

Automatic Number Plate Recognition

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ABSTRACT

Automatic Number Plate Recognition (ANPR) has many applications as (highway electronic toll collection, Police applications, Average Speed Enforcement, Bus Lane Enforcement, Parking Management Systems, Journey Time Systems, detection of stolen vehicles, etc.). It is worth mentioning that there is a scarcity in researches that introduce an automatic number plate recognition which depends on Arabic language.

In this study, a smart and simple algorithm is presented for Egyptian vehicle's number plate recognition system. The proposed algorithm consists of two major phases: plate region extraction and plate recognition. For extracting the plate region, edge detection algorithms and the alignment algorithm are used. And finally DCT or LDA is used for plate recognition.

The performance of the proposed algorithm has been tested on real images. Based on the experimental results, we noted that our algorithm shows superior performance special in number plate recognition phase.

KEYWORDS

Extraction plate region, Number plate recognition, Edge detection, Prewitt edge detector, dilation, a label connected components technique, Discrete Cosine Transform, Linear Discriminate Analysis, Euclidean distance.

1. INTRODUCTION

Nowadays vehicles play a very big role in transportation. Also the use of vehicles has been increasing because of population growth and human needs in recent years. Therefore, control of vehicles is becoming a big problem and much more difficult to solve.

Due to the rapidly increase in number of vehicles across the world's big cities and one of them is Cairo, number plate recognition system has become one of the most important digital image processing systems to be used.

Real time ANPR plays a major role in automatic monitoring of traffic rules and maintaining law enforcement on public roads. ANPR is used to identify vehicles by only their number plates. Since every vehicle carries a unique number plate, no external cards, tags or transmitters need to be recognizable, only number plate.

The field of ANPR and its application has attracted many researchers to search and develop systems which can process images and get useful information from them. Most previous researches and applications have faced some kind of poor performance due to the diversity of plate formats, the non uniform outdoor illumination conditions during image acquisition, noisy patterns connecting characters and poor edge enhancement.

Accordingly, these researches and applications have in some way restricted their working conditions, such as limiting them to indoor stationary backgrounds, fixed illumination, limited vehicle speeds, designated ranges of the distance between camera and vehicle, the best position of the camera and the maximum vertical view angle of the camera.

So many researches of car identification have been approached by car license plate extracting and recognition, some of the related work is as follows: Syed Ali Khayam [1], the results presented in this document show that the DCT exploits interpixel redundancies to render excellent decorrelation for most natural images. Thus, all (uncorrelated) transform coefficients can be encoded independently without compromising coding efficiency.

In addition, the DCT packs energy in the low frequency regions. Therefore, some of the high frequency content can be discarded without significant quality degradation. Such a (course) quantization scheme causes further reduction in the entropy (or average number of bits per pixel). Lastly, it is concluded that successive frames in a video transmission exhibit high temporal correlation (mutual information). This correlation can be employed to improve coding efficiency.

Serkan Ozbay, and Ergun Ercelebi [2], this paper presented application software designed for the recognition of car license plate. Firstly it extracted the plate location, and then it separated the plate characters individually by segmentation and finally

applied template matching with the use of correlation for recognition of plate characters. This system is designed for the identification Turkish license plates.

Ibrahiem M. M. El Emary [3], the medical image of human chromosome is treated by this software. It is entered in filter algorithm to remove the noise of the image that it can contain with cleaning percentage reach to 91.7%. Then this filtered image entered to segmentation algorithm, which cuts the original image into most likely segments which can contain one object (one chromosome) or in some bad cases it can contain more than one object (overlapping or touching chromosomes) then it can classify the human chromosomes by entering the images after segmentation into the Neural Network to study each segment and classify the chromosome that is contained in it.

N. Senthilkumaran and R. Rajesh [4], this paper mainly focuses on the study of soft computing approach to edge detection for image segmentation. The soft computing approaches namely, fuzzy based approach, Genetic algorithm based approach and Neural network based approach is applied on a real life example image of nature scene.

Mohamed El-Adawi, Hesham Abd el Moneim Keshk, Mona Mahmoud Haragi [5], this system can identify license plate with a good accuracy. It deals with the characteristics of the Arabic letters and Hindi numbers, and has a good ratio (80%) success rate.

Kuo-Ming Hung and Ching-Tang Hsieh [6] the purpose of this paper is to establish a low-cost, highly efficient dynamic vehicle license plate recognition system. Instead of fixed point installation, the video camera is installed in a car to capture the license plate of a random vehicle in front.

M. M. Shidore, S. P. Narote [7], an algorithm for vehicle number plate extraction, character segmentation and recognition is presented. Database of the image consists of images with different size, background, illumination, camera angle, distance etc. The experimental results show that, number plates are extracted faithfully based on vertical edge detection and connected component algorithm, with the success rate of 85%. Character segmentation phase using connected component analysis and vertical projection analysis works well with the success rate of 80%. The success rate achieved for character recognition is 79.84%.

Saqib Rasheed, Asad Naeem and Omer Ishaq [8], this paper presents a novel method for detection and recognition of Islamabad vehicle number plates. The proposed technique of automated number plate recognition is divided into two modules, one license plate localization module using canny detector and Hough lines, second license number recognition module using template matching.

Raseena A, Asst. Prof. Muhammad sajeer [9], Application software designed for the recognition of car license plate. It extracted the plate location with the input image and also with the skew angle, and then it separated the plate characters individually by segmentation and finally applied template matching with the use of correlation for recognition of plate characters.

Najeem Owamoyo, A. Alaba Fadele, Abimbola Abudu [10], an algorithm for vehicle number plate extraction, character segmentation and recognition is presented. The experimental results show that, number plates are extracted faithfully based on vertical edge detection and connected component algorithm, with the success rate of 85%. Character segmentation phase using connected component analysis and vertical projection analysis works well with the success rate of 80%. The success rate achieved for character recognition is 79.84%.

The paper is organized as follows: Section 2 provides an overview of the overall system. Extracting the plate region is explained in Section 3. Section 4 deals with recognition of number plates. Section 5 provides experimental results and the paper conclude with Section 6.

2. STRUCTURE OF THE ANPR SYSTEM

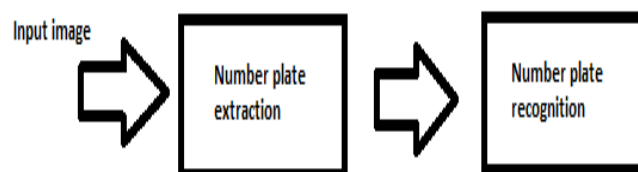


Figure (1) Number Plate Recognition System

The input of the system is the original image of the vehicle number plate captured by 14 MP high resolution digital cameras. This image is processed through the number plate extractor and its output will be provided to the recognition part. The proposed system considers the following assumption about the number plates:

- 1- The plates have a rectangular shape.
- 2- The plate has dark characters on a bright white background.
- 3- The width-height relationship of the number plate is approximately known.
- 4- The Plates consist of two groups of characters and digits have the same size.
- 5- The number of characters doesn't affect the recognition process.
- 6- A metallic bar separates two groups of characters, located in the plate centre and is useless in number plate recognition operation and may be ignored.
- 7- A coloured area above characters area is useless in the number plate recognition operation and may be ignored.

3. PLATE REGION EXTRACTION

A simple edge detection algorithm is first applied on the image to obtain the rectangular shape that has the same characteristics of the number plate; once the plate is located the alignment algorithm is processed on it to make it ready to the next stage.



Figure (2) Process of plate extraction

First, we convert the input color image to a gray-scale. To speed up the process, the image is first downsampled to 50% of the original. There are many methods of performing edge detection. We detected the edges here using Prewitt edge detector which takes a gray-scale image as its input, and returns a binary image of the same size as an output image, where the function finds edges in the input image. Then perform a dilation for all lines in a vertical directions to avoid broken line problem, then discard small lines that are impossible to be a part of the plate borders using a label connected components technique, then check the objects detected that has the same characteristics as the number plate.

Then alignment process is applied on the image. The whole idea depends on detecting the horizontal line inside the number plate as shown



Figure (3) Process of plate alignment

Prewitt edge detector with a high threshold is applied, dilation for all lines in the horizontal directions is then performed to avoid the broken line problem, The small lines that are very unlikely to be a part of the required horizontal line are discarded using a label connected components technique, Then the algorithm checks for any horizontal lines connecting the two vertical right and left edges detected earlier, which represent the vertical boundaries of the number plate, discarding the top and bottom lines, If nothing is detected, the algorithm attempts the same process again using a different threshold levels until a certain edge represent the required horizontal line, The input image is rotated around its centre from an angle of 7° to -7° in increments of 0.5° , with every rotation, the locations of the upper left and upper right corners of the character area are calculated at each stage, and then the difference between those values is calculated, The minimum difference recorded represents the required angle; this angle is then applied to the image.

4. PLATE RECOGNITION

The proposed algorithm does not need a process for segmentation of input image of number plate (character segmentation) but finds features in the whole number plate image. LDA (linear Discriminant Analysis) and DCT (Discrete Cosine Transform) feature extraction methods are used to classify the given number plate candidate. This algorithm may lead the recognition process to have high accuracy.

The number plate recognition algorithm is divided into two phases:

- a) Training phase.
- b) Test Phase.

a) Training Phase:



Figure (4) Sample of database plate image

Training Phase algorithm training on data base image by reading images then using one of the feature Extraction methods as DCT or LDA then a classifier method is used see the following DCT and LDA flowchart.

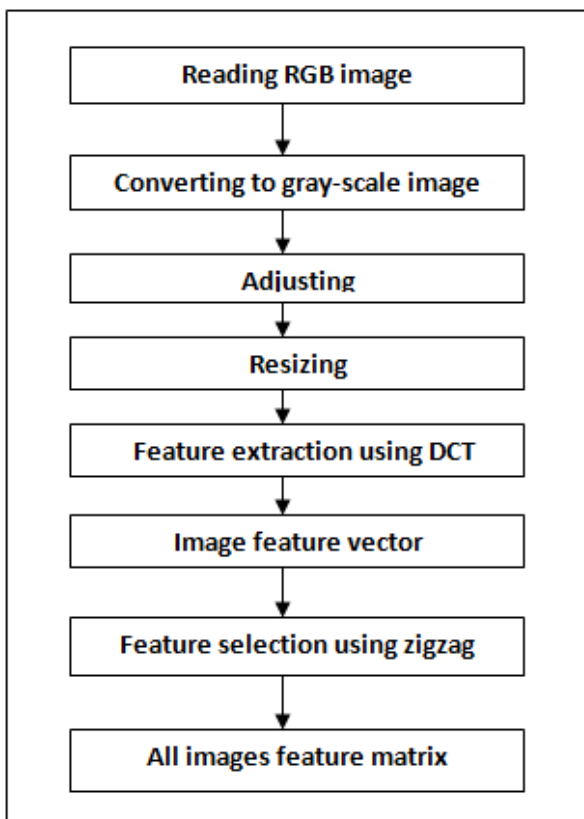


Figure (5) DCT flowchart

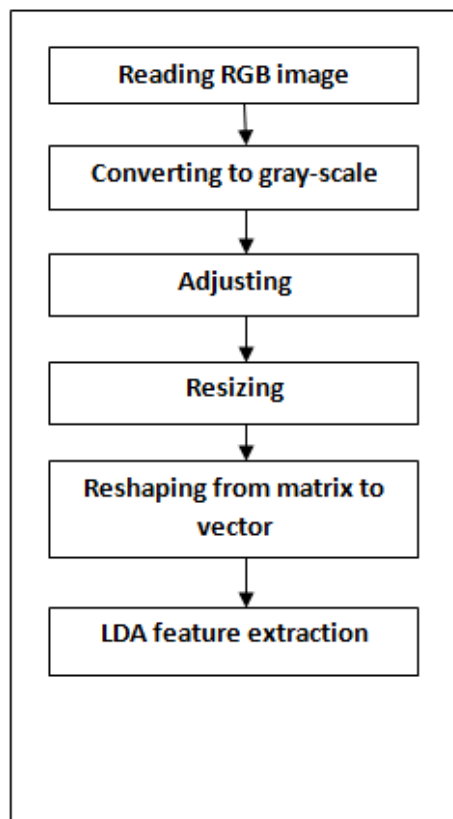


Figure (6) LDA flowchart

2) Test Phase:



Figure (7) Sample of test plate image

This algorithm try to recognize a test image in the training data base images and the minimum distance classifier method (Euclidean distance) will be used.

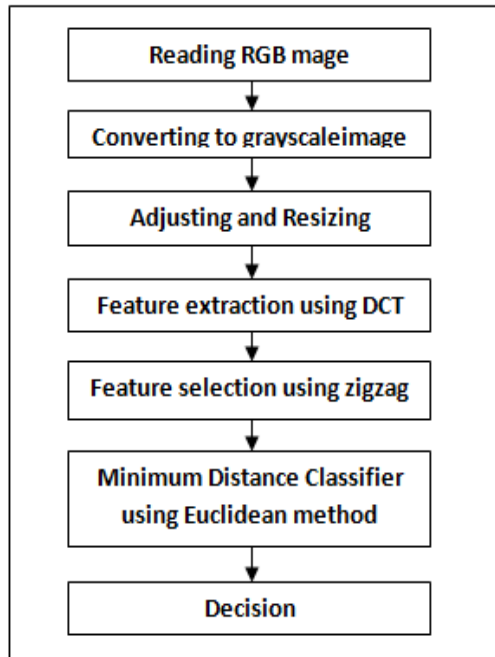


Figure (8) Test Phase by DCT and Euclidean method flowchart

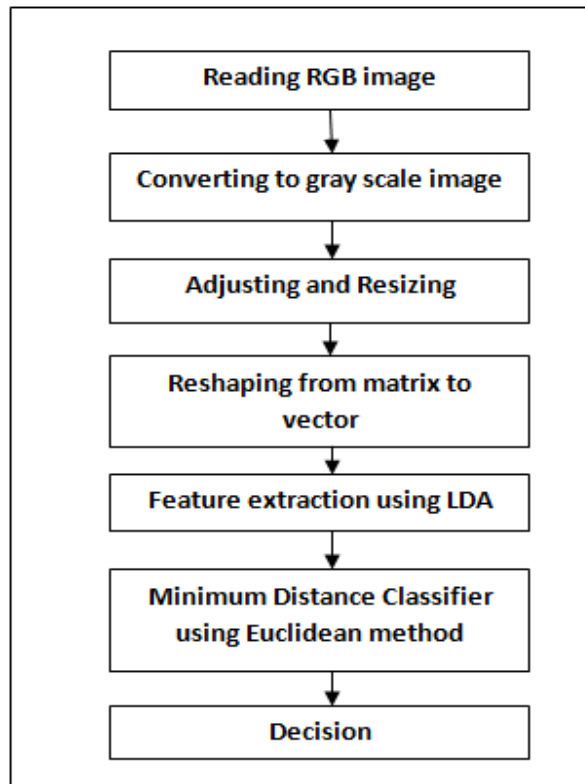


Figure (9) Test Phase by LDA and Euclidean method flowchart

5. EXPERIMENTAL RESULTS

Units of ANPR system	Percentage of accuracy
Number plate extraction	59.7 %
Recognition using LDA (with Egypt bar)	79.1 %

Recognition using LDA (without Egypt bar)	90.2 %
Recognition using DCT (with Egypt bar)	68 %
Recognition using DCT (without Egypt bar)	93 % best result

Table (1) Performance of proposed ANPR system

6. CONCLUSION

The purpose of this study has been to create an automatic number plate recognition system. It describes complete intelligent digital image processing system to recognize the Arabic letters and Hindi digits within the Egyptian vehicle number plate using a sequential multistage approach performed over gray-scale images, consists of two parts extraction of vehicle number plate from the image, and recognition of number plate. For extracting the vehicle number plate edge detection algorithm used.

Unlike the traditional methods for number plate recognition, the innovation of the proposed algorithm is that it does not need a process for segmentation of input image of number plate (character segmentation) but finds features in the whole number plate image. LDA and DCT feature extraction methods are used to classify the given number plate candidate. The experimental results show that our new method is of higher recognition accuracy than using traditional methods. This new approach provides a good direction for automatic number plate recognition. The system was designed using MATLAB 2013a.

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