Recognition of Vehicle Registration Plate with "Neural Network" using "Segmentation"

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ABSTRACT
Localization algorithms have been working with very large number of various domains. But the research area is under discussion with the domain of VRPR i.e. vehicle registration plate recognition system. The authenticity of license plate recognition system deals with the performance of the localization algorithm.

This computational process takes a lot of time to confine the vehicle license plate. In this research area is under discussion to the diverse types of localization algorithm and one distinct of them should be worked for a particular relevance. Different states have their distinct types of plates for example. Some utilize single line horizontal plate while others utilize multi-line non horizontal and differently located number plate. Some of the broadly utilized localizations algorithm which is worked in the neural network recognizer is Double threshold scheme.

General Terms
Image Recognition, Security, Algorithms.

Keywords
Segmentation, Neural Network, Double Thresholds Algorithm, VRPR

1. INTRODUCTION
Localization of an entity means to take out the less significant (smaller) subfield consisting of that entity from a larger field .The majority of VRPR (systems) method is not robust to noise and occlusion. The main reason of noise is poor sight (conditions) circumstances such as fog or bad weather .The image of vehicle captured by the traffic surveillance camera is not always clear enough to be localized and recognized. If the vehicle is blurred or it is also possible that the license plate of the vehicle consists of some scratches or dents so that making it look not clear to be recognized. Any time the vehicle would not be in an ideal position (full front or full rear facing towards the calibrated camera) so as to allow the mobile camera to capture a perfect clear image ready to be processed for localization. Firstly the image is to be converted into gray scale then apply localization algorithm. There are so many schemes for the same. We will compare the result of our algorithm with other localization algorithm in our implementation of the VRPR i.e. vehicle registration plate recognition system .The algorithm work with the area is under discussion consists of two phase. In phase 1st, an approximate license plate section is find out and in phase 2nd the exact section of number plate is detected .The Flow-chart of the localization algorithm is shown below.

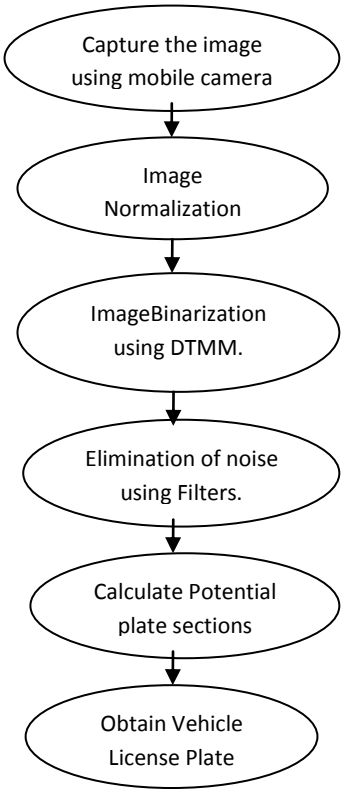

Fig 1: Schematic algorithm

1.1 Algorithm Steps
Step1. The monocular image of the vehicle is captured using a low-resolution standardized mobile camera. Thus, capturing the image of the vehicle must have to contain the license plate section show on it whether on the front or back side of the vehicle. The new approach accepted in this algorithm which takes care of noise and occlusion.

Step2. The image is preprocessed i.e. the brightness, skewness and contrast of the image is modified to make it easy to be valid as an input for localization. This is called image normalization.

Step3. To remove noise (Salt and Pepper, Gaussian).of the image using various filter techniques.

Here Statistical median filter has been used.

Step4.Global threshold technique is used to Binarized the image.

Here DTMM method has been implemented which is a computerized method of acquiring binarized image from a gray scale image.

Step 5.Identification and capturing of the prospective vehicle license plate section by checking for the sub regions in the complete picture depends on appropriate characteristic such as color, size and shape .If the picture is not clear then it can be improved by using anisotropic band pass digital filters.

Step6. Implement the average correlation filter (TO-MACH) to localize prospective license plate section. To obtain the exactly correct vehicle registration plate section on the basis of threshold and the Binarization.

2. NUMBER PLATE LOCALIZATION THROUGH CANNY EDGE DETECTION METHOD

The localization of the vehicle license plates through edge finding algorithms which is different approach works with object detection in edges map of images. The edges methods appropriating the vehicle plate localization focus on the principle which is the vehicle plates emerging in the image of the vehicle has some different aspects that prepare it distinguish simply from the rest of the images such as high contrast of vehicle license plates as compared to the remaining of the image of the vehicle license plate.

Figure 2: Distinct kinds of vehicle license plates of several states in India

In the above diagram the vehicle license plates typically have darker foreground or lighter background and or vice versa that illustrate a change in intensity. So that the aim is to find out the changes in intensity horizontally due to the rows containing no. of plates would give a lot of sharp deviation in intensity. Thus this algorithm calculates the highest amount of deviation for each possible row and then chooses the rows having the highest amount of deviation in intensity evaluated to the other rows. This accurate location of the plate is calculated by the obtaining the location of the coordinates where this kind of variation occurs.

A famous approach to object detection is the Canny edge detection method which accepts the principle of edge based object localization.

2.1 Three-frame differential with Canny edge detection method

The principle of a Three-frame differential transforms including some of the following processes:-

2.1.1 Dilation Process

The dilation operation creating all background points are joined into contact with the object in the picture, so apply boundary outward expansion process. It can be implemented to fill the holes in picture.

Dilation operation can be represented as

$A \oplus Y$ Means

$A \oplus Y = \{a | (\hat{Y})_a \cap A \subseteq A\}$

The image can be obtained by the origin of Y with a displacement of the picture. The member of A elaborated by Z is the set of a. $\hat{Y}$ and A at least has one member overlap. With the concept of morphological operation, set Z is frequently delegated to as structural members. Concept is referred as:

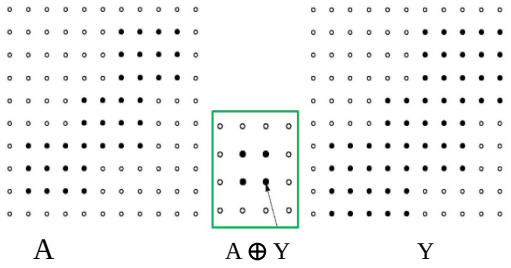

Figure 3: Dilation Process Operation

2.1.2 Upgraded process of Edge Detection through Canny Edge Detection Algorithm

Through, edge detection and dilation process, merge owning the inter-frame deviation use a few picture pre-processing. So that it can merge the three frames differential method owning early edge correlation to obtain absolute picture detection and invent a new process of moving object detection.

2.1.2.1 Working of Algorithm

Let obtain three frame of picture in a row order applies differential process then in between two of them i.e. frame F_{j-1} and frame F_j picture beginning to obtain movable object, for the moment, apply canny operator to take out picture edge detection (in regulate) to find edge outline of the recent frame then after phase the expended differential picture and edge detection results.

The profile of movable object can be got initially. The method of three- frame differential as it can prepare the profile of the movable object accessible excluding usually prepare the shape not continuously, so that we can phase the shape of movable object get subsequent time to obtain extra whole information of shape.

Edge shape of the object obtains here as well as includes ingredient of the edge shape within the objects. After the merged field detection, lots of difficult merged fields can be present. So that it's not simple to openly take out the part of filling, so can be implemented to some different process apply on filling in distinct type.

The concept is to swap the black and white part of the binary picture. In merged field marker detection, spot the original black part, to obtain the whole merged field as the background, and return the take of 0, at the same time all the left over part is the movement of the object area obtain task of 1. At last, this indicates the merged field less than 1% of the whole part in order to remove inaccessible noise point so that can be obtained the resultant movement object part.

In this research work, through the concept of three-frame differential process, merge the vehicle plate edge detection, and recommend an upgraded algorithm.

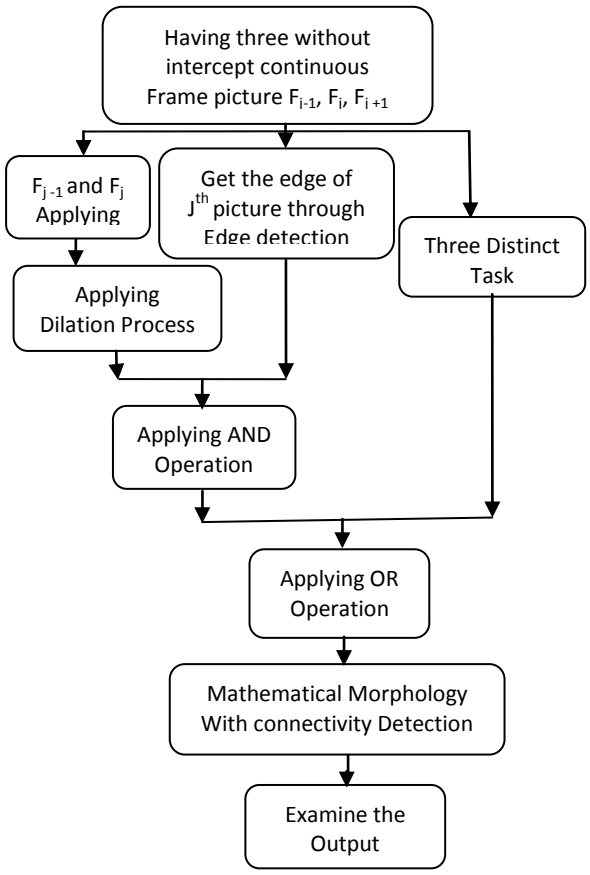

Figure 4: Upgraded process of Edge Detection

Figure 5: Vehicle plate having so much noise (unclarity)

The above figure 5 shows that the vehicle number plate has so much noise, which is detected using the process of edge detection method which is also described in figure number 4, which is also known as canny edge detection method i.e. three frame differential process.

Figure6: Various Images from Canny Edge Detection Algorithm

- **(i) Original Picture**
- **(ii) Gray Scale Picture**
- **(iii) Picture after Three-frame differential Process**
- **(iv) Vertical Projection**

3. LOCALIZATION OF NUMBER PLATE THROUGH ADAPTIVE DOUBLE THRESHOLDS

After completing the text, the paper is prepared for templation. The detection of edge dependent license plate localization process is not matched with the situations where the failure of the vehicle license plate is not too different from the remaining of the background or if there is so much noise (unclarity) is involved in the frame. Some different cases of front which are mutilated font this systematic plan leads to under segmentation.

The localization technology depends on the digital filters, which are too cumbersome to work with the big license plate.

The aim is to show the frame of the vehicle license plate. And eliminate the remaining part; this frame is fixed by the nuts protecting the plate attached to the vehicles. Consequently a vehicles license plate contains alphanumeric character printed with a dark color (generally black color license plate for vehicles in India) the frame support and unacceptable noise (unclarity) in the form of mud, scratches or inadequate illumination. The background of the vehicles license plate is generally light in contrast to comparatively fore-ground color of the printed character.

This vehicles license plate recognition system has to examine by using distinct types of vehicles license plate of the distinct states.

So each final detail is taken into consideration such as shape, features and orientation of the vehicles license plate.

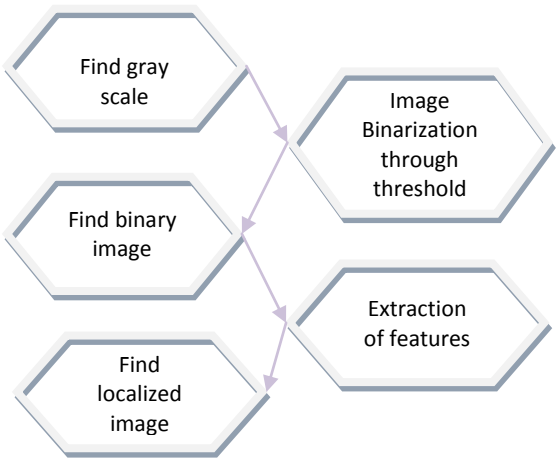

Figure 7: Flow of steps in location algorithm through threshold scheme.

Thresholding methods are the segmentation techniques depending on the different features of picture like color, intensity, texture or some combination of all of these features. Generally, the thresholding algorithm may be divided into two categories. The double thresholding techniques may not be implemented in that case from which illumination alters with the time.And the single thresholdingprocess is called as adaptive thresholding process.

Figure 8: A vehicle license plate having alpha numeric characters with nuts keeping the frame.

The DTMM method is a globally adaptive threshold technique.

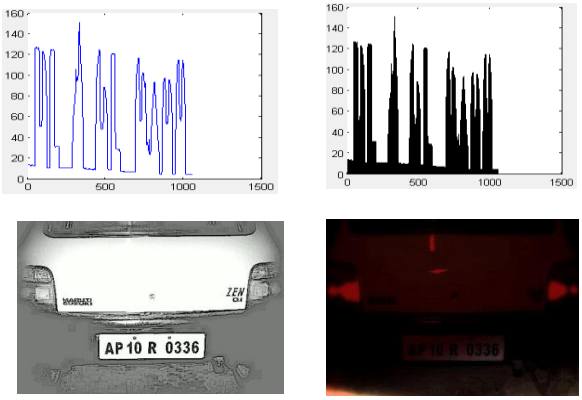

Figure9: Various Images from DTMM method

(i) Original Histogram
(ii) Vertical Projection
(iii) Gray Scale Picture
(iv) Thresholding Picture

3.1 Background improving method

3.1.1 Working of the algorithm

The classic background algorithm working with distinct process artificially removes an image without moving the object in the beginning of the background. But, in the case of road traffic, the maximum area in low resolution camera has vehicles, and the illumination always altering. However, shades and other distinct noise would present .so that it is not easy to obtain a constant background without moving the objects. The latest process would delete noise fine.

Initially: a series of picture after was to taken implement multi-frame average to initialize the background. The suggested process was depending on a single threshold motion mask algorithm. It acquired double thresholds motion mask (DTMM) to improve the background. The execution of the background improving module is followed in schematic diagram.

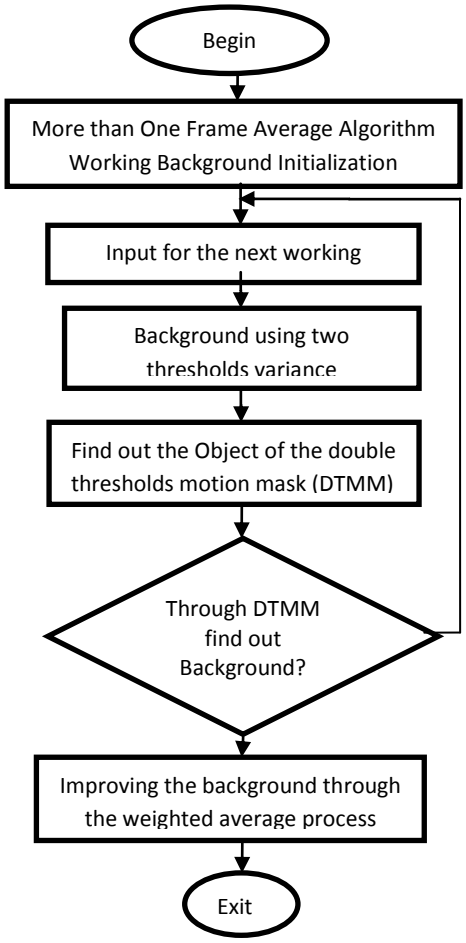

Figure 10: DTMM Background Improving Module Flow-Chart

The working of DTMM background I moving algorithm is as:-

1) Let $j_0, j_1, - - - - - - - - -, j_{n-1}$, (n>=10) is a set as the picture order that is obtained. With the multiple frame picture average algorithm, the beginning background AB_0 may be explained as:

$$AB_0 = \frac{\sum_{j=0}^{n-1} Nj}{n} \quad \text{(i)}$$

2) Implemented formula is as

$$OT = \begin{cases} 1, & |AI\text{-}AB| < KL \,|AI\text{-}AB| > TH \text{ and} \\ 0, & \text{Otherwise.} \end{cases} \quad \text{(ii)}$$

We may obtain two adjacency binary picture object masks, which are as $0T_{J-1}$ and $0T_j$

3) Calculate the value of DTMM depending on the above two adjacent binary picture object masks.

The following formula is used as:

$$TT_J = OT_J \,\&\, (\sim OTj_{-1}) \quad \text{(iii)}$$

4) Through TT_j, can be calculated the foreground and the background. If the value of TT_j is equal to the 0, use the formula for the weighted average $BB_j = \psi\ BB_j + (1\text{-}\psi)\ BB_j$ to improve the background. And if TT_j is equal to 1 then the background will not be improved. Implement $BB_j = BB_{j-1}$ to explain the present background. So that it can improve the pixels, those are the background in the present frame and the foreground in the just before frame. But the k value would. Disturb the improving speed. With the help of algorithm working, say ψ as.95.

5) Through the functional link neural network (FLNN) to improve the two thresholds, the working of algorithm is present in part b. And the value of pixels not improved would be decided in the next frame and so on.

The previous single threshold background improving algorithm is not perfect in segmenting the pictures and improved speed is restricted that's why the current DTMM background improving algorithm working may not only clear this kind of problems, and also extract more shade. And last it may not be disturbed by beginning situation.

3.2 The Automatic Double Threshold Improving

There are so many algorithms which are improved thresholds automatically. The general processes most of the time used are iterative methods, kirsh operator method, bimodal methods and many more. The threshold is non-linear relationship to the input of average value of gray scale for every picture frame. So that the concept $U = f(J_{avg})$ presents. The relationship of non-linear may implement the form of power series which explained as

$$U = Z_0 + Z_1 I_{avg} + J_2 I^2_{avg} + - - - + J_m I^n_{avg} \quad \text{(iv)}$$

So that the gray levels J_{avg} (j=1, 2, 3…… n) is calculated for each and every picture frame correspondingly and for say input data can be obtained and extensional data set say {1, J_{avg} , J^2_{avg} ,……..,J^m_{avg}}.

Let us assume that all of set components be the input of neural network. And also observe the respectively threshold value $\hat{W}_j$ as the approximated output. A representation of a functional link neural network structure for input and output data is shown:-

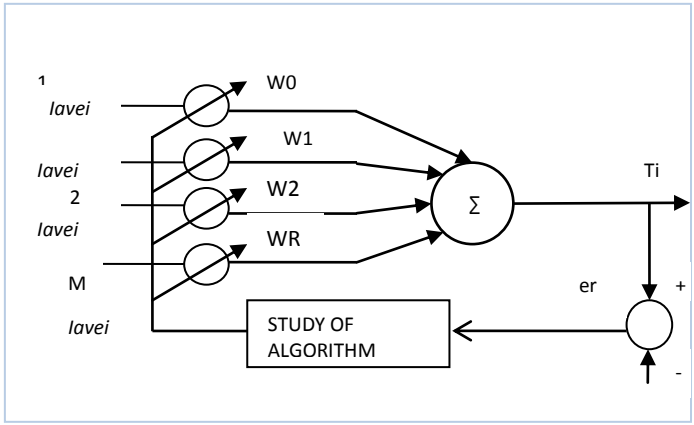

Figure 11: Functional Link of Neural Network

The functional link neural method in [vii] and [viii] may be about to happen over the nonlinear function correspondingly. According to (iv), the high threshold W_h. N should be in polynomial order. The greater n shows additional accuracy approach over the nonlinear function works and the updated threshold is additional perfect. But there are some additional concealed coefficients, and additional training time. These are the regions to affect the updated speed. Through so many practical implementations, it has been showed that if n equals to 4 then the result will assure the necessity of accuracy as well as assure updated speed. Z_0, Z_1, Z_2……, Z_n is the coefficients for polynomial equations. First n is calculated then the weighted coefficients may also be calculated by training the sample.

3.2.1 The Working of Algorithm

Let a be used for the dispute J_{avg}, and let b be used for the automatically updated threshold U. So that the nonlinear function can be written as:-

$$b = Z_0 + Z_1 a + Z_2 a^2 + \ldots\ldots\ldots\ldots + Z_n a^n \quad \text{(v)}$$

And the output showed as:-

$$\hat{c}_j = \sum_{j=0}^{n} a^j \, Zi \quad \text{(vi)}$$

Error shown as:-

$$er_j = b_j - \hat{c}_j \quad \text{(vii)}$$

Weights adjusted shown as:-

$$Z_i = Z_i + \eta\ er_j\ a^k_j \quad \text{(viii)}$$

The input of the J^{th} sample for neural network, b_j, $\hat{c}_j$ and er_j all are in that order the expected output, actual output, and in between the actual output and estimated output. The input $\mathbf{I^{th}}$ can be weight value Z_i for neural network. Here n is used as study factor. In each group input, the values of weighted factor are regulated by manually changing the T_H constantly. At last, the weighted coefficients would be determined to find out the finally updated background for recognition. Likewise for different values and input training sample may obtain final weighted coefficients. So that the two thresholds may be updated adaptively depends on best possible weighted

coefficients, and all these can be determined from before and average gray slate value from the image.

4. IDENTIFICATION OF MOVING OBJECTS: DOUBLE THRESHOLDS ALGORITHMS

The scene of traffic is simply authorized by conditions of weather. When illumination is powerful then the light reflection may create the road surface intensity, surface close to white vehicle. However for cloudy weather, the road surface intensity would same to black cars. Through the single threshold difference method it is clear that those vehicles, which are having same intensity as road surface would be overlooked or divide to blocks, and then that block is very tiny to be beaked up from noise, directing to sign vehicle approximately session part B in III, to update double threshold adaptively, use the average grey values as input data. And this updated threshold may adjust to after of illumination fine. However, with the background difference method, some of the shades may be removed by updated background commence in part A of III. The vehicles whose intensity is nearest to background would be detected exactly. The algorithm steps are follows:-

$$A_L = \begin{cases} 1, CI - CB \leq TL; \\ 0, \text{Otherwise.} \end{cases}$$

$$A_H = \begin{cases} 1, |CB - CI| >= TH; \\ 0, \text{Otherwise.} \end{cases}$$

$$A = \begin{cases} 1, A_H \cup A_L; \\ 0, \text{Otherwise} \end{cases}$$

So that the object segment using low threshold having many more shade and noise, ever as it was not whole part through high threshold. So that, firstly the mathematical morphology must be used to increase foreground segment by high threshold. Through which, it would delete trivial holes. Therefore the foreground with some small holes is to be removed by low threshold. Through the algorithm among this kind of distinct image. Using the continuity of the areas of object the holes would be removed. So that the corrosion process would create the finishing output more correct.

5. EXPERIMENTAL RESULTS AND ANALYSIS

The Requirements of hardware for keeping out the research of the projected processes are a high resolution digitalized camera, a memory unit and a processor of 3.5GHz frequency. The software used for the same is MATLAB R2011a with 3GB RAM. All the pictures are captured by digitalized camera. The researches are proposed on 180 vehicle license plates of different states and we report a very successful accuracy of 93.7%with no extra space above the subsection head.

Figure12: Original Picture

Figure 13: Localized Vehicle License Plate

Figure 14: Original Picture

Figure 15: Localized Vehicle License Plate

6. CONCLUSION

In this research work, the work has been been done with a purpose of appraisal of vehicle license plate localization and outlining its concert with respect to different-different algorithms. The technical views of the vehicle license plate localization are pointed out and discussed the merits and demerits with its limitations of applying the methodology to be examined as a ration for real time traffic inspection system in future. The localization through Canny Edge Detection Algorithm transform is widely appropriate and considered but it has a restriction that is assigned to multiple objects to be finding out at some time because of the presence of peaks in the Canny Edge picture. The results explain higher performance for picture having multiple objects of attention and applicable enhancement in exact detection of vehicles license plate from the picture of the vehicles.

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