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A Survey On Automatic Vehicle Number Plate Detection System

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ABSTRACT

Now in these days a significant amount of growth on vehicle traffic is observed. Due to this the manual monitoring and traffic management becomes a major issue. A number of different techniques on traffic management and surveillance are employed to reduce the complexities of the traffic management. In this context the number plate recognition is one of the most essential techniques for managing the traffic using digital techniques. In this presented work a survey on automatic number plate recognition technique is presented. Additionally different methods and techniques are defined that helps to provide accurate estimation of the number plate recognition. In addition of that a model for accurate number plate recognition is also incorporated in this work, which is implemented in near future and their performance is evaluated.

Keywords:- Traffic Management, Number Plate Recongition, Image Processing, Feature Estimation, Object Recongition Model

I. INTRODUCTION

India is a growing country and advancement is reflected on a number of things. In last 10 years the culture and life style of every Indian in rapidly changed. In addition of that in order to match with the current life style a number of things are also involved in our life style. Among these life style products the vehicle is become one of the most essential part of our life. But the impact of this fast and luxurious life style is occurred in different areas such as leaving places and traffic around us. In order to deal with this increasing traffic and the upcoming traffic a number of different techniques and management skills are employed. Among them the automatic vehicle number plate recognition is a requirement of new generation traffic management and control.

Vehicle's number plate recognition system is a special area of traffic monitoring and surveillance. Not only the monitoring this system can be employed on different areas of traffic management, without engagement of human effort such as toll collection point or parking lot. Basically this technique is integrated with the video vehicle detection systems.That is installed in places of interest according to requirements such as traffic monitoring or detection of stolen vehicle etc.

There are a number of techniques used for recognition of number plates such as BAM (Bi-directional Associative Memories) neural network character recognition [1], pattern matching [2] etc. [3].In this presented work a survey on different techniques which are used for automatic number plate recognition is studied. Therefore first we discuss the different approaches that are recently developed and provide accurate outcomes for recognition. In further some techniques of edge detection techniques are explored and finally a new model for accurate recognition is proposed.

II. LITERATURE SURVEY

This section provides the essential contributions and techniques that are recently developed for accurately identification of vehicle number plate.

Sandipan Chowdhury et al [4] proposes calculations to confine vehicle number plates from regular foundation pictures, to fragment the characters from the restricted number plates and to perceive the sectioned characters. The revealed framework is tried on a dataset of 560 specimen pictures caught with various foundations under different enlightenments. The execution exactness of the proposed framework has been computed at each stage, which is 97.1%, 95.4% and 95.72% for confinement and extraction, character division and character acknowledgment individually. The proposed strategy is likewise equipped for limiting and perceiving numerous number plates in pictures.

Sahar S. Tabrizi et al [5] presents another technique for Iranian License plate acknowledgment frameworks that will expand the exactness and lessening the expenses of the acknowledgment period of these frameworks. In such manner, a mixture of the k-Nearest Neighbors calculation and the Multi-Class Support Vector Machines (KNN-SVM) model was produced in the review. K-NN was utilized as the primary characterization display as it is basic, vigorous against uproarious informational collection and powerful for a substantial informational index. The perplexity among the tag comparative characters issue was overcome by utilizing the various SVMs characterization display. The SVMs show has enhanced the execution of the K-NN in the acknowledgment of comparative characters. The present review test comes about uncovered that there is a huge change in the character acknowledgment stage rate contrasted and a comparable review.

TejendraPanchal et al [6] address License Plate limitation with the incorporated division approach. As the noteworthiness of open travel system constructs an Automatic License Plate Recognition has wound up being a basic investigation subject. ALPR outfitted with various sharp perception structures like, road movement organization, security organization, modified toll gathering system, et cetera. Different frameworks have been offered for tag acknowledgment, each bearing its own specific purposes of intrigue and blocks. The critical stride in ALPR framework is the exact repression of number plate, Segmentation, Recognition. Harris corner calculation is proposed in this paper which wind up being powerful in changing movement and enlightened lightning conditions. While the exactness of License Plate confinement is nourished forward to the Segmentation organize. The Segmentation is refined by a strategy for associated segment investigation solidified with Pixel check, Aspect proportion and Height of characters. At the end, the reenacted results are appeared with conclusion and future work.

Tag acknowledgment framework for stolen vehicles and recovery of proprietor's subtle elements is produced by ***UtkarshaGurjar et al [7]*** utilized for distinguishing the stolen vehicles and is actualized at police checkpoints and toll square. Additionally fundamental subtle elements of enlisted clients can be recovered. This framework essentially comprises of three modules: tag confinement, character division and character acknowledgment. The proposed framework first catches the picture of vehicle utilizing the camera and concentrates the tag number utilizing the ideas of advanced picture handling. At that point it approves the tag number against the database containing the subtle elements of substantial tag numbers. On the off chance that it is found in the legitimate tag database then it will check in the stolen auto database and a ready message is appeared if match is found.

In this paper, ***PooyaSagharichi Ha et al [8]*** exhibit an Automatic License Plate Recognition System (ALPRS) to distinguish tags which is an utilization of picture preparing. The primary procedure of ALPRS is isolated into four stages: The clamor in the picture is expelled by utilizing FMH channel. A straightforward calculation is utilized for foundation subtraction. Shrewd edge identification is utilized to limit the tag area. At last, letters and digits are separated through format coordinating strategy. The proposed calculations have two preferences: First, the technique has solid strength against commotion. Second, it can manage tags with various hues. The execution of the calculation is tried in an ongoing video stream. In view of the outcome, our calculation demonstrates the missing rate is right around 16% from 70 vehicle pictures.

III. EDGE DETECTION TECHNIQUES

This section provides the study about different popular techniques of edge detection approaches.

A. GABOR filter

In one-dimensional case, the Gabor consists of a multifaceted exponential (a cosine or sine function, in genuine case) localized approximately x = 0 by the cover with a Gaussian pane shape [9].

$$g_{\alpha,\varepsilon}(x) = \sqrt{\alpha/\pi}\, e^{-\alpha x^2} e^{-i\varepsilon x}$$

for $\alpha \epsilon R^+$ and $\varepsilon, x \epsilon R$, where $\alpha = (2\sigma^2)^{-1}$, σ^2 is a variance and ε is a frequency. Dilation of the compound exponential function what's additional, move of the Gaussian window when the amplifying is fixed shape piece of a Gabor limit. The Gabor change (a unique instance of the brief span Fourier change) utilizes such part for time-recurrence flag examination. The specified Gaussian window is the best time recurrence limitation window it could be said of the Heisenberg vulnerability rule [10].

In a two-dimensional case, irrefutably the square of the connection between's a picture and a two-dimensional Gabor work gives the ghastly vitality thickness thought around a given position and recurrence in a specific course. Also, the two-dimensional convolution with a round (non-curved) Gabor capacity is distinguishable to arrangement of one-dimensional ones

$$g_{\alpha,\varepsilon}(x) = g_{\alpha,\varepsilon 0}(x_0) g_{\alpha,\varepsilon 1}(x_1)$$

For $\varepsilon = (\varepsilon_0, \varepsilon_1)$ and $x = (x_0, x_1)$Here, the actual frequency of the two-dimensional function is determined by $\varepsilon = (\varepsilon_0^2 + \varepsilon_1^2)^{1/2}$ Furthermore $\vartheta = \arctan\left(\frac{\varepsilon_1}{\varepsilon_0}\right)$ is an angle between x-axis and a lineperpendicular to the ridges of a wave.

GABOR WAVELET

Fundamentals of a family of reciprocally similar Gabor functions are called wavelets when they are produced by dilation and shift from one uncomplicated Gabor function (mother wavelet), i.e.

$$g_{\alpha,\varepsilon,a,b}(x) = |a|^{-1/2} g_{\alpha,\varepsilon}\left(\frac{x-b}{a}\right)$$

For $a\epsilon R^+$ (scale) and $b\epsilon R$ (shift). By convention, the mother wavelet has the energy localized aroundx = 0 as well as all of the wavelets are normalized $\|g\| = 1$. Although the Gabor wavelets do not form orthonormal bases, the discrete set of them form a frame.

The used notation is in accordance with [11]. The first order partial derivative of image I with respect to variable x is symbolized by I_x. Analogously I_{xx} symbolized second order partial derivative with respect to x and I_{xy} is the second order diverse derivative. In addition $I_x(x, \sigma_D)$) symbolized a partial derivative achieve at the location of an point x and considered by using a Gabor wavelet with scale $a \propto \sigma_D$

EDGE DETECTION

For the edge recognition, the convolution in two opposite headings is performed with differently widened wavelets (e.g., independently in line and segment bearings). It is important to utilize a wavelet which fills in as the first arrange halfway differential administrator (e.g., a first subordinate of a Gaussian function).Consequently, neighborhood maxima of module

$$M(x, \sigma_D) = \sqrt{I_x^2(x, \sigma_D) + I_y^2(x, \sigma_D)}$$

are originate. Just the maxima over a specified threshold are measured (due to noise and unimportant edges). As a consequence, the edges for each scale are obtained.

CORNER DETECTION

The key idea is to obtain the partial derivatives needed for a construction of an autocorrelation matrix

$$\mu(x, \sigma_I, \sigma_D) = \sigma_D^2 g(\sigma_I) * \begin{bmatrix} I_x^2(x, \sigma_D) & I_x I_y(x, \sigma_D) \\ I_x I_y(x, \sigma_D) & I_y^2(x, \sigma_D) \end{bmatrix}$$

by utilizing the convolution with the Gabor wavelets. A Gaussian window of SI scale is utilized for averaging of the subsidiaries. On this framework, indicators are based. Additionally here, it is important to utilize such a Gabor wavelet which fills in as the first order partial differential operator.

BLOB DETECTION

Following the same principle, blobs can be detected [12] from the second order partial derivatives using a Hessian matrix

$$H(x, \sigma_D) = \begin{bmatrix} I_{xx}(x, \sigma_D) & I_{xy}(x, \sigma_D) \\ I_{xy}(x, \sigma_D) & I_{yy}(x, \sigma_D) \end{bmatrix}$$

B. Canny Edge Detection

The Canny edge detector is an edge detection operator that uses a multi-stage algorithm to perceive an extensive range of edges in images. The Canny filter is a multi-stage edge detector. It uses a filter based on the derivative of a Gaussian in order to calculate the concentration of the gradients. The Gaussian decreases the consequence of noise nearby in the image. Then, prospective edges are thinned down to 1-pixel curves by eliminate non-maximum pixels of the gradient magnitude. Finally, edge pixels are set aside or detached using hysteresis thresholding on the gradient magnitude. Edge detection is an image processing practice for discovery the limits of objects surrounded by images. It workings by detect discontinuities in intensity. Edge detection is used for image segmentation and data withdrawal in areas such as image processing, computer vision, and machine vision [13].

Development of the Canny Algorithm

Canny's intend was to determine the most favorable edge detection algorithm. In these circumstances, an "optimal" edge detector means [13]:

Good detection – the algorithm should spot as many actual edges in the image as feasible.

Good localization – edges noticeable should be as close as achievable to the edge in the real image.

Minimal response – a given edge in the image should only be distinct once, and where potential, image noise should not generate false edges.

In a digital image, an edge is a point in the image where the brightness changes sharply. The canny edge detector [14] was developed by John F. Canny in 1986. It is used to detect a wide range of edges in images. Below are some of the attributes of the Canny Edge detector:

Good Detection: In determining a true or false edge, thresholds are required. The Canny edge detector can be fine-tuned with the right threshold to provide good edges on average.

Noise sensitivity: The Canny edge detector eliminates or reduces noise that could corrupt results.

Orientation sensitivity: The Canny edge detector accurately detects not just the edge magnitude, but also the edge orientation which can be used in post processing to connect edge segments and in turn suppress non-maximum edge magnitude.

Speed and efficiency: The Canny edge detector allows for recursive implementation which improves efficiency.

C. K-Mean Clustering

Clustering algorithms have successfully been applied as a digital image segmentation technique in various fields and applications. However, those clustering algorithms are only applicable for specific images such as medical images, microscopic images etc. K-means is a simple yet powerful clustering algorithm. The procedure groups a given set of data points into k clusters, where k is the number of desired clusters which is fixed a priori. The algorithm finds k cluster centroids and assigns each point to its nearest cluster. For example, assume that we have a set of all pixels in an image and we want to group them into two clusters. In an ideal case, all the edge pixels are assigned to one cluster and the non-edge pixels are assigned to another cluster [15].

Edge detection plays an important role in various areas of image analysis and computer vision. Edge points are pixels at which abrupt gray-level changes occur because of changes in surface orientation, depth or physical properties of materials. The aim of edge detection is providing a meaningful description of object boundaries which are due to discontinuities manifesting themselves as sharp changes, in a scene from intensity surface.

K-Means algorithm is an unsupervised clustering algorithm that classifies the input statistics points into several classes based on their intrinsic distance from each other. The algorithm assumes that the data features form a vector space and attempt to find usual clustering in them. The points are clustered approximately centroids $\mu_i \forall_i = 1, 2, 3 \; \ldots . k$ which are get hold of by diminish the objective [16].

$$V = \sum_{i=1}^{k} \sum_{x_j \in s_i} (x_j - \mu_i)^2$$

Where there are k clusters $S_i, i = 1,2,3, \ldots . k$ and μ_i is the centroid or signifies point of all the points $x_j \in s_i$

As a part of this, an iterative description of the algorithm is available. This algorithm acquires a 2 dimensional image as input. Different steps in the algorithm are as follows:

- Calculate the intensity distribution (also called the histogram) of the intensities.
- Initialize the centroids with k indiscriminate intensities.
- Reiterate the following steps until the cluster labels of the image do not adjust anymore.
- Cluster the points based on distance of their intensities from the centroid intensities.

$$c^{(i)} := arg \min_{j} ||x^{(i)} - \mu_j||^2$$

Compute the new centroid for each of the clusters

$$\mu_i := \frac{\sum_{i=1}^{m} 1\{c_{(i)} = j\} x^{(i)}}{\sum_{i=1}^{m} 1\{c_{(i)} = j\}}$$

Where k is a parameter of the algorithm (the number of clusters to be found), i iterates over the all the intensities, j iterates over all the centroids and μ_i are the centroid intensities.

D. Wavelet Transform

Edge detection refers to the process of identifying and locating sharp discontinuities in an image Edge detection acting an significant function in computer vision and image analysis, and is an imperative dispensation in the image analysis and pattern recognition. Edges are the sudden change points in the image which are the fundamental features of the image. These unexpected variations on points give the locality of the image contour that demonstrates the essential feature. The edge illustration of an image diminishes the quantity of data to be progression, and it keeps hold of imperative information about the shapes of objects in the prospect. The explanation of an image is trouble-free to incorporate into a large quantity of detection algorithms used in computer vision and other image processing applications [17].

Wavelet transform is a representation of signals in terms of basic functions that are obtained by dilating and translation a basic wavelet function [18]. We can take a wavelet transform as a tool of low-pass and high-pass filters for edge detection. The wavelet transform has the properties of locality, multi-resolution, compression, clustering and persistence. These properties are suitable for most applications in image processing including edge detection

The wavelet transform has similar properties to Fourier transform as a mathematical technique for signal analysis, the main difference between both is that wavelets are localized in both time and frequency, whereas the standard Fourier transform is only localized in frequency.

A signal can be decomposed by a wavelet transform through of a series of elementary functions, created from dilations and translations of a basis function Ψ, which is known as the mother wavelet. The basic functions of a discrete wavelet transform, $\Psi_{j,k}(t)$, of time independent variable t, can be expressed as

$$\Psi_{j,k}(t) = 2^{-j/2}\Psi(2^{-j}t - k)$$

Where, j and k guide the dilations and translations of the function Ψ to generate a family of wavelets [19].

IV. LITRETURE SUMMARY

In the previous sections we studied about the various different techniques of recognizing the number plate. These techniques can be broadly classified in three major parts:

1. By using the machine learning techniques
2. By using the template matching techniques or pattern matching techniques
3. By feature computation and utilization with some optimization algorithms or classifiers.

Therefore, according to the presented survey work the following domains can be possible for the future research extensions.

1. Evaluation of different pattern matching algorithms or template matching algorithms which produces high rate of accuracy.
2. Evaluation of the machine learning approaches for identifying the numbers such as neural network and others
3. Evaluation of different feature selection techniques
4. Evaluation of different optimization algorithms
5. Evaluation of different classification techniques

In this work the different edge feature selection technique is investigated. Therefore a model for recognizing the numbers using the features and their classification is proposed.

V. PROPOSED WORK

The proposed data model for approximating the number plate is demonstrated using the figure 1. The different participating components of the system are also introduced in this model.

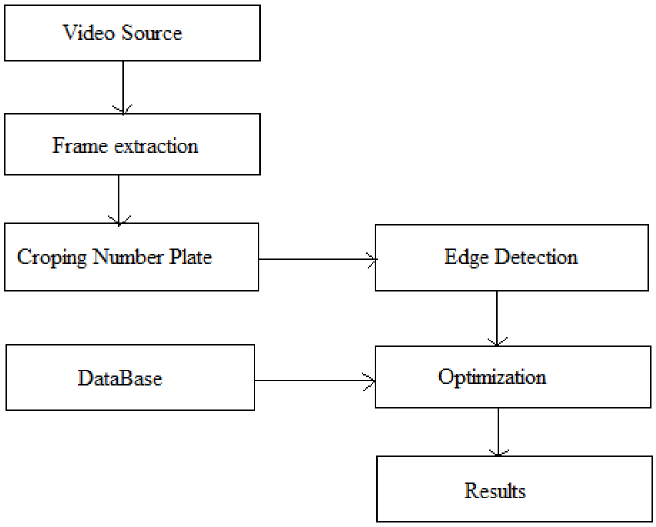

Figure 1 proposed model

Video source: as the initial input to the system a video data source is required, which continuously capture the videos or run the videos live. The running video is used for extracting the required information.

Frame extraction: now a third party API (FFMPEG) is required to convert the videos into the number of frames.

Cropping number plate: this phase differentiates the process is automated or semi-automated. If the system automatically identifies the templates then the system is automated or if a manual effort required to identify the area of number plate then it is semi-automated system. Both kinds of techniques are feasible for implementation here the template matching algorithms are appropriate for finding or detecting the place of number plate.

Edge detection: after obtaining the required object (number plate) the edge detection approach is required to find the actual characters in the given number plate. The proposed survey describes different approaches of edge detection. The Gabor technique is a much effective technique for recovering the edges and corners of the image. Thus the survey suggests the Gabor edge detection technique for future implementations.

Database: sometimes the different characters are notified using different styles thus different available patterns a database of edge features and their actual values are preserved in database.

Optimization: after extraction of the characters from the image the features are compared with the database features. Thus any optimization algorithm such as genetic algorithm, ACO, or ABC algorithm is suitable for compare and match the most optimal characters among the available one.

Results: the obtained characters are recognized as the outcome of the number plate characters.

VI. CONCLUSION

The presented survey work can be concluded using the following points:

1. Paper first includes the different recent contributions placed in order to recognize the number plate automatically
2. Paper also includes the different techniques that are frequently used for automatic number plate recognition systems
3. Paper includes the different approaches used for computing edges of the images or characters
4. Finally a technique for recognizing the number plate is proposed.

In near future the proposed technique is enhanced more and their implementation and their results are provided.

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