Real Time Number Plate Recognition System using Hybrid Models

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Abstract: **This Paper presents a new approach for number plate recognition system to extract details from license plates. It was decomposed into three stages. The first stage was to extract number plate region from the captured image. Then top-hat transformation technique is used for this purpose. Second stage is to segment the extracted number plate characters by using Blob analysis. And final stage is to recognition the segmented characters using template matching. Further, extractions of number plate region in adverse conditions were considered. In this work, it is proposed that Top-hat transformation technique is used to eliminate some adverse conditions such as rain, dust, different fonts, extra characters on the number plate and skewed input cars.**

Keywords: **Image Acquisition, Localization, Extraction of Number plate, Character Segmentation, Template Matching**

I Introduction

Traffic monitoring system has now become an essential administrative part in most of the developed and developing countries. Nowadays vehicles play dynamic role in transportation. Also the use of vehicles has been increasing day by day because of population growth and human desires of vehicles. As the number of vehicles increases day by day, breaking traffic rules, entering restricted area are also increases linearly. Traffic Management is becoming one of the most important issues in rapidly growing cities. Due to bad traffic management a lot of man-hours are being wasted.So the purpose of this work is to develop an application which recognizes license plates from cars. The Vehicle License plate Detection Method has many applications like cars parking in hotels, traffic signal violation, electronic toll collections and border crossing vehicle etc. Any detection method has some major challenges like License plates have arbitrary sizes, orientations, complex backgrounds and localization of license plates.The purpose of this work is to develop an application which recognizes license plates from cars. We are trying to develop an Automatic License Plate Recognition (ALPR) Technique using Image Processing for Indian Conditions where number plate standards are rarely followed. The steps involved in ALPR are identifying a vehicle by reading its license plate, extracting license plate region and recognizing the characters in the license plate. Hybrid methods are introduced in this work in order to improve efficiencies and to overcome adverse conditions. We apply the methodology on an FPGA-based Automatic License Plate Recognition (ALPR) system used in Electronic toll collection (ETC) for real time applications. Arulmozhi K et al. [1] proposed a smart, simpleand efficient algorithm for Indian License Plate Localization using Top Hat Transformation, which suppresses the background of image and remove the non-uniform illumination. Jin Chong et al. [2] developed a new way of vehicle license plate recognition. In license positioning, the license positioning method is based on median filtering double edge detection; in character segmentation, it adopts a combinative method of locating the original level and improved vertical projection segmentation algorithm; in character recognition, the recognition method is based on the classification template matching of font characteristics. AymanRabee et al. [3] proposed highly reliable license plate detection and recognition approach using mathematical morphology and support vector machines. Sahil Shaikh et al. [4] proposed innovative method for number plate recognition. It uses series of image manipulations to recognize number plates. Shoaib Rehman Soomro et al. [5] presented a paper which is implemented for automatic toll collection. The system detects the vehicle first and then captures the image of the front view of the vehicle. XiaojunZhai et al. [6] presented a FPGA implementation of a complete ANPR system which consists of Number Plate Localization (NPL), Character segmentation (CS) and Optical Character Recognition (OCR). M. Venkata Subbarao et. al. [7] proposed a navel approach for decomposition of an image using DWT and NN. Youngwoo Yoon et al. [8] present a character segmentation method to address automatic number plate recognition problem.

II Proposed Approach

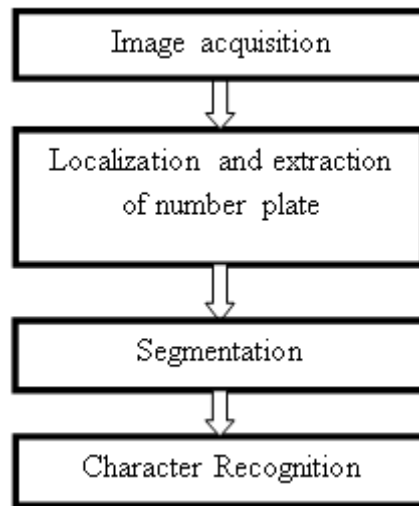The major steps involved in the proposed approach for a number plate recognition system is shown in the Fig. 1.

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┌─────────────────────────┐
│    Image acquisition    │
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             ⇓
┌─────────────────────────┐
│ Localization and extraction │
│    of number plate      │
└─────────────────────────┘
             ⇓
┌─────────────────────────┐
│      Segmentation       │
└─────────────────────────┘
             ⇓
┌─────────────────────────┐
│  Character Recognition  │
└─────────────────────────┘
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Fig.1 Major Steps in Proposed Approach

A. Image Acquisition

In this stage an input image is pre-processed to enhance a low contrast image into high contrast image for recognition of the number plate. The aim of Pre- Processing is to improve image and to suppress unwanted or to enhance some image features important for further processing. Preprocessing images commonly involves removing low-frequency background noise, normalizing the intensity of the individual particles images, removing reflections, and masking portions of images. Smoothing filters are used for blurring and for noise reduction. Blurring is used in preprocessing tasks, such as removal of small details from an image prior to object extraction, and bridging of small gaps in lines or curves. Noise reduction can be accomplished by blurring with a linear filter and also by nonlinear filtering. Smoothing in frequency domain is achieved by high frequency attenuation i.e. by low pass filtering. The visual quality of an image can be enormously degraded if the high frequencies are attenuated or completely removed. In contrast, enhancing the high frequency components of an image leads to an improvement in the visual quality. Image sharpening refers to any enhancement technique that highlights edges and fine details in an image. Image sharpening is widely used in printing and photographic industries for increasing the local contrast and sharpening the images. Sharpening operation is used to preserve edges of the image. The main objective of sharpening is to highlight transition in intensity.

B. Localization and Extraction of Number Plate

Localization of number plate normally requires two major sub-tasks. The first one is to enhance the License Plate (LP) and eliminate Non-License Plate (Non-LP) areas and the second one is extracting the License Plate. In this proposed method, under normal condition i.e. if number plate is clear then morphological operations are used for extracting the number plate. Under adverse conditions various methods are used. The best method to extract number plate under adverse condition is Top-hat Transformation.

C Character Segmentation

Segmentation is one of the most important processes in the automatic number plate recognition because all further steps depend on it. The localized output having extracted number plate region is given to the segmentation module for separating each alpha numeric character.The above output is segmented using connected component analysis and Bounding Box is generated around each character present in the number plate region. Now, all the segmented characters are extracted and smoothing operation is applied in order to eliminate noise components. Then each character is saved as individual character images. From the number plate region each and every alpha numeric characters are extracted using bounding box principle and only characters and numbers in the number plate region are extracted. These segmented characters are the input to recognition module for further identifying the number plate. The segmented characters obtained are given to recognition module. Here, template matching is used to identify each alpha numeric characters present in the number plate. Each segmented character is compared with the previously stored characters present in the template database which is called character database. Whenever there is a matching occur between segmented character and character database then that character is identified and displayed. Then check for next character and so on. Finally, the valid number plate is getting identified and displayed in the command prompt or graphical user interface.
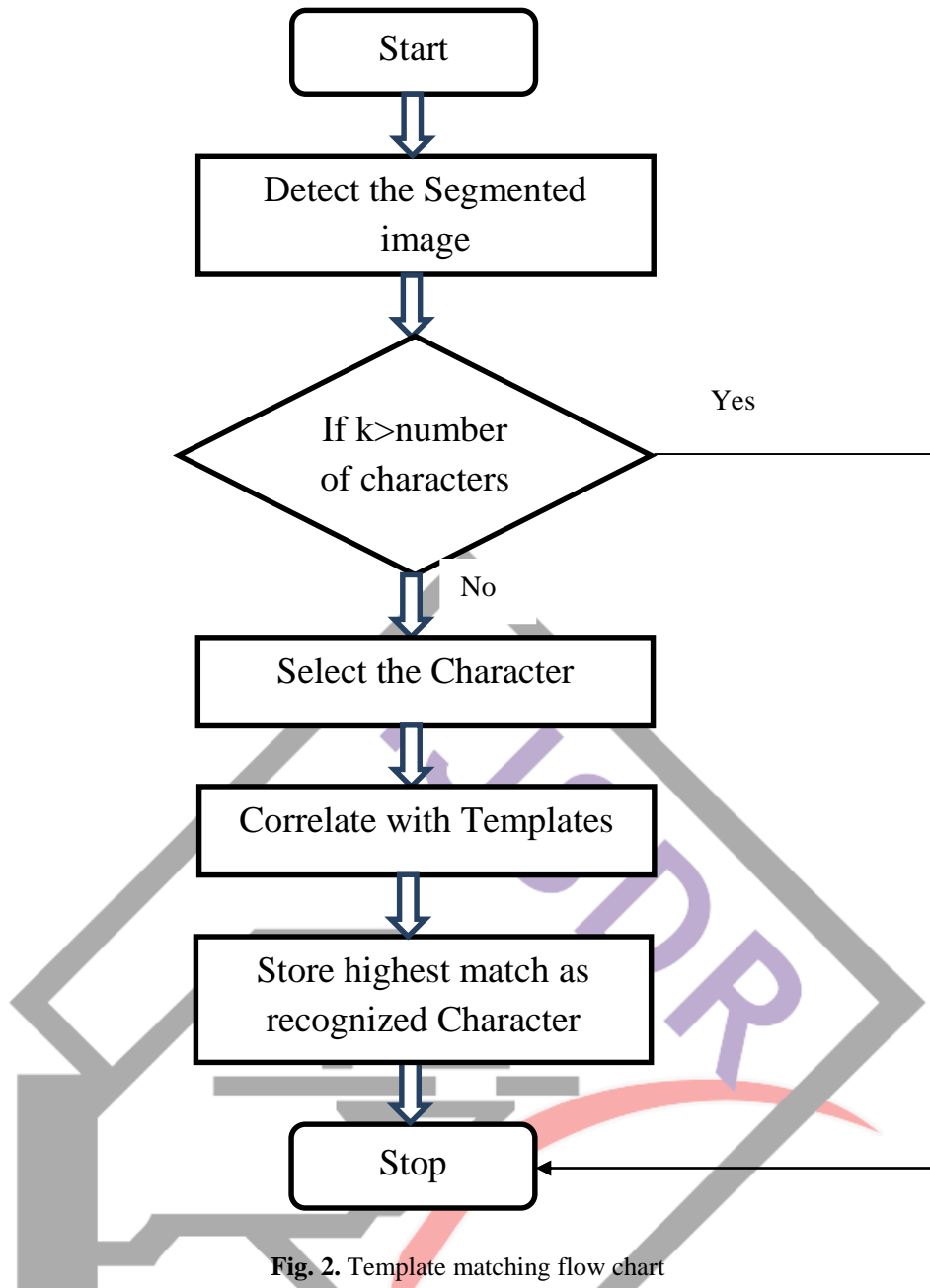
Fig. 2. Template matching flow chart

D Template Matching

Template matching is a technique in digital image processing for finding small parts of an image which match a template image. It can be used in manufacturing as a part of quality control, a way to navigate a mobile robot, or as a way to detect edges in images. Templates are most often used to identify printed characters, numbers, and other small, simple objects. The flow chart of template matching is shown in Fig. 2.
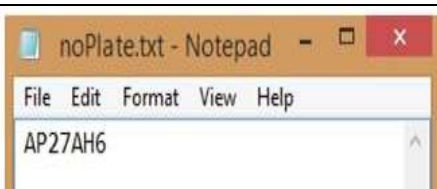
III Results & Discussions

The number plate recognition system is tested on car number plate images captured under various conditions. First car number plate is captured using camera then it is converted into gray scale image for further processing then top-hat transformation is applied on the gray scale image and then it is applied to the edge detection algorithm to find out its edges then morphological operation called 'closing' is applied on the edge detected output then finally localized image is obtained. Then the localized number plate is applied to binary conversion then complemented image is obtained from binary converted image and from these borders will be adjusted and then characters will be adjusted finally characters will be separated by using segmentation algorithm.

The experimental results shown below

Case-1: Number Plate with Full of Dust

Input Image	Step by Step Procedure	
	Localized Plate	
	Bounding Box Image	
	Segmented Characters	
	Final Notepad Image	

Case-2: Number Plate with Extra Names

Input Image	Step by Step Procedure	
	Localized Plate	
	Bounding Box Image	
	Segmented Characters	
	Final Notepad Image	

IV Conclusion

This Paper presents a new approach for number plate recognition system to extract details from license plates. It was decomposed into three stages. The first stage was to extract number plate region from the captured image. Then top-hat transformation technique is used for this purpose. Second stage is to segment the extracted number plate characters by using Blob analysis. And final stage is to recognition the segmented characters using template matching. Further, extractions of number plate region in adverse conditions were considered.   In this work, it is proposed that Top-hat transformation technique is used to eliminate some adverse conditions such as rain, dust, different fonts, extra characters on the number plate and skewed input cars. There is a further scope to study the extracting the number plate by using different methods to eliminate adverse conditions and the design of automatic gate opening system which opens the gate only when the detected number plate matches with the existing database.

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