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# Automatic License Plate Detection in Foggy Condition using Enhanced OTSU Technique

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***Abstract-*** Automatic detection of license plate (LP) is to localize a license plate region from an image without human involvement. So far a number of methods have been introduced for automatic license plate detection (ALPD), but most of them do not consider hazardous image conditions that exist in many real driving situations. OTSU based technique is best suited for hazardous image conditions having foggy weather effects, tilted LP area. In this technique after denoising and normalization of the image, the digits and characters within the image can be extracted. In this paper large database set of LPs under different conditions like clear images and images with foggy effects is considered and various performance parameters like MSE, PSNR, SSIM and Aspect Ratio are considered to extract the results. These parameters have shown improvement with percentage 14.93%, 14.12%, 39.21% and 40% respectively.

**Key term: Neural Network, HMM, foggy**

## I. INTRODUCTION

Automatic license plate detection (ALPD) involved extraction of vehicle's license plate (LP) area from an image without human intervention. It is one of the important stages of automatic LP recognition (ALPR) system [1].In an ALPR system, there are three major stages: i) acquisition of a car image by an image capturing device; ii) detection of the potential LP area from the image; iii) feature extraction and recognition of characters from the LP area. The objective of an ALPR system is automatic identification of a vehicle by reading the LP data from an image or a video. In an ALPR system, stationary cameras are mounted on the road signs, street lights, buildings or highway overpass for capturing the image of the vehicle [2]. Then the captured image goes through a software system that detects possible LP location in the image, and converts the LP information into a computer readable format. The recovered identity of the vehicle can be used in real time or stored in the database for future. In an ALPR system, LP detection is the most crucial stage and the performance of the whole system highly depends on it [3]. In the detection stage, we need to deal with a number of important issues, such as:

i. Hazardous weather conditions (rainy and foggy) Hazardous background (presence of non-LP objects in the background)
ii. Low contrast image environments (indoor, night, blurry and uneven illumination)
iii. Horizontally tilted LP in the image due to camera position.

Collectively all these issues are identified as the hazardous image conditions. All these issues make ALPD a challenging research topic. In our research work we mainly focus on automatic detection of license plate with foggy effects using enhanced Otsu technique. The enhanced Otsu technique is based on assigning labels to the image uniformly and extraction of digits and characters is performed based on various performance parameters such as MSE, PSNR, SSIM and Aspect Ratio.

**MSE (Mean Square Error):** The Mean Square Error (MSE) of a procedure for estimating an unobserved quantity measures the average of the squares of the errors or deviations, that is, the difference between the estimator and what is estimated. It is a method used to check for errors. Two MSEs are calculated and then are compared to find the accuracy of an image. It calculates the quantitative score that helps to measure the degree of homogeneity or the level of error or distortion between them. When a zero-mean random source x passes through a cascade of K additive independent zero means distortions. A lower MSE value will result in higher quality image.

**PSNR (Peak Signal-to Noise Ratio):** The ratio between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation. Because many signals have a very wide dynamic range PSNR is usually expressed in terms of the logarithmic decibel scale. PSNR is most commonly used to measure the quality of reconstruction of lossy compression codec (e.g., for image compression). The

signal in this case is the original data, and the noise is the error introduced by compression. When comparing compression codec, PSNR is an approximation to human perception of reconstruction quality. Although a higher PSNR generally indicates that the reconstruction is of higher quality, in some cases it may not.

**SSIM (Structural Similarity Index Measure):** It is well known quality metric that is used to calculate the similarity between two images. It is designed by modeling any image distortion as three factors that are contrast distortion, luminance distortion and correlation. The SSIM index is a full reference metric, the measurement or prediction of image quality is based on an initial uncompressed or distortion-free image as reference. SSIM is designed to improve on traditional methods such as peak signal-to-noise ratio (PSNR) and mean squared error (MSE).

**Aspect Ratio:** The aspect ratio of an image describes the proportional relationship between its width and its height. It is commonly expressed as two numbers separated by a colon. For an *x*:*y* aspect ratio, no matter how big or small the image is, if the width is divided into *x* units of equal length and the height is measured using this same length unit, the height will be measured to be *y* units.

## II. LITERATURE SURVEY

**[1] S. Archana(2016) et al:** This paper presents VLSI implementation of handwritten digit recognition system based on analog neural network. The recognition system is based on the least hamming distance neural network which both learning and classification. This type of circuit can be utilized by visual tracking system providing them ability to have backup recognition utility in case first recognized pattern proves to be incorrect.

**[2] Mrs. Soni Chaturvedi(2014) et al:** Neural Networks are found as an effective tool for pattern recognition. In this paper a Feed Forward Neural Network and an Izhikevich neuron model is applied for pattern recognition of Digits and Special characters.

## III. FLOWCHART

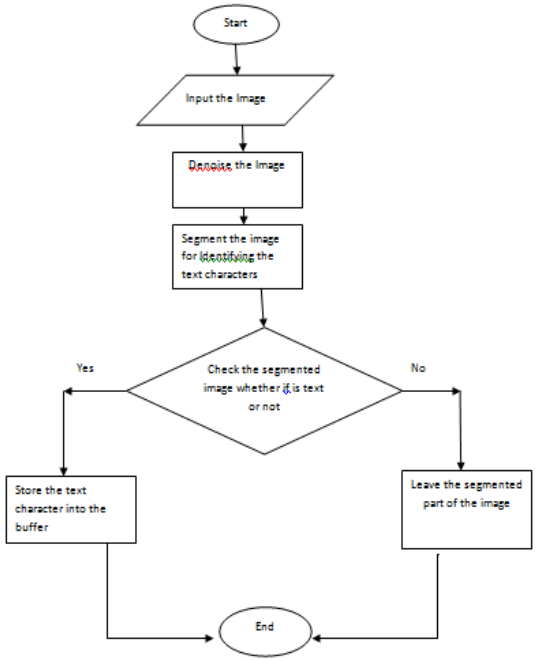



Fig. 1 Flowchart explaining the steps involved

## IV. Proposed Algorithm

**Step1** Input the image from the outer source, the source may be CCTV camera capturing real time pictures of vehicles.

**Step2** Preprocess the image. The preprocessing of image includes resizing and denoising.

a. Resizing of an image involves neutralization of size along height and width as well.
b. Denoising is done with the help of Salt and pepper technique and Gaussian technique.

**Step3** Employ the optimum threshold based technique in order to segment the image.

a. Identify the optimum threshold using OTSU based on ~im2bw (image n, threshold) function.

**Step4** Extract the text characters from the image.

a. Identify the text based on bounding box function as propied=regionprops(L,'BoundingBox').

**Step5** Ignore the unwanted letters from the segmented components.

a. Except character all the remaining points are declared unwanted using [L Ne] =bwlabel(imagen) function.

**Step6** Store the required components into the memory buffer.

a. Store the extracted text letters into the local disk space.

## V.BASIC STEPS FOLLOWED

**1. Read the image**: An image residing in the local directory is fetched and further stored in the form of matrix where intensity values of pixels are represented across rows and columns.

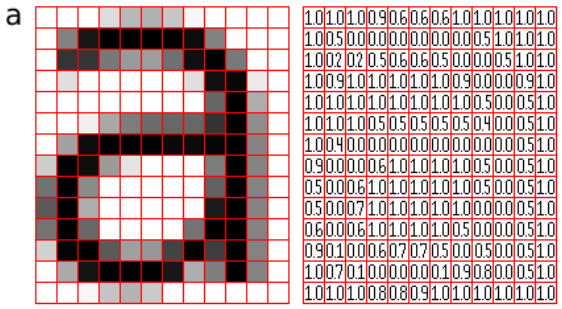



Fig .2 Intensity values of image stored in the form of matrix

**2. RGB to grayscale conversion:** Color images are often built of several stacked color channels each of them representing value levels of the given channel. For example, RGB images are composed of three independent channels for red, green and blue primary color components. Here is an example of color channel splitting of a full RGB color image. The column at left shows the isolated color channels in natural colors, while at right are their grayscale equivalences:

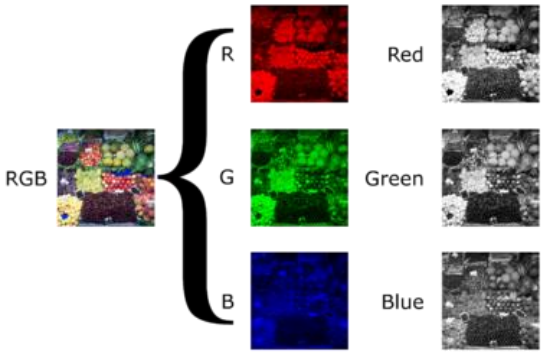



Fig. 3 Conversion of an image from RGB to grayscale

In MATLAB, I= rgb2gray (RGB) converts the RGB image to the grayscale image of intensity I. The rgb2gray function converts RGB images to grayscale by eliminating the hue and saturation information while retaining the luminance.

**3. Optimum thresholding based segmentation:**
An image contains only two principal regions (object and background) and the number of misclassified pixels can be minimized with the help of prior knowledge about the distributions of the gray level values that make up the object and the background.

**4. Extraction of ROI:** In order to extract the segment of image called ROI the characters of number plate are marked with the help of green bounding box. Further, the required components of image are stored within the corresponding local directory. The MSE, SSIM, PSNR and Aspect ratio values are then compared for base technique and Otsu technique.

Fig. 4 Extraction of ROI using green bounding box

## IV. RESULTS

In order to avoid complexity in this research paper, performance parameters of single license plate are calculated and compared.

### 4.1 Dataset taken


Fig. 5 License Plate used as dataset


Fig .6 License Plate used as dataset

### 4.2 Comparative tabular and graphical representation of MSE values

| Image | Base Technique | OTSU Based |
|---|---|---|
| A | 0.23 | 0.34 |
| F | 0.21 | 0.24 |
| R | 0.20 | 0.21 |
| S | 0.17 | 0.23 |
| I | 0.161 | 0.19 |
| - | 0.11 | 0.12 |
| N | 0.23 | 0.28 |
| D | 0.28 | 0.29 |
| 4 | 0.34 | 0.39 |
| H | 0.23 | 0.27 |
| 2 | 0.24 | 0.28 |
| 0 | 0.27 | 0.30 |

**Table 1**

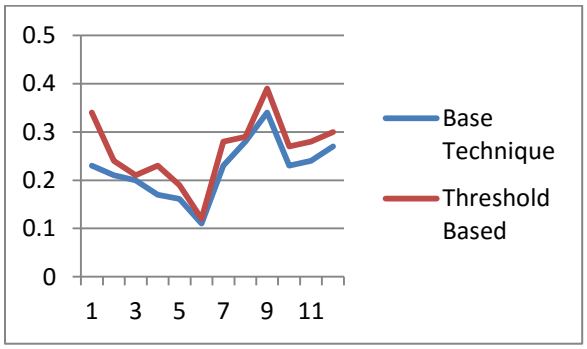



Fig. 7 Graphical representation of MSE values

**Analysis:** In comparative analysis of MSE values of base technique and threshold based technique, threshold based technique yields higher MSE values and hence performs better for LP under foggy conditions.

### 4.3 Comparative tabular and graphical representation for PSNR values

| Image | Base Technique | Threshold Based |
|---|---|---|
| A | 40 | 44 |
| F | 39 | 41 |
| R | 34 | 42 |
| S | 35 | 41 |
| I | 36 | 42 |
| - | 32 | 39 |
| N | 33 | 38 |
| D | 45 | 49 |
| 4 | 23 | 34 |
| H | 45 | 49 |
| 2 | 46 | 52 |
| 0 | 45 | 46 |

**Table 2**

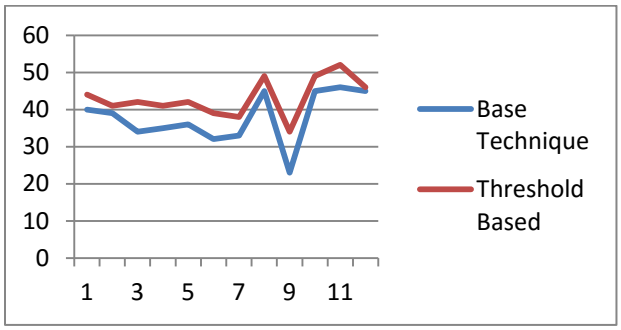



Fig. 8 Graphical representation of PSNR values

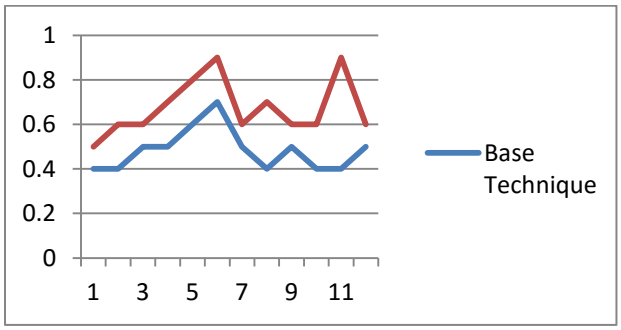



Fig.9 Graphical representations of Aspect ratio values

**Analysis:** Under the comparative analysis of two perspectives on the basis of PSNR value, the comparative lower PSNR value of the threshold based technique makes it more suitable for LP under foggy conditions.

**Analysis:** Under the comparative analysis of two perspectives based on Aspect Ratio value. The Threshold based technique has higher Aspect Ratio value due to which the image extracted will be of equal size as compared to the original image under foggy conditions making it more reliable.

### 4.4 Comparative Graph for ASPECT RATIO values

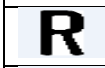
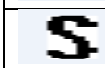
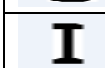
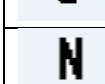
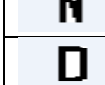
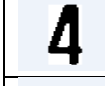
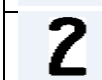
| Image | Base Technique | Threshold Based |
|---|---|---|
|  | 0.4 | 0.5 |
|  | 0.4 | 0.6 |
|  | 0.5 | 0.6 |
|  | 0.5 | 0.7 |
|  | 0.6 | 0.8 |
|  | 0.7 | 0.9 |
|  | 0.5 | 0.6 |
|  | 0.4 | 0.7 |
|  | 0.5 | 0.6 |
|  | 0.4 | 0.6 |
|  | 0.4 | 0.9 |
|  | 0.5 | 0.6 |

**Table 3**

### 4.5 Comparative Tabular and Graphical representation for SSIM values

| Image | Base Technique | Threshold Based |
|---|---|---|
|  | 0.4 | 0.5 |
|  | 0.4 | 0.6 |
|  | 0.5 | 0.6 |
|  | 0.5 | 0.7 |
|  | 0.6 | 0.8 |
|  | 0.7 | 0.9 |
|  | 0.5 | 0.6 |
|  | 0.4 | 0.7 |
|  | 0.5 | 0.6 |
|  | 0.4 | 0.6 |
|  | 0.4 | 0.9 |
|  | 0.5 | 0.6 |

**Table 4**

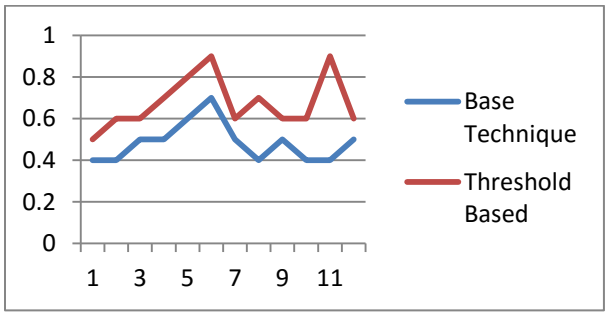



Fig. 9 Graphical representation of SSIM values

**Analysis:** Under the comparative analysis of two perspectives based on SSIM value. As compared to the base technique the Threshold based technique has Higher SSIM value which means images with less clarity under contrast background provides results.

## V. CONCLUSION

The calculations and comparisons carried out in our research work states that optimum threshold based technique is the better approach for image segmentation .Since image of any resolution is used as an input and various image processing steps are carried out easily. Thus, it remains better image segmentation technique as compared to other techniques. Under foggy conditions, when image is blurr, the same technique can extract the letters once denoising is done i.e. the image is enhanced in specific region of interest. In research work various performance parameters like MSE, PSNR, SSIM, Aspect ratio are compared with the existing technique and the improved results are compared in tabular form for every parameter.

## VI. FUTURE WORK

The research can be enhanced in this topic by further considering the uncontrolled dataset. In our Current research the threshold based technique is applied on controlled image set and hence the results are regenerated on the controlled dataset. In future this dataset can be enhanced for further testing the technique.

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