Detection of Traffic Violation at Unmanned Road Crossing in Urban Areas

Sourav Singh, Subhalaxmi Pal, Rahul Kumar Badhan
Department of Computer Science and Engineering
Silicon Institute of Technology, Bhubaneswar

ABSTRACT
Optical Character Recognition (OCR) is an image processing technology which uses number (license) plate to identify the vehicle. The objective is to design an efficient automatic authorized vehicle identification system by using the vehicle number plate. The system is implemented on the un-controlled junction on the road. The developed system first detects the vehicle and then captures the vehicle image. Vehicle number plate region is extracted using the image segmentation in an image. Optical character recognition technique is used for the character recognition. The resulting data is then used to compare with the records on a database so as to come up with the specific information like the vehicle’s owner, place of registration, address, etc. The system is implemented and simulated in Matlab, and it performance is tested on real image. It is observed from the experiment that the developed system successfully detects and recognize the vehicle number plate on real images.

Keywords—Extraction, Segmentation, Template, OCR

1. INTRODUCTION
In last couple of decades, the number of vehicles has increased drastically. With this increase, it is becoming difficult to keep track of each vehicle for purpose of law enforcement and traffic management. In order to save a little time & fuel people put their life at stake even knowing that the violation of traffic rule in absence of a traffic police could turn to a traumatic accident. There are strict traffic rules to cross the lane but the passenger often violates the rule for quick completion of journey. The violation of rules has been mostly detected in those areas where either there is no traffic post or no human observation. Every country uses specific vehicle identification system for the control of traffic, traffic surveillance, monitoring against illegal activities, security control of restricted areas, traffic law enforcements, toll collection and parking management etc and as such India also has its own system of assigning unique numbers to vehicles. These unique numbers plates are assigned to the vehicles by RTO (Regional Transport Office). These plates in general are easily readable by the human beings because of very high level of intelligence but when it comes to do the same using machines, many effects such as illumination, blur, background and foreground color etc. pose a problem. The new format license plates can be of lengths 8,9,10. A typical example of an Indian license plate (for car) is shown in the fig. 1. with the significance of each character.

![Figure 1: Format of Indian License plate](image-url)
The latest license plate format is shown above.
1. Country Code
2. State Code
3. District Code
4. Type of Vehicle (car, two wheeler, commercial etc.)
5. Actual Registration Number

Another variant of an Indian license plate which is mostly used for two wheelers is also shown below.

![Figure 2 Valid License Plate format](image)

In this we are designing an automated system which identifies the license plate of a vehicle and extract the characters from the region containing a license plate. The license plate number can be used to retrieve more information from the central database placed with traffic control administration about the vehicle and its owner, which can be used for further processing like penalizing.

2. Related works
The automatic vehicle license plate recognition system is an extremely effective system for vehicle monitoring in automatic zone access control. This system uses two character recognition techniques namely neural network character recognition and pattern matching of characters. Multilayer feed-forward back-propagation algorithm is used. The performance of the proposed algorithm has been tested on several real life car plates and provides good results [1]. Automatic Number Plate Recognition (ANPR) is an automatic and authorized vehicle identification system which uses image processing methods to identify a vehicle’s number plate. The developed system detects the vehicle and captures its image. The number plate region is extracted from the whole vehicle image using image segmentation. Optical character recognition method is used for the character recognition. The resulting data is then compared with the records on a database to obtain specific information like the vehicle’s owner, place of registration, address, etc. The system is implemented and simulated in MATLAB, and its performance is tested on real images. Experimental results show that the system is very efficient in recognizing real images [2].

Automatic License Plate Recognition (LPR) is a technique which is used to identify a vehicle by reading its license plate using image processing methods. The system presented in this paper is capable of extracting the license plate region from a rear end image of the vehicle. The system consists of a digital camera, the software module which extracts and recognizes the license plate number and the software which interfaces the camera with the software module. The camera captures the image of a certain resolution and passes it to the software module. The software module works in four phases: input image analysis, identification of the location of the license plate using the idea of connected components in the image, segmentation of the characters on it using digital image labeling and recognition of the characters using template matching. The algorithm was implemented in MATLAB and the test results obtained by experimental verification agreed with theoretical predictions [4].

Lebanese License Plate Recognition is system for identify vehicles by their Lebanese license plates using image processing techniques. The system presented uses two methods for classifying the
Lebanese plate namely Labeling and K-Means. Next, the French line and the Arabic line are extracted from the plate. Each character is separated from each line using the vertical profile method. Then the characters are recognized by the K-PPV algorithm which recognizes characters with a rate of 91% for French/English characters [5].

Persian License Plate Detection and Recognition System is an approach used to identify a vehicle by its license plate using image-processing techniques. In this system the first stage is the isolation of the license plate from the digital image of the car. The digital image of the vehicle is obtained by a digital camera under different circumstances such as illumination, slop, distance, and angle. The algorithm starts with preprocessing and signal conditioning. Next license plate is localized using morphological operators. The second stage is character recognition within the plate which is done using a template matching scheme. This system was implemented with help of Isfahan Control Traffic organization and showed 98.2% of correct plate’s identification and localization and 92% of correct characters recognized [7].

3. METHODOLOGY ADOPTED
The algorithm initially used various inbuilt functions and implemented few user defined routines related to image processing. Once the algorithm was developed, it was verified with multiple input images containing car number plates. The input images contained number plates that were aligned horizontally as well as at some angle from horizontal axis. The system implements the character recognition algorithm i.e. Optical Character Recognition (OCR) for extraction of text from image. OCR technology provides reproductive systems by scanning and imaging systems the ability to convert images of characters in a font of machine character that can be understood or recognized by a computer. The goal of Optical Character Recognition (OCR) is to classify optical patterns (often contained in a digital image) corresponding to alphanumeric or other characters. The process of OCR involves several steps including segmentation, feature extraction, and classification. OCR technology provides reproductive systems by scanning and imaging systems the ability to convert images of characters in a font of machine character can be understood or recognized by a computer. The feasibility study of OCR is based on Technical implementation, Financial, Resources & Operational feasibility. A complete OCR system consists of a scanner, the recognition component, and OCR software that interact with the other components to store the computerized document in the computer.

4. SYSTEM MODEL
The whole work can be dived into mainly two part i.e. hardware system & other is software system. We will discuss mainly the software system here. The main and the most important portion of this system is the software model. The software model use series of image processing techniques which are implemented in MATLAB 7.0.1. The algorithm is broadly explained below: The first step is the capturing of an image using the USB camera connected to the PC. The images are captured in RGB format so it can be further process for the number plate extraction.

4.1 Converting colored image to grey image
The algorithm described here is independent of the type of colors in image and relies mainly on the gray level of an image for processing and extracting the required information. Color components like Red, Green and Blue value are not used throughout this algorithm. If the input image is a colored image represented by 3-dimensional array in MATLAB, it is converted to a 2-dimensional gray image before further processing.
4.2 Converting grey image to Binary image
In this we convert image to binary image, based on threshold. The output image BW replaces all pixels in the input image with luminance greater than level with the value 1 (white) and replaces all other pixels with the value 0 (black). Specify level in the range [0,1]. This range is relative to the signal levels possible for the image's class. Therefore, a level value of 0.5 is midway between black and white, regardless of class. We compute a global threshold that can be used to convert an intensity image to a binary image. Level is a normalized intensity value that lays in the range [0, 1]. It uses Otsu's method. In this method we choose the threshold to minimize the intra class variance of the black and white pixels.

4.3 Filtering of image
Digital images are prone to variety of noise. Noise is the result of errors in image acquisition process that result in pixel values that do not reflect the true intensities of real scene. Noise is filtered by using pixel wise adaptive Wiener filtering function. It filters the image using pixel wise adaptive Wiener filtering, using neighborhoods of size m by n to estimate the local image mean and standard deviation. If one omits the [m, n] argument, m and n default to 3.

4.4 Localization of number plate
The image which is mathematically can be expressed as the 2d array of white and black pixel after converting into binary image. But while localizing, captured number plate one has to eliminate the portion of image which are not required for the number extraction by rejecting those row where there is a continuous black or white pixel i.e. continuous 0’s or continuous 1’s. One has to find out the irregular row which contain both 0’s & 1’s as the number plate has a black background & the numbers appeared in the white pixel in the binary image. We creat an interactive Crop Image tool associated with the image called the target image. The Crop Image tool is a moveable, resizable rectangle that you can position interactively using the mouse.
4.5 Segmentation
After localizing the number plate one has to segment to extract the text. This can be achieved by segmenting each alphabet and digit. We remove, from a binary image all connected components (objects) that have fewer than P pixels, producing another binary image, BW2. This operation is known as an area opening. The default connectivity is 8 for two dimensions, 26 for three dimensions.

4.6 Template creation
It’s a system prototype which contains sub image of all the English alphabet & numeric digit of specific fonts and size. Our system uses Arabic font which has size as 42*24. It contains the entire alphabet in bitmap image format i.e. black–white image of 1 bit. The template-matching algorithm implements the following steps:

- Firstly, one of the segmented image from the pool of the segmented image available.
- After that, the image to the size of the first template is rescaled.
- After rescale the image to the size of the first template (original) image, both are correlated. Then the highest match found is stored. If the image is not match repeat again the third step.
- The index of the best match found is stored as the recognized character.

4.7 Character recognition
Template matching is one of the Optical Character Recognition techniques. Template matching is the process of finding the location of a sub image template inside an image. The purpose of template matching is to solve the problem in recognizing the character which is before that it is difficult to recognize the character without using any techniques and Template Matching is as one of the solution to overcome the problem. Once a number of corresponding templates is found their centers are used as corresponding points to determine the registration parameters. Template matching involves determining similarities between a given template and windows of the same size in an image and identifying the window that produces the highest similarity measure. It works by comparing derived image features of the image and the template for each possible displacement of the template.

4.8 Optimization
When the system runs the system sometimes confuse with same type of the alphabet i.e. for example 8 & B, o-0 & Z-2. To overcome one has to ensure that specifically in India according to the rule the first 2 letter has to be alphabet so when system encounters 0, 2 & 8 then it is taken as O, Z & B respectively. Similarly according to rule the next 2 letters are digit so when we encounter O, Z & B then it is taken as 0,2&8. The final string is written into a text file.

5. Results and output
The results of each step of the algorithm followed are stated below as image:
6. CONCLUSION
Application of Automatic Vehicle Identification System is needed to monitor movement of vehicles in our environment in order to maintain law and order. Therefore a new approach for effective Automatic Vehicle Identification System has been proposed in this work. Recognition of license plate is done using the scan line algorithm used in graphics with calculation of number of white & black pixel in the ROI. The proposed system is different from previous systems in term of feature extraction and image modeling method which is inefficient unlike the proposed method here. In future the system can be made more efficient by working on the detection of the various font as the Indian traffic quite often manages to obey the mentioned traffic rule. It would be luminance independent i.e. the lack brightness would not hamper the result of the system. The system will yield result in all-weather condition. After ensuring this system would be connected to the database using the WSN to ensure the fast data transmission from the nodes to detect the traffic violation.

REFERENCES
[6] YiQing Liu, Dong Wei Ning Zhang, MinZhe Zhao,”Vehicle-License-Plate Recognition Based on Neural Networks”, Proceeding of the IEEE International Conference on Information and Automation Shenzhen,China, June 2011.
