is a possibility to detect a failure by a syntactical analysis of the recognized plate. For country specific rules, we can evaluate the validity of that plate. The image obtained after segmentation is Grayscale. The match score is generated for every template and the one which gives the highest score is taken to be the recognized character. Character sets used for training the OCR are contained in a directory named "OCR Training Data".

IV. MATHEMATICAL MODEL

Check-in:

Consider user is unauthorized then OCR is used.

Let's say receiver receives input to the system as values I.

Let T be set of all value "t" at particular instances when vehicles are coming.

Now,

$T = \{I1, I2, I3\ldots It\}$. …… (1)

Whenever we get the value N is assigned with N->NO. Of car.

Let 'E' be set of entries for all coming vehicles.

Values of vehicles number plates are stored in database and 'E'.

Now,

$E = \{E1, E2, E3\ldots Et\}$. ……. (2)

Along with checking we assign an area for parking to vehicles Say 'A'.

Now

$E = \{A1, A2, A3\ldots At\}$.

Each I in E contains Ai values.

Now,

$E = \{I1, I2, I3\ldots It\}$. ……. (1) & (2)

Therefore

$I1 = \{A1\}$,

$I2 = \{A2\}$,

$I3 = \{A3\}$,

$It = \{At\}$.

Let P be area where vehicles parked compare P with K.

Let L be the set of all Parking lots

Now,

$L = \{I1, I2, I3\ldots It\}$.

Compare P with A of It in E { }.

If P=A then no changes to make, else replace A with P

Following operations are carried out to updates and get resultant set.

$O1 = E \cap L$.

$O2 = L - E$.

$O = O1 \cup O2$.

V. CONCLUSION

This article describes the application of OCR technology to identify the vehicle where the vehicle's license plate is captured by the digital cameras and then images are processed to get the number plate information. The mechanism consist of Number Plate Localization, Pre-processing, Character Recognition, Character Segmentation. This will help to recognize the unique license plate and easy to store accurate information into the Database of the vehicle. Quality of security can be increased by merging it with metal detection system.

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