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Vehicle Number Plate Detection through Airway using Multiple image Processing Techniques

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Abstract -: *To tackle the problem of illegal encroachment of roads and help in arresting the drastic slide of carbon emissions, this paper aims to carry out the use of a UAV-based system to identify license plates of vehicles in illegal parking spaces. There are numerous close-circuit cameras for indoor and outdoor lots. However, these systems use hardware that are steeply priced and is implemented using bespoke software. The main goal of this project is to develop an autonomous license plate surveillance system using low-cost hardware and open-source software. The drone can be used to subvert the role of actual traffic personnel by automatically chastising the wrongful owner. It will help make the road less congested and more immune to traffic related accidents thus overcoming the inflexibility of wall mounted cameras.*

Keywords: **License plate, Raspberry Pi, UAV, Image segmentation, OpenCV.**

1. INTRODUCTION

Vehicle Number Plate Detection System uses the concept of optical character recognition to detect the characters on a vehicle license plate and then extracts the text from the processed image. This is made possible using the calculation modules, location algorithms, segmentation plate and character recognition. License Plate Detection is the foremost and the most important stage of the system where the position of the license plate is determined. It finally procures the license plate image as output from the image of the vehicle [1]. The penultimate stage is the Character Segmentation wherein the characters on the license plate obtained from the previous stage are segregated into individual images. The segmented images thus obtained lead to the Character Recognition phase where they are finally identified.

2. EXISTING METHODOLOGY

The necessary vehicle number plate detection applications that do not use airways are as follows. The drone system is deployed on the roadside, and performs a match between the passing cars and the blacklist and provides real-time alerts to the nearby police station. The number plate is also used to generate a traffic rules violation fine. This automated process replaces the manual process of preparing a violation fine that greatly reduces the overhead and turnaround time. The fines can be viewed and paid on-line [2].

2.1 Smart Phone Camera

The first phase of this system is acquisition of number plate image using the camera mounted on the drone. The camera in question here will be a 5 mega pixel shooter with a maximum resolution of 2592x1944 pixels. The captured images during this process will be of 640x480 pixels to save on storage space and also reduce computational complexity [1].

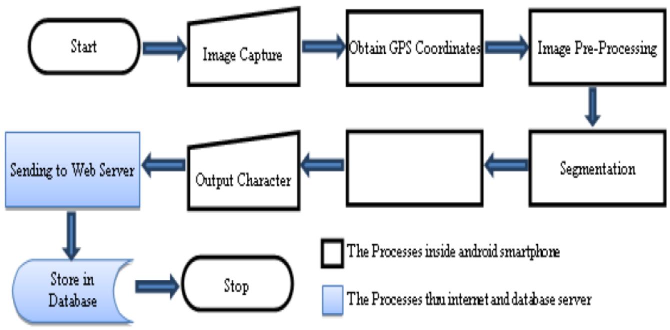

Fig -1: Flow Chart of ANPR in Android Smartphone and Database Server[1]

System design consists of capturing of images, pre-processing images required for extracting license plate, segmenting individual characters from license plate and recognizing each character individually using optical character recognition process and recurrent neural networks. License plate Numbers are sent to web server where the owners information associated with license plate are obtained and the fine generated is send to owner with coordinates of nearby legal parking spots.

2.2 Smart Video Capturing devices

The video capturing process requires the processing of entire video sequence. It uses a fast algorithm which extracts the image regions that contain the plate. This allows the reduction in the processing time which is usually lower than 40msec on a PC platform. This ability ensures that it does this in real-time. The architecture of the number plate incudes a pre-processing block which performs a screening in order to select images or sub-images showing motion [3].

Fig -2: Typical car image with superposed line segments[3]

I. Sequence pre-processing

The pre-processing of the sequence accounts for the estimation of the background image which is recursively updated as soon as new image is formed. The two images are then computed for there differences in order to identify larger image regions. The coordinates of the bounding box are then evaluated with respect to other lower level image processing functions. It is done using the superposed line segments [3].

II. Image processing engine

The image processing engine is used to extract character information from the raw images. For this to happen, we need to achieve maximum speed and to allow real-time sequence processing, we design an algorithm. This algorithm is an amalgamation of pinpoint accuracy and computational complexity [3].

2.3 Image Uploading through application

The image is first clicked using the camera application of the smart phone. On initiating the recognition process, the license plate is perceived from the captured image of the vehicle and the vehicle number is obtained in the below text field of the smartphone application. In order to get the owner's information, one can request the application to connect to the vehicles database and derive the respective owner's details [3].

Fig -3: Vehicle plate detection app through image uploading method [4]

3. RESEARCH METHODOLOGY

The proposed surveillance system that not only monitors the vehicles for the irregularity in illegal parking spaces but also penalizes them for the same. It helps in reducing the pollution as well as managing the traffic loads on the roads. It helps offer solution to the owner by redirecting them to legal parking lots provided by the local government. Failure in compliance of using these legal parking lots enables them in being legible for a government issued fine. This will ensure in smooth traffic flow as well as reducing the pollution to greater extent.

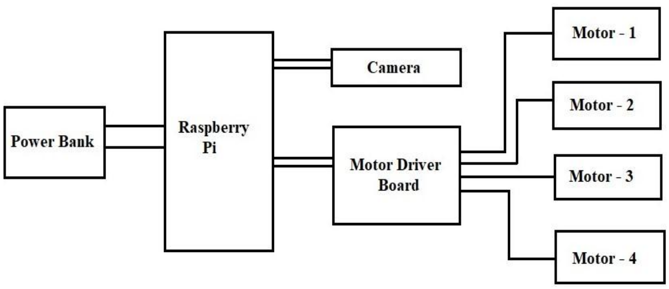

Fig -4: Block Diagram of the System

The drone is initially provided power output through power bank. The raspberry pie will then send the control signals to the motor driver board which will in-turn power the motors to start and run the propellers. There are four motors in total so all the corresponding motors will run simultaneously. While this process is running the camera will also be activated for it to capture the vehicle images. The drone will be controlled by a mobile application that will help make its initial ascent including the three movements yaw, pitch and roll. The navigation of drone will be controlled by the virtual joystick present in the application.

Electronic Speed Controller (ESC), which is part of the quadcopter, is a form of digital circuitry with the ability to change the speed of motor, braking along with its direction. ESCs are an integral component of modern quadcopters. They offer immense power, variable frequency, high resolution 3-phase AC power to the motors.
Quadcopters and drones rely solely on the differential speed of the motors driving the propellers. This variation of the UAV offers differential RPM thrust and cruise control present in motor/ propeller speed gives the quadcopter all the required propulsion to fly [5].

Fig -5: Top View of the Drone [5]

In the diagram above, there is a view of the quadcopter motor configuration, that includes 2 / 4 motors having rotating counter clockwise (CCW motors) and the 1 / 3 motors are rotating clockwise (CW motors). With these two sets of quadcopter motors configured to rotate in opposite directions, the total angular momentum thus obtained is zero [5].

Nearly all quadcopters that have been released in the past few years are using the brushless electric motors. Quadcopter brushless motors are efficient, and more reliable than a brushed motor. The type of motor and its design is extremely important. A more efficient motor means incremental battery drain and more time in the air.

Quadcopter Propeller Design

Length – The first is length (Diameter), represented in inches. while the disc is spinning, length of the propeller is actually the diameter of the disc.

The higher the Kv rating, the smaller the props needed. Smaller props allow for greater speeds, and reduced efficiency. It uses less current and also lifts more weight.

Prop Pitch –Prop dimensions are quoted in the form 21 x 7.0 inch (533 x 178 mm) which comes under DJI E2000 propulsion system. The first number refers to the propeller length as mentioned above. The second is pitch, which is defined as the distance a prop would be needed to pull forward through a solid in a single revolution.

The minimum hardware required for the development of this project is as follows-1800 KV A2212 Brushless Motor (x 4), ESC 30A (x 4), F450 Landing Gear, 10 4.5 Propeller (x 4), F450 Frame, Raspberry Pi 3 - Model B - ARMv8 with 1GB RAM, Camera Module for Raspberry Pi (Sunrom Technologies), REES52 2Packs L298N Motor Drive Controller Board, SanDisk UHS-I A1 98Mbps 32GB Ultra MicroSD Memory Card and 3000mAh 3S 40C/80C Lithium polymer battery Pack (LiPo) (11.1 V).

Image processing techniques applied:

I. Grayscale image calculation

the color comprises of three-bands which are represented by lightness, chroma, and hue. The conversion process from color to grayscale is actually reducing from three bands to a single band. The lightness information is kept while the chroma and hue information are ignored. Mathematical formula of the conversion is as follows [6]

$$\text{GRAY image} = W_r*R + W_g*G + W_b*B$$
$$W_r + W_g + W_b = 1$$

Where:

Weight= summation of all three weights (R, G, and B) which must be equal to 1 Assuming that the R, G, and B are values of monochrome colors (Red, Green, and Blue) where the images which are linear in luminance, Wr is the coefficient (fixed weight) of red color, Wg is the coefficient (fixed weight) of green color, and Wb is the coefficient (fixed weight) of blue color [6].

Fig -6: Grayscale Conversion [7]

II. Gaussian Filter

This filter is a non-uniform low pass filter. Central pixels tend to have a higher weighting than those present on the periphery. Kernel size has to increase for it to maintain the gaussian nature of the filter. Coefficients must be close to zero at the edge of the mask. For fast computation to happen, the gaussian kernel must be made separable. Gaussian filtering helps in removing the noise, detail and also in blurring the images. The Gaussian function thus defined is:

$$g(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2}$$

where σ=Standard deviation

The distribution has a mean of zero. The distribution uses a 2d approach with reference to a point spread function attained by convolving 2D gaussian function along with the image. The gaussian filters may not help in preserving the image brightness [8].

III. HSV of Image

HSV is closer to how humans perceive color unlike RGB and CMYK. It has hue, saturation and value as three components. The color space is described in terms of their brightness value and saturation color wheel appears as a cone or cylinder. It uses these three components as follows: Hue is the color wheel of the model expressed in a range from 0 to 360°. Saturation is described as the concentration of grey from 0 to 100%. When this component approaches zero it produces a faded effect with more grey color. Value works in tandem with saturation and describes its intensity from 0 to 100% where 0 is pitch black and 100 being the brightest.

IV. Histogram Calculation of Image

Histograms are cumulative total of data organized into a set of predefined bins. The data collected can be any feature that describe the image. The histogram of pixel projection comprises of finding the upper and lower limits or left and right of each character. The value of a group of histograms is equal to the sum of the white pixels along a particular line in the horizontal direction. When all the values in the horizontal direction are calculated, the horizontal projection of the histogram is obtained. The average value of the histogram is used as a threshold to calculate the upper and lower limits. The central area is recorded as the area delimited by the upper and lower limits. We then calculate the vertical projection histogram but by interchanging the rows and the columns of the image to have the two limits of each character [9].

Fig -7: Histogram Image calculation [9]

V. Image Normalization

It is the process that tends to modify the range of intensity values of the pixel. Its applications include photographs with low contrast due to glare. It is sometimes called contrast stretching or stretching of the histogram. The purpose of the expansion of dynamic range in normalization is usually done to bring the image that is more familiar [10].

$$I_N = (I - \mathrm{Min})\frac{\mathrm{newMax} - \mathrm{newMin}}{\mathrm{Max} - \mathrm{Min}} + \mathrm{newMin}$$

$$I_N = (\mathrm{newMax} - \mathrm{newMin})\frac{1}{1 + e^{-\frac{I-\beta}{\alpha}}} + \mathrm{newMin}$$

4. CONCLUSION

This drone can fly in any geographic region to detect vehicle number plate. Using same drone, vehicle can be tracked and identified in any region. This drone uses Raspberry Pi Computer which has variety of applications. This drone can be used in other applications also.

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