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Automatic Ethiopian Vehicle Number Plate Detection System using MATLAB

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Abstract:- **Automatic vehicle number plate detection is the technique of extracting an area of license number plate from captured vehicle image. The development of number plate detection system includes image capturing, Pre-processing where a lot of disturbances and noises present in the image cleared and Plate region extraction which is the process of extracting license number plate area. This research, focus on introduction of Ethiopian number plate unique feature, selection of appropriate algorithm and technology required for detection system development finally, by taking sample input image of vehicle a system with an in-house built MATLAB code successfully developed for the preprocessing and detection of Ethiopian vehicles number plate area.**

Keywords— Pre-processing, Automatic vehicle number plate detection, MATLAB

INTRODUCTION

License plate detection is an important step in the automatic detection and recognition of a license plate. The detection and extraction of the plate area is the process of locating the area of the plate throughout the image. It contains several concepts of image processing, such as gray scale conversion, dilation, noise filteringedge processing, detection of probable areas and others. [1]Figure 1 shows an example of Ethiopian license plate which contains Numeric and Amharic character codes printed in rectangular plates .Ethiopia has unique license plate styles which reflects three Categories of information such as Location of Vehicle Number plates issued region, The intended service of the car, Particular identification number for the car with a different color background [2] these features are shown in fig 1, Table 1 and Table 2 respectively

Figure 1: Sample Ethiopian Number Plates Styles

Table 1: Regional Codes Utilized In Ethiopian Number Plates

Issuing Region	***English Code***	***Amharic character***
Ethiopia	ET	ኢቲ
Addis Ababa	AA	አአ
Amhara	AM	አማ
Afar	AF	አማ
Benshangul Gumuz	BG	ቤጉ
Dire Dawa	DR	ድሬ
Gambella	GM	ጋም
Harar	HR	ሐረ
Oromiya	OR	ኦሮ
Somali	SM	ሶም
SNNP	SP	ደሕ
Tigray	TG	ትግ

Table 2: Ethiopian vehicle number plate classes based on services intended

N_o Code	*English Code*	*Amharic Code*	*Service Type*	*Foreground Colour*
1			Taxi	Red
2			Private	Blue
3			Trade	Green
4			Governmental	Black
5			Non –government	Orange
6	CD	ኮድ	Diplomatic	Black
7	AU	አህ	African union	Light green
8	AO	ዐድ	Aid organization	Orange
9	UN	የተመ	United nation	Light blue
10		ፖሊስ	Police	Black
11		የአለት	Temporary	Red
12		ተላላፊ	Transit	Light blue
13		ልዩ ተ	Special vehicle	Red

In this research the authors focus on detecting the license plate area which includes the unique Ethiopian numeric characters.

I. LITERATURE REVIEW

Yasser M.Alginahi presents recognition of Arabic license plate system by using a neural network, Horizontal projection, and zoning, 470 image samples are used for feature extraction with a precession of approximately 97%. [3].M.M Shidore and s.p. Narote discuss recognition of Indian vehicle number by using different algorithm SVM, Vertical edge detection and connected component analysis with a precession of approximately 78.84% [4].Deepti sagar and maitreyee dutta proposed vehicle number plate recognition in case of India by using block based neural network with a precession of

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approximately 98.2%. [5] Seble Nigussie and Yaregal Assabie presents Ethiopian License Plates Recognition by using Correlation based template matching and use Gabor filter for plate detection and CCA for feature extraction get an accuracy approximately 71.06%.[6]. M. K. B. Ashan1 and N. G. J. Dias studied recognition of vehicle license plates in sri lank using matlab Foreground detection and blob analysis used for vehicle detection, edge processing and filtering for license plate isolation and finally the OCR from the detected license plate by using character segmentation and template matching methods and get accuracy around 85 %for detection of license plate and 70 % for recognition of license plate.[7] Ibrahim turkylmal and Kirami Kacan present recognition of vehicle number plate system by using Artificial Neural Networks, divide the recognition process into three stages, license plate area detection using, segmentation of character on the number plate, and finally recognition of character on the number plate. for license plate area detection Edge-based image processing Techniques is used, for segmentation of character vertical projections in Binarized images for area used and to recognize character on number plate ANN is used got success rate around 97%.[8]Reshu kumara and surya Prakash Sharma presents automatic number plate recognition by using machine learning techniques and divided the process into three capturing the image, plate localization and recognition of digits on the plate and also use HOG features
for training and SVM for classification, they obtained is 99%accuracy.[9] .P.surekha et.al presents vehicle number plate recognition by using image processing and neural network and obtained 97% accuracy.[10].fei Xie el.al proposed license plate detection and character recognition system based on a combined feature extraction model and also use BPNN, for feature combination, training the feature vectors to get the best accuracy of 97.7%.[11] Inga astawa et.al presents Detection of vehicle number Plate by using Sliding Window, Histogram of Oriented Gradient, and Support Vector Machines also use mobile phone to identify location of vehicle number plate get recognition accuracy of 96%.[12] Gajendra Sharma presents Analysis of Vehicle Number Plate Recognition System and their performance by Using Template Matching Techniques also connected component analysis used for feature extraction on 90 sample images get 67.98% cross correlation and 63.46% phase correlation. [13].

The main motivation of this project work is to create Ethiopian license plate detection system framework that requires less human involvement for the traffic control process and increased manageability of the traffic system.

II. PROPOSED METHODOLOGY

This section involves methodology used for detection and extraction of plate. The system development begins from a given captured image of a vehicle with license plate. This process is a most important stage and foundation for detection system development, the activities which are implemented on this stage has great change on the outcome of the whole detection system.
The 'License plate detection' comprises three subsections. These subsections are capture image Section, preprocessing section, Localization or detection of Number plate area a as shown in figure 2 brief explanation of these subparts presented in the following section.

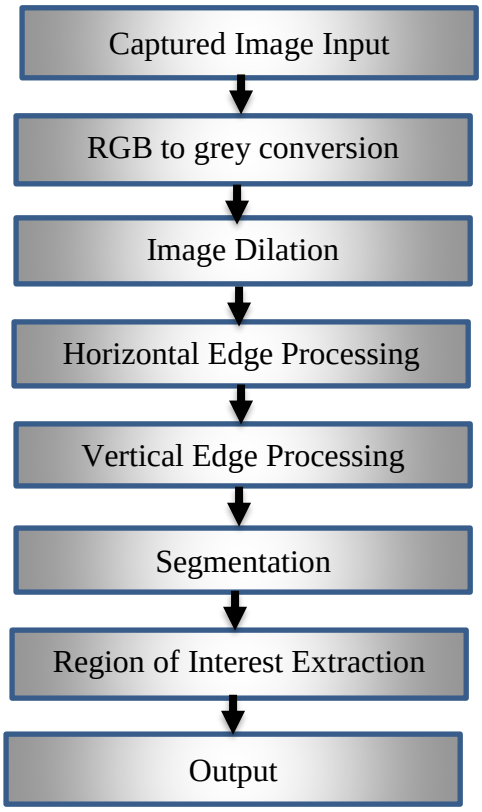

Figure 2: detection algorithm in MATLAB

Grayscale image

The first step is to preprocess the imported in Red Green Blue (RGB) format Followed by the conversion of the imported RGB image to grayscale to reduce the number of colors, which reduces the brightness. Which to some extent helps to reduce the noise in the image and facilitates the processing of the image. Figure 3 shows a gray transformed image of a vehicle with a gray filter applied

Figure 3: Grayscale Image

Dilate an Image

Dilation can helps to fill holes, sharpen the edges of objects, increase the brightness, noise removal and join the broken lines of a given image. The accuracy of edge detection can be increased by making the edges sharper the difference of gray value between neighboring pixels at the edge can be increased by making the edges sharper. During this conversion, certain

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important parameters like lighter edges of object, difference in color, etc. may not be there. Figure 4 shows an image of a vehicle that has dilated from the previous step.

Figure 4: Dilated image.

Horizontal and Vertical Edge Processing of a vehicle Image

In this stage, the dilated image from the previous step passes through successive steps of edge processing techniques which are horizontal and vertical edge processing for both edge processing histograms will be plotted. The step is initiated by horizontal edge processing for getting horizontal histogram, then the algorithm moves through each column of the image. In each column, the algorithm begins with the second pixel from the top. The difference between second and first pixel is calculated. If the difference exceeds certain threshold, it is added to total sum of differences. Then, algorithm moves down to calculate the third and second pixels difference and So on, it moves until the end of a column and calculate the total sum of differences between neighboring pixels. Finally, it creates column-wise summed array. Similarly, similar steps are taken to process rows instead of columns to obtain vertical histogram.

Passing Histograms through a Low Pass Digital Filter

The values of the histogram suddenly changes between columns and subsequent rows. Therefore, to overcome the loss of important information in later steps, it is recommended to mitigate such sudden changes histogram values. Similarly, the histogram passes through a digital low-pass filter. When this step performed, all the histograms are calculated based on the average, taking into account right and left values. This step is must be performed both for the horizontal histogram and for the vertical histogram.

Filtering out Unwanted Areas in Image

Once the histograms pass through a digital low-pass filter, unnecessary parts of the image are deleted. In this scenario, rows and columns with low histogram values are unwanted areas. Very small variations between adjacent pixels that contain portion of the image indicated by low histogram value. Therefore the area with a license plate contains a plain background with alphanumeric characters, the difference in the adjacent pixels, especially along the edges of characters and the license plate, will be very large. This results in a high histogram value for that part of the image. Therefore, the likely area of a license plate is the area with a high horizontal and vertical Histogram values, and therefore the remaining Areas with lower value are no longer required, or it is the unwanted area that is removed from the image by applying a dynamic threshold. In this algorithm, the average value of a Histogram is equal to the dynamic threshold which the horizontal and vertical histograms are passed through a filter with this Dynamic threshold finally in this process a high-probability histogram in which the license plate is located. Edge processing plots for horizontal and vertical edges are shown in figure 5 and figure 6 respectively.

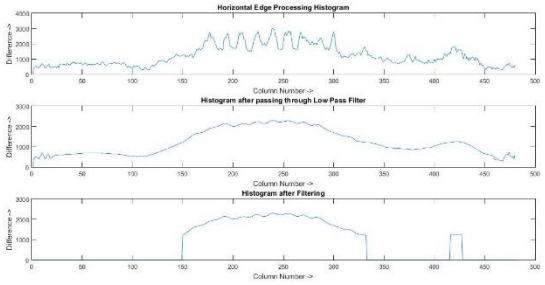

Figure 5: (A) Histogram Plot for Horizontal Edge Processing (B) Histogram Plot after Low Pass Filter Applied

(C) Histogram Plot after Unwanted Rows Removed

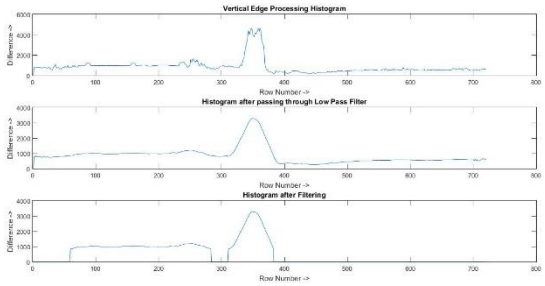

Figure 6: (A) Histogram Plot for Vertical Edge Processing (B) Histogram Plot after Low Pass Filter Applied (C) Histogram Plot after Unwanted Rows Removed

Detection Of Probable Candidate Plate Area

At this stage, all areas in the image that are likely to have a license plate are detected. In the previous step, all unwanted rows and columns were deleted using dynamic filters. The remaining columns and rows make up these most likely areas as candidate areas. Probable detected region shown in figure 7.

Figure 7: Probable Candidate Regions

Region Of Number Plate Area Interest Extraction

At this stage, the area with the maximum histogram value is considered the most likely candidate for a license plate from other regions. All areas are processed in rows and columns to find a common area with maximum values of the horizontal and vertical histogram. The area with the greatest probability of accommodating the license plate area is shown in Figure 8.

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Figure 8: Detected License Plate Area

CONCLUSION

In this paper, a system was developed that detect an Ethiopian car license plate area using MATLAB. Sample vehicle images taken from various resources. The development process began by collecting samples of Ethiopian vehicle images and studying their unique features, followed by a review of the published literature to adopt the appropriate detection algorithm for the project, then choosing the appropriate technology to use, which is MATLAB, and studying the software how to use it, the detection of the license plate has two different phases such as preprocessing and detection of probable license plate area. For preprocessing phase, gray scale conversion technique is used then by using horizontal and vertical edge processing the license area successfully detected.

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