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Theft Vehicle Identification and Tracking System

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Abstract: ***In India, motor vehicles theft/violation rate keeps on increasing every year. It is very difficult to solve these problems effectively using traffic enforcement cameras which are placed along road sides and traffic signals. The proposed idea to detect, recognize the number plate of the preceding vehicle and track the vehicle number using server information. This is achieved by fixing a camera in front of the car which automatically acquires the proper frames (low movement noise) of the preceding vehicle by applying movement detection algorithm and extracts the number plate from the acquired image using edge detection, morphological operation and contours. The Latin characters of the extracted number plate are segmented using Connected Component Analysis (CCA) and Boundary Box Analysis (BBA) and characters are recognized by template matching using correlation. The recognized number plate characters will be sent to the centralized system if it is matched with the defaulters in the database of the theft vehicle. The proposed project addresses the relative movement effect of the actual and preceding vehicles while taking the image and cost constraints by using low cost embedded board.***

Keywords: Movement detection algorithm, Edge detection, Morphological operation, Contours, Connected Component Analysis (CCA), Boundary Box Analysis (BBA), Template matching, Embedded board.

I. INTRODUCTION

Theft vehicle identification and tracking system is the most challenging task in today's world. The rate of vehicle theft is increasing day by day. Moreover, theft vehicle are used for crime purposes. In order to reduce this problem the theft vehicles must be identified and tracked. Identifying the theft vehicles using traffic enforcement cameras has proved to be insufficient because it works out well for monitoring offenses, traffic, accidents, etc. Since traffic enforcement cameras are not much familiar in rural areas, monitoring various issues is not feasible. In many cities monitoring systems are installed but the true fact is that it needs human to monitor those systems. There is a little difficulty in the monitoring system that is it occupies a large capacity and the video gets stocked up and does not get updated automatically. One more struggle is, recognition of number plate in moving vehicles. Whereas the proposed system works out efficiently well overcoming all the problems previously faced. The objective of the system is detecting, tracking and also identifying the vehicle number plate using cameras which are fixed in front of the moving vehicles. A theft vehicle is identified by its number plate and more precisely using its characters. The system keeps on monitoring the preceding vehicles in video mode and then continuously performs image processing techniques to detect the characters in number plate and only recognizes when the license plate characters match with the defaulters list. Identification of number plate from the acquired image includes the following steps such as pre-processing, morphological operation, edge detection, number plate extraction.The characters are segmented and recognized using algorithms such as Connected Component Analysis (CCA), Boundary Box Analysis (BBA) and template matching using correlation. The characters recognized when getting matched with the database list are sent to the server with the recognized characters and location. The details can be accessed remotely using GPRS system. This system reduces the bandwidth consumption by only recognising and tracking the matched number plate. Since the proposed system uses template matching it can acquire the images with all resolutions and with various intensities.

A. Related work

Earlier various approaches were made for extracting the number plate and recognizing the characters in the number plate of vehicles. Such an approach were carried out by various techniques and algorithms which are as follows. Khalid W. Maglad proposed a study for recognition and detection of license plate for Saudian vehicles [1]. Sachin Prabhu B, Subramaniam Kalambur, Dinkar Sitaram proposed an idea of recognition of Indian number plate from live stream videos using CNN(Convolutional Neural Networks) [2]. Ankita Yadav, Deepak Chaudhary used MATLABR2013 to run the programs and template matching for recognition of characters [3]. Sarbjit Kaur, Sukhvir Kaur designed an efficient approach for ANPR and found it to be tedious for processing multi-plates at a time [4]. Bhavin V Kakani, Divyang Gandhi, Sagar Jani proposed a system which was fast, accurate and robust using OCR algorithm [5]. Kingshuk Mukherjee brought out a solution for preventing vehicle theft by using GSM modem and GPS module interfaced to an Arduino microcontroller. The system is based on sending messages to the controller for tracking and immobilizing the vehicle [6].

G.S.Prasanth Ganesh, B.Balaji, T.A.Srinivasa Varadhan has developed a low cost, first efficient tracking system only using GSM for anti-theft [7]. Swetha Kumari, Leeza Gupta, Prena Gupta had designed a system for automatic license plate number recognition using artificial neural network algorithm. The system designed found it difficult to recognize the information when the positions were changed [8]. Avadhut S Joshi, Digambar A Kulkarani brought forth a strong technique for localisation, segmentation and recognition of characters within the located plate. The challenging part was in tracking the vehicles location [9]. Sai Krishna Thangallapally, Raghupathi Maripeddi, Vamshi Krishna Banoth, Cheggoju Naveen,, Vishal R.Saptute modelled a system for tracking the vehicles entering and leaving a locality using KNN algorithm. It was found to be challenging for blurred and broken number plate images [10]. Sarmad Majeed Malik, Rehan Hafiz proposed a system for Automatic Number Plate Recognition of Punjab number plates using Connected Component Analysis method [11]. Kumar R Soumya, Angel Babu, Laya Therattil proposed a system for number plate identification and recognition using contour analysis [12]. Amit Kukreja, Swati Bhandari, Jyoti Chavda, Smita Lad projected a method which can detect the number plate in very less time and also segments the characters in seconds [13]. Ganesh R. Jadhav developed a system for extracting the vehicle number plate from cameras [14]. Kulkarani Suraj Deeliprao, Pallavi.S.Deshpande proposed a system for Automatic Vehicle License Plate Recognition using fundamental image processing steps with MATLAB for theft detection.
This proposed system has been designed using Connected Component Analysis, Boundary box analysis and Template matching [4].

II. PROPOSED APPROACH FOR NUMBER PLATE RECOGNITION

An efficient system with greater accuracy is proposed for number plate identification and character recognition. The excellent results obtained during the process are brought forward to verify the techniques performed. The produced output is successfully reached by these steps illustrated in Fig.1).

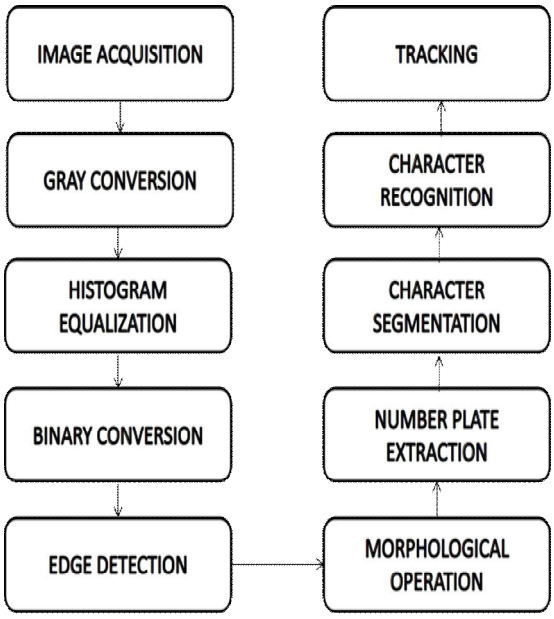

Fig.1) Steps dealt in the proposed system

A. Image Acquisition

Image acquisition is nothing but capturing the image from digital camera which is the input image for further processing. This input can be acquired at certain distance that can be measured by ultrasonic sensor. The proper frames can be taken at low movement noise using movement detection algorithm. The captured image is used for pre-processing. The pre-processing technique includes conversion of RGB to gray scale image, histogram equalization, binary conversion / thresholding, edge detection using canny operator and morphological operation using dilation.

B. RGB to Gray Conversion

The acquired image is in Red Green Blue format and hence the foremost step is to carry out pre-processing. Pre-processing is a technique which is used to enhance the image features. Here pre-processing is carried out to convert the RGB to grayscale image. This step reduces the number of color levels.

C. Histogram Equalization

Histogram equalization is a technique in image processing for adjusting the intensity of images for contrast enhancement. It assigns the intensity values of pixels in the input image such that the output image contains a uniform distribution of intensities. This helps to improve the image and easier for identifying the key features.

D. Binary conversion and Thresholding

Image thresholding or Image binarization is a technique which is used to analyze images. It is an effective way of partitioning an image into foreground and background in the frame. Thresholding helps to change the coloured image into a binary image which consists of black and white only. Several algorithms can be used for thresholding such as adaptive thresholding, dynamic thresholding, Ostu thresholding etc. Ostu thresholding is carried out to automatically perform clustering-based image thresholding, or the reduction of a gray scale image to a binary image.

E. Edge Detection

In image processing, Edge detection technique is a fundamental tool used to find the boundaries of object. It helps to reduce the amount of data (pixels) to process and maintains the structural aspect of the image. Canny Edge Detection is a popular edge detection algorithm.Canny edge detection algorithm is used to detect a wide range of edges in images with noise suppressed at the same time.

F. Morphological Operation

Morphological operation performed in image processing is used for processing the images based on the shape of the image. Basically the operation is processing on binary images for that two inputs are needed such as original image and structural element or kernel. The main operation in morphological is erosion and dilation but it also includes various forms like opening, closing, gradient, etc. Morphological opening method can also be used for removing noise from images and it is just another name of erosion which is followed by dilation. But the proposed operation is Dilation. Dilation is the most important technique in morphological operation. The basic effect of the dilation process on a binary image is to gradually enlarge the boundaries of regions of foreground pixels (*i.e.* white pixels, typically). Thus areas of foreground pixels grow in size while holes within those regions become smaller.

G. Number Plate Extraction

Number plate should be extracted for further process such as character segmentation and character recognition. Therefore number plate extraction is the next step of number plate detection which can identify and extract the number plate using various algorithms such as masking, histogram and contours. The algorithm carried out is contour detection which is used to detect the object boundaries and edges. Then the extracted number plate can be enhanced for processing the segmentation step easily.

H. Character Segmentation

The purpose of segmentation is used to extract the target of interest from an image. Similarly character segmentation aims in segmenting the characters from the localised number plate image. Character segmentation process is achieved using two analysis such as Connected Component Analysis(CCA) and Boundary Box Analysis(BBA).

I. Character Recognition

Character recognition is a process which allows computers to recognize written or printed characters such as numbers or letters and to change them into a form that the computer can use. Character recognition is employed using various methods such as K- Nearest Neighbour (KNN) algorithm, Neural networks, optical character recognition, and template matching. The proposed technique is template matching using correlation. This technique is more effective and produces greater accuracy.

J. Tracking System

It helps in tracking the theft vehicles using the characters obtained.The defaulters list present in the database is compared with the recognized characters. When both gets matched then the recognized characters of the number plate and the location is sent to server using GPRS and GPS module. The defaulters list gets updated automatically.

III. EXPERIMENT RESULTS

The following figures represents the experimental outputs obtained by low cost embedded board raspberry pi 3 coded with opencv python. Fig.2) displays the original image obtained as a result from the low movement detection algorithm. Fig.3) is the converted image from RGB to Gray scale image for further process. Fig.4) is the output on performing histogram equalization on the gray scale image. Fig.5) shows the binary converted image from the original image. Fig.6) represents edge detection which is the result of applying canny operator to the binary image. Fig.7) enhances the pixels and helps in finding contour. Fig.8) represents all contours (purple) and exact contour for number plate (green). Fig.9) brings out a enhanced number plate from the previous result. Fig.10) is the exact number plate identified and cropped automatically.

Fig.2) Original image

Fig.3) Gray image

Fig.4) Histogram

Fig.5) Binary image equalization

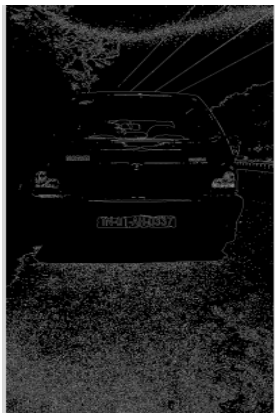

Fig .6) Edge detection

Fig.7) Dilation

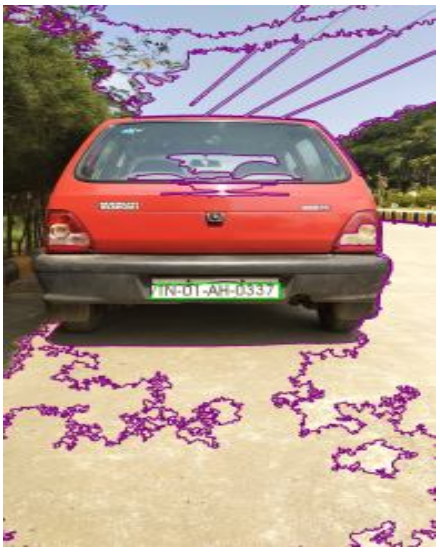

Fig.8) Contours


Fig.9) Enhanced number plate

Fig.10) Cropped image

IV. CONCLUSION AND FUTURE WORK

Thus the proposed system achieves extraction of number plate and recognition of characters in moving vehicles. It works out better using a low cost embedded board and software such as python. It is very easily built in Raspberry pi board when compared to other programming codes. It makes the work much easier and saves time. Template matching technique is one of the most advantageous techniques carried out in the proposed system. It helps in recognizing the characters with great accuracy and makes the identification more closer. Template matching is the suited technique and can be improved by using more templates for reference. The future work is implementing this system in all cars and to look for techniques that are much suited during dark and heavy raining conditions.

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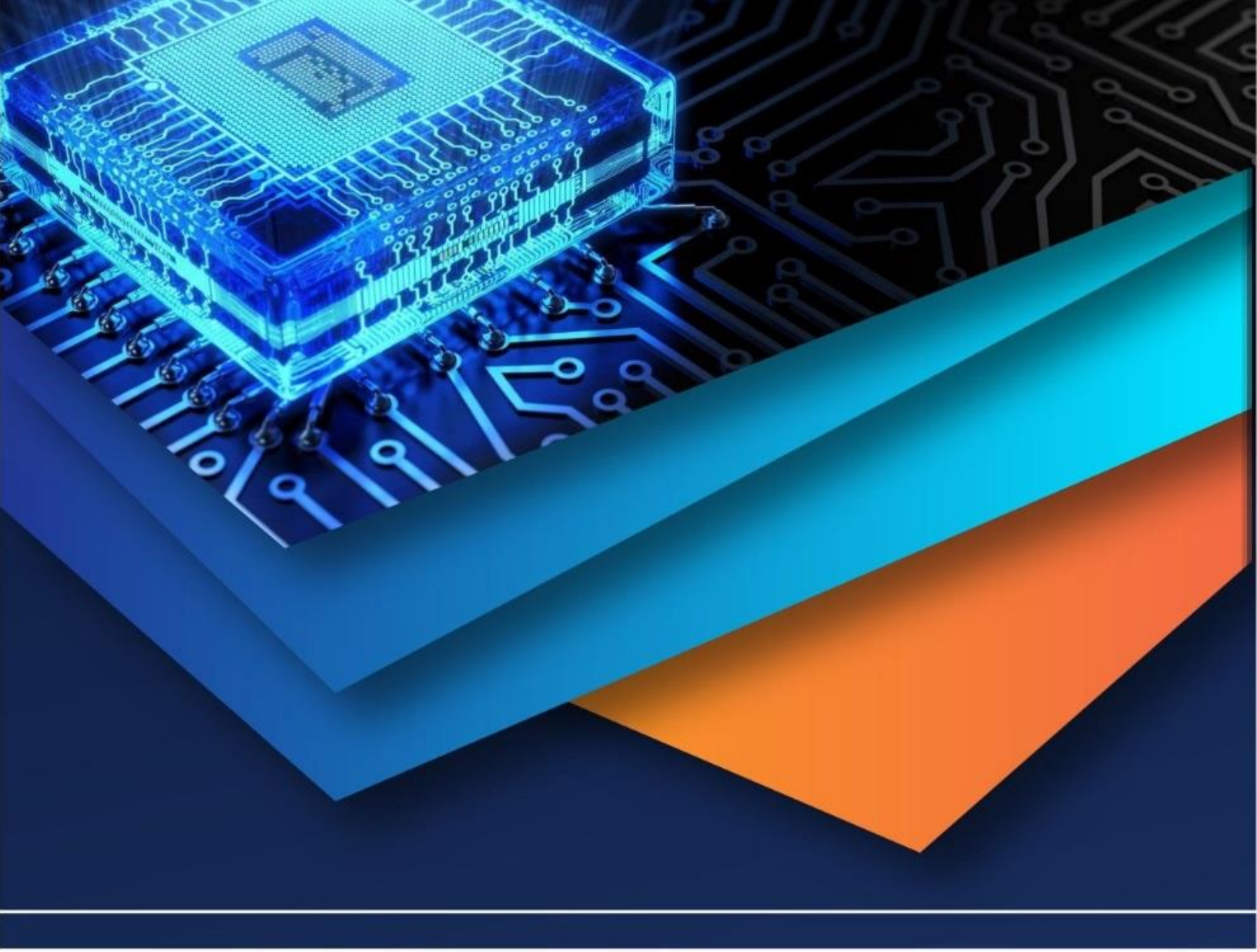

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