IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Implementation of License Number Plate Recognition system for vehicle registration

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Abstract: License Plate Recognition (LPR) systems have some common framework of steps for processing, such as, number plate detection, plate characters segmentation and recognition of each character. License Plate Recognition (LPR) systems have some common framework of steps for processing, such as: number plate detection, segmentation of plate characters and finally character recognition. The detection of the number plate is a challenging process because there is a large the diversity in the format of the number plate and the other reason is that environmental conditions becomes a problem in the image acquisition stage. The efficient plate detection plays a major role in accurate character segmentation and recognition. This paper provides a detailed study and analysis on the techniques which are in the forefront of license or number plate detection and recognition.

Keywords—number plate detection; character segmentation; character recognition.

1. Introduction:

The work being developed is an image processing based work for Automatic Recognition of Number plate from the image of the vehicle taken into consideration which allows one to recognize unique number plate of the vehicle for an intelligent traffic or vehicle management system. With the rapid development of highway and the wide use of vehicle, people have started to pay more and more attention on the advanced, efficient and accurate intelligent transportation systems (ITSs). The License Number Plate recognition (LPR) task is quite challenging from vehicle images due to the view point changes, when vehicle bodies and license plate have similar colour, multi-style plate formats, and the non uniform outdoor illumination conditions during image acquisition[2].

In the intelligent transportation system, license plate recognition (LPR) is a widely used image processing technology. The world has seen a boom in the economy over the last few decades, which has led to widespread urbanization. This has increased the number of privately owned cars and, consequently, license plates. Due to the vast number of vehicles, it is now difficult to distinguish one specific vehicle from

a large group of vehicles. Different countries have different types and colors of license plates. Every country has a unique format for license plates. Therefore, each nation creates a suitable LPR system that fits the format of their transport vehicle license plate. The weather and environmental factors, such as uneven illumination outdoors, present challenges for LPR systems. The majority of the systems that make up the intelligent transportation system will function in environments with various lighting levels, set vehicle speeds, predetermined routes, and backgrounds.

The LPR is used widely for detecting speeding cars, security control in restricted areas, unattended parking zones, traffic law enforcement, and electronic toll collection, etc. The major steps to accomplish the proposed work can be given as 1. Image acquisition 2. Number plate recognition 3. Edge Detection 4. Character Segmentation 5. Character Recognition

The purpose of the proposed paper is to address the issue of parking lot toll collection. We propose a system that will automatically capture the vehicle's image and preprocess it to remove noise and blur using image preprocessing techniques because human intervention makes the system very error-prone and inefficient. The next step, which is to locate the region of interest, which is our license plate, uses this pre-processed image, which is the partial output. Using the captured image, this method will identify the license plate. The image that was partially processed as the result of the previous step will be used for the next step, which is to sharpen the number plate's edges. The Canny Edge detection algorithm is used to sharpen edges, and in addition to sharpening edges, it also improves image quality by filtering the image using a Gaussian kernel. Following sharpening, the image is fed into a segmentation algorithm that extracts individual characters from the output of the preceding step. We will use that information to identify each character on the license plate and match them one at a time.The digitalized version of the vehicle's license plate numbers will be the system's final output.

The paper is organised as follows: Section II presents the related work on Number plate recognition system. Section III presents proposed methodologies. Section IV results.Finally section V concludes this paper.

II. Related work:

The work that has already been done on this system by different researchers employing various techniques and algorithms is included in this section. The brief descriptions of a few of them are as follows:

Car Plate identify Using the Template Matching Method is proposed by M.I.Khalil [1]. An LPR system typically consists of four modules: segmentation and individual character recognition, licensed plate extraction, and image acquisition. Nevertheless, the "segmentation" of the input image is not necessary with the template matching method. The information recognition phase (IPR) is applied following the license plate extraction phase. The "moving window technique" is applied in this phase. The license plate image loads as the main image so that the country name can be recognized. Next, the country image set's first image entry is loaded as an object. To find that object in the picture, the moving window technique is used. The name of the country that corresponds to the given country name is retrieved from the country names

table if the response is "YES". And if the response is "NO" then the next country name image is loaded as the object & this procedure is repeated till the end of the characters**.**

An Efficient Method of Vehicle License Plate Recognition Based on Sliding Concentric Windows and Artificial Neural Network is proposed by Kaushik Deba, Md. Ibrahim Khana, Anik Sahaa, and Kang-Hyun Job [2]. Sliding concentric windows, or SCWs, are the segmentation technique used in this system.This technique aids in the analysis of road photos, which frequently feature automobiles. and locate the vertical and horizontal edges from the vehicle region in order to extract the license plate from the natural properties. Based on an innovative adaptive image segmentation method, candidate regions are identified and their color is verified using the HSI color model. Hue and intensity in the HSI color model are used to verify green and yellow LP and white LP, respectively. The new artificial neural network (AAN) algorithm, which is based on the Korean number plate system, is the main focus. You will understand how this system operates if we attempt to follow the diagram up above.How the candidate region selection taking place and how grey image conversion taking in there.

SVM Based License Plate Recognition System is proposed by Kumar Parasuraman [3]. Statistical Learning Theory (SLT) serves as the theoretical basis for SVM, a supervised learning technique that uses structural risk minimization as its optimal object to achieve the best generalization. There are two primary methods that have been proposed for using SVMs in multiclass classification. "One against one" and "one against all" are their stances. The mean shift method is used to locate and extract a number plate region; the horizontal histogram projection method is only used for basic segmentation. Then it is normalized into size of 140x36. Then 315 dimensional feature vectors are obtained by averaging values in 4x4 windows of the normalized sub-images. The feature vectors are used to train SVMs with RBF kernel. From literature survey it has been observed that there are certain limitations about proposed algorithms like:

1. Poor image resolution
2. Less Accuracy
3. Poor lighting and low contrast
4. Higher Computational Cost
5. Lack of standards of the plate of the vehicles
6. Improperly segmented characters will result in misrecognized characters

III. Methodology:

3.1 Image Acquisition:

The first stage of any vision system is the image acquisition stage. After the image has obtained, various methods of processing can be applied to the image to perform the many different vision tasks required today. Even with the help of some kind of image enhancement, the intended tasks might not be possible if the image has not been acquired satisfactorily. With image acquisition, you can import pictures and videos straight into MATLAB and Simulink from camera frame grabbers. Hardware can be automatically detected, and its properties can be configured. Advanced workflows enable background acquisition, synchronize

sampling across multiple multimodal devices, and trigger acquisition while processing in-the-loop[5-7]. You can use imaging devices ranging from affordable with support for several hardware vendors and industry standards. from webcams to expensive scientific and industrial equipment that can operate in harsh conditions and at high speeds. In MATLAB, the image captured by the camera will be displayed as a binary matrix consisting of 0s and 1s.

3.2. License Plate Extraction:

The task of localizing potential license plate regions from vehicle images is difficult because these regions vary greatly in terms of size, shape, colour, texture, and spatial orientation. Any License Plate Recognition (LPR) system's general goal is to identify possible license plate region(s) from car photos taken by a roadside camera and then use template matching to interpret the images in order to determine the license number of the vehicle. Real-time tracking of moving vehicles via the surveillance camera is made possible by an online LPR system, which instantaneously localizes and interprets license plates from incoming still frames[8–10]. An offline LPR system, in contrast, captures the vehicle images and stores them in a centralized data server for further processing, i.e. for interpretation of vehicle license plates. Images with more than 256 colors will need to be dithered or mapped and, therefore, might not display well. Image has more than 256 colours, MATLAB cannot store the image data in a uint8 array but generally uses an array of class double instead, and making the storage size of the image much larger (each pixel uses 64 bits).

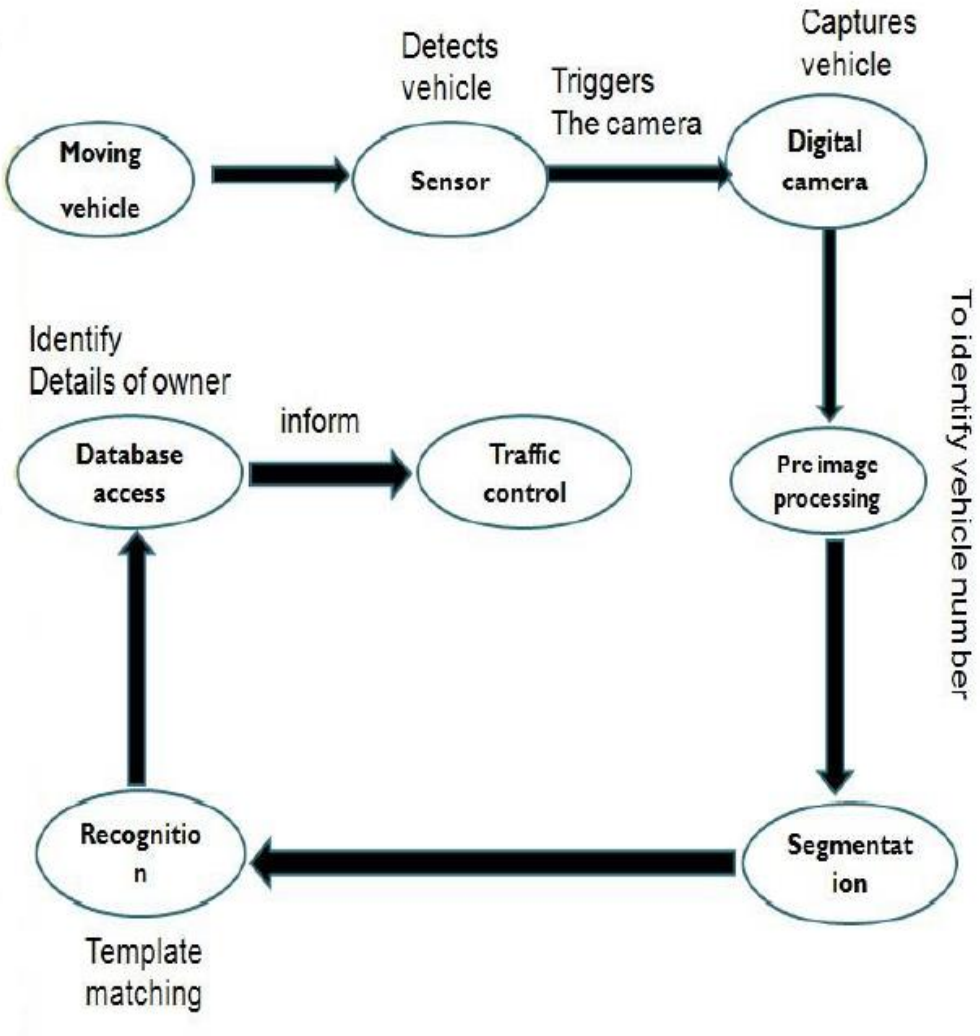

Fig 1: Block diagram of Licence plate recognition

3.2.1. Pre processing techniques:

3.2.1.1. Reduction of colors:

A problem arises while processing image is that colour can appear differently in different lightning conditions. To overcome this we reduce the number of colors around 50. Following can be reasons for colour reduction:

3.3. Gray scale conversion:

From the 24-bit colour value of each pixel (i, j) the R, G and B components are separated and the8-bit Gray value is calculated using the formula:

Gray(i, j) = 0.59 * R(i, j) + 0. 30 G(i, j) +0.11 * B(i, j) (1)

Fig 2:Gray Scale Image

3.4. Dilation:

Dilation enables objects to enlarge, emphasizing their shapes and geometric details within an image. A simple matrix of 0s and 1s, which can have any size or shape, is a structuring element.

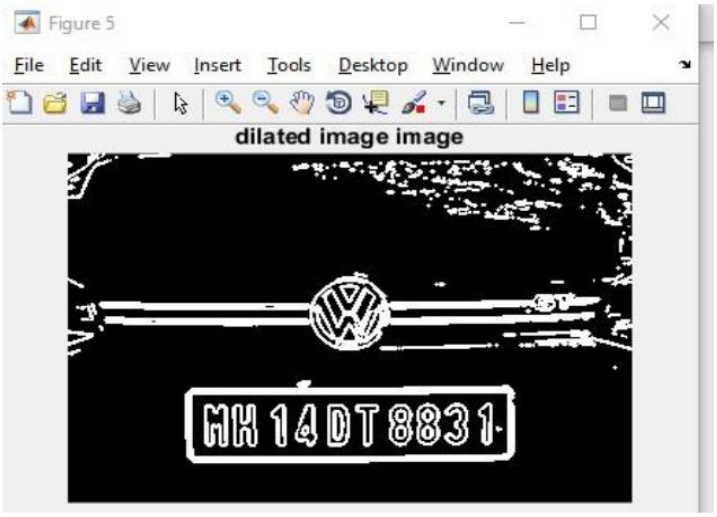

Fig 3: Dilated image

3.5. Filling:

Dilated image is filled with 'holes' to emphasize region of interest. Following examples shows images before dilate and erode operation.

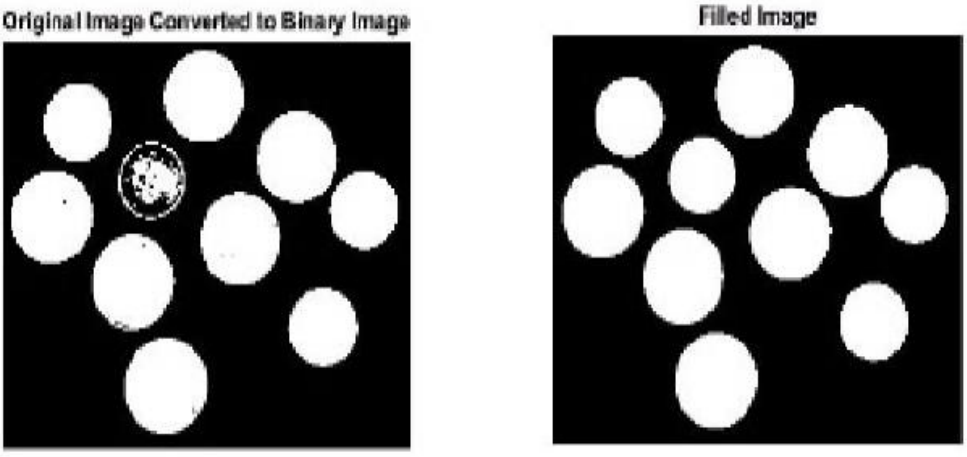

Fig 4:image filling

3.6 Edge Detection:

We have extracted the edges made by the characters on the license plate in this work. It can be observed that when the license number is written horizontally, each character's vertical edges have a set height and appear at regular intervals. Additionally, the vertical edge concentration and pattern continue to match the license number pattern. According to statistics, the license plate is the only place in the image's natural scene where the vertical edge pattern appears. The region's area shouldn't be smaller than the designated threshold values. The ratio of length to width, or aspect ratio, should be between 10:1.

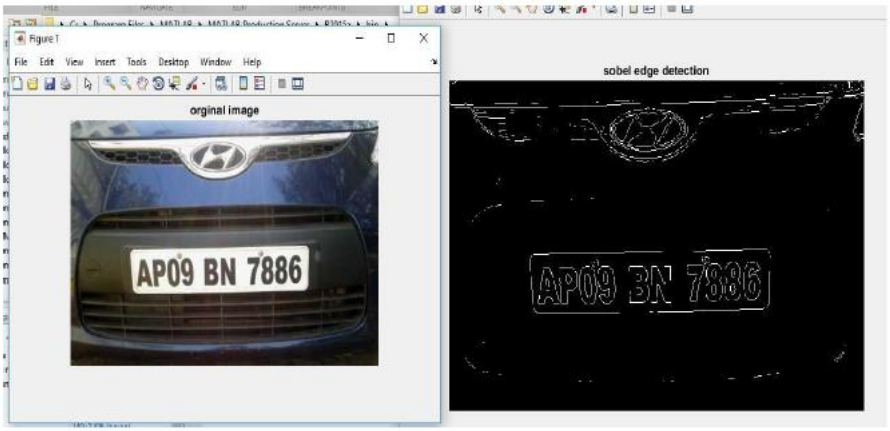

Fig 5:Edge Detection

3.7 Normalization and contrast enhancement

3.7.1 Median filtering :

Median filter is a non-linear filter, which replaces the gray value of a pixel by the median of the gray values of its neighbours. We have used 3x3 masks to get eight neighbours of a pixel and their corresponding gray values. This operation removes salt-and-pepper noise from the image.

3.7.2 Contrast enhancement:

Contrast of each image is enhanced through histogram equalization technique, Total 256 numbers of gray levels (from 0 to 255) are used for stretching the contrast. Let total number of pixels in the image be N and the number of pixels having gray level k be nk. Then the probability of occurrence of gray level k is, Pk= nk/N. The stretched gray level Sk is calculated using the cumulative frequency of occurrence of the gray level k.

3.8 Segmentation:

The process of dividing an image into sections or regions is known as image segmentation. This segmentation into sections is frequently determined by the properties of the image's pixels. To locate regions in an image, for instance, one method is to search for sharp discontinuities in pixel values, as these typically denote edges. Regions can be defined by these edges. Using color values to separate the image into regions is another technique. Blob analysis is used for segmentation, and it requires the execution of commands. Rectangle is used as the Bounding Box around the objects, and both of these commands are used to label the objects. boundaries of each object with a label, and then cropped the license plate's characters using these boundary coordinates. At this stage, cropped character may also contain garbage objects as well as useful LP characters and numbers; few of the extracted objects.

Fig 6:Segmented Number Plate

IV. Simulation and Results:

Implementation of License Plate Detection algorithm using MATLAB. MATLAB is a very powerful software tool used to implement the tasks that require extensive computation. It provides easy and quicker implementation of algorithms compared to C and C++. The key feature in MATLAB is that it contains a rich library functions for image processing and data analysis. This makes MATLAB an ideal tool for faster implementation and verification of any algorithm before actually implementing it on a real hardware. Sometimes, debugging of errors on actual hardware turns out to be a very painful task. MATLAB provides an easy approach for de-bugging and correction of errors in any algorithm. Other than this, MATLAB contains many features including workspace, plot, imread, imhist, imshow, etc. for data analysis and image processing, which makes it a better choice over other software languages like C and C++.Considering the above advantages, we are implementing an algorithm for License Plate Detection using MATLAB.

At first, the algorithm makes use of a number of built-in functions as well as a few user-defined image processing routines. After the algorithm was created, it was tested using several input photos of license plates. Number plates that were oriented at an angle from the horizontal axis as well as horizontally were present in the input images. User-defined functions were used in place of MATLAB's built-in functions once the algorithm had been thoroughly validated.

First we have executed our program in MATLAB then command window appears. Then user enters the file name in the format of "file name jpg". Then need to specify our requirement whether to display each stage output or only final output by either entering (y or n). As soon as we choose our requirement the program imports the image and program performs processing operations according to program. Masking and localization of plate are performed according to specified threshold values. The characters in the localized plate are cropped and segmented and segmented outputs are displayed in figure window. The number extracted from the number plate is saved in a text file for the future use.

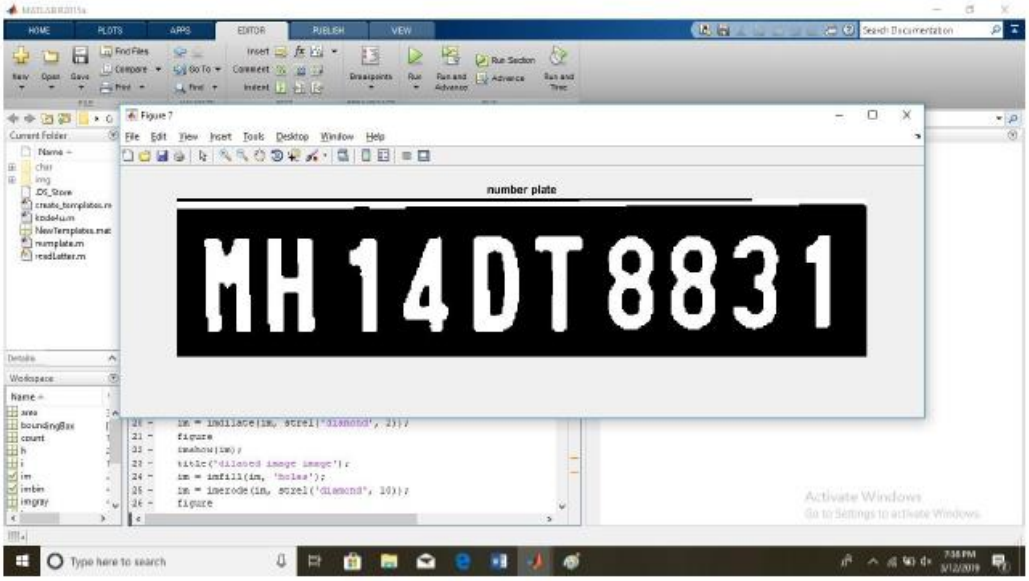

Fig 7:Segmented Number Plate

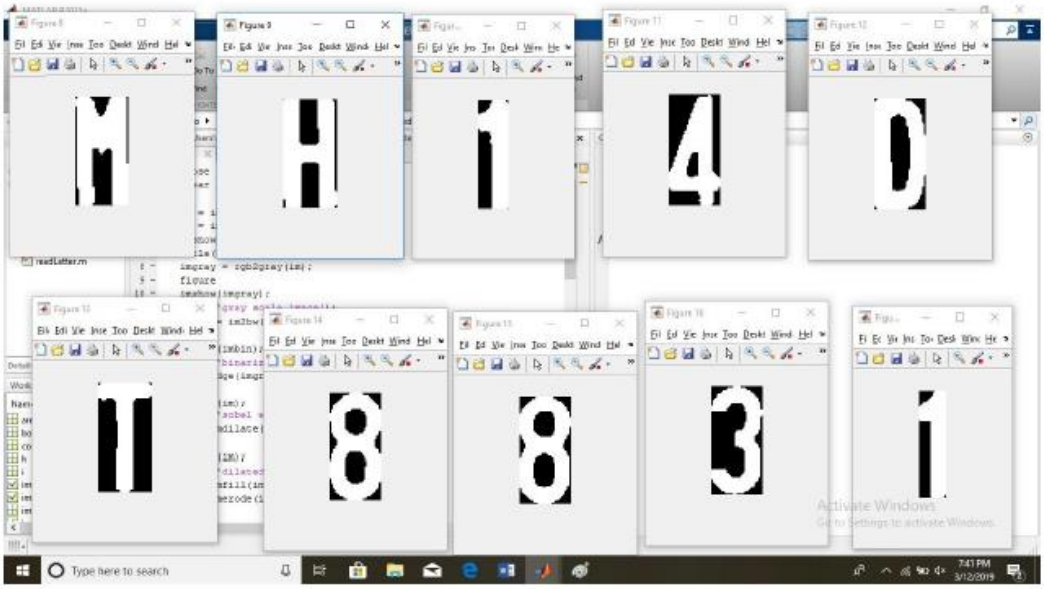

Fig 8:Segmented Characters

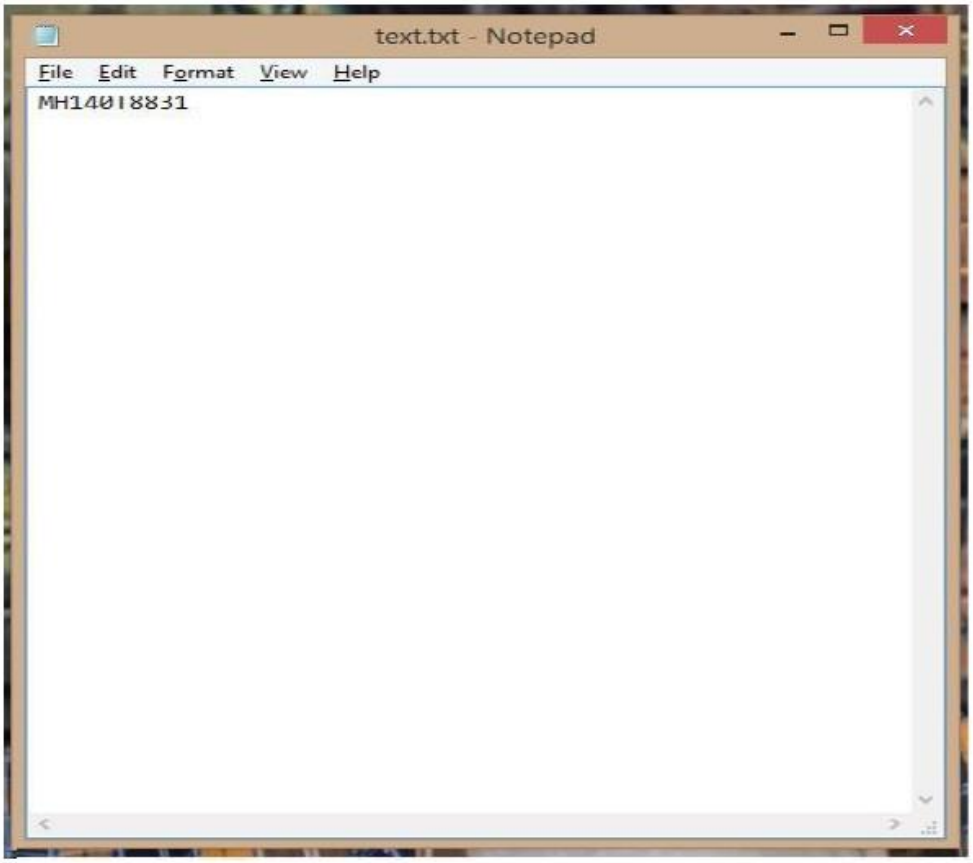

Fig 9:Text Converted Number Plate

V. Conclusion

In this paper proposes a plate localization and extraction technique from vehicle number plates. we extraction of plate location, then separation of the plate characters individually by performing different pre-image processing techniques and segmentation, finally the segmented numbers is correlated with the standard templates in the library. In order to extract the plate location a bounding box method is used. And also each character is also segmented using the same bounding box method. The Segmented characters are identified by using Template Matching Method. The suggested method is tested with various types of vehicles like four wheelers and with yellow and white background. The number plates with additional unnecessary data are also segmented with great accuracy.

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