Automatic number plate recognition using raspberry pi and image processing

Technology, Cars

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Nowadays, image processing is among rapidly growing technologies. This paper provides an extensive review on use of digital image processing and its applications in the field of character recognition. In addition to this, the paper proposes the design of a Raspberry Pi based automatic detection of vehicle number plate using image processing. The proposed system uses a digital camera along with a display circuit interfaced with Raspberry Pi circuit. This system is expected to eliminate the drawbacks of License Plate Recognition (LPR), a commonly used technology abroad, by utilizing a sensor which will switch the camera ‘ On’ only in presence of vehicle and will hence reduce the power consumption and enhance the overall efficiency of system.

Introduction

Nowadays, vehicle is the most common mode of transportation as the population is increasing drastically. So, it’s obvious to hear various theft and security issues related to it. It’s rather a challenge for the vehicle management systems because these issues lead to loss of information and smuggling of vehicles parts irrespective of the original identity of the person

owning that vehicle. Also, the parking systems are unable to track back those vehicles which are being smuggled after being stolen. Our country is still lacking some automated techniques which can resolve these issues.

In abroad, a system named License Plate Recognition (LPR) is utilized in which the number plate or license plate is linked to the individual person‘ s data owning that particular vehicle and that is stored in the database. This kind of system decreases the chance of theft and security breaches, as every time the person’s identity (data) is authenticated with its license plate which is stored in the database, it will automatically tell whether that vehicle is authorized or not. The LPR system consumes more power due to continuous monitoring of the system, irrespective of presence or detection of the vehicle as stated earlier. To overcome this issue, this paper proposes a number plate recognition system using Raspberry Pi interfaced with a digital camera, which will work on the basis of IR sensors. These sensors will determine the time at which the camera will capture the image. The sensor will trigger the camera exactly the time at which they will detect an object (vehicle) which will decrease the power consumption of the system leading to larger system life. The scope of proposed system is to target the governmental institutions such as hospitals, banks, educational institutions and other public places where human gathering is more and requires proper vehicle management.

In this paper, section II describes the related studies, section III discusses the proposed model and section IV summarizes the expected outcomes along with scope and challenges.

LITERATURE REVIEW

A. Background Many methods have been proposed for number plate recognition system and they are often subjected to substantial constraints due to unexpected difficulties. The most common approaches are enlisted as under:

1. Template matching: It is one of the simplest ways of character recognition, which is used to authenticate the stored data against the character to be recognized. The matching operations determine the degree of similarity between two objects. This recognition method is very sensitive to noise and image deformation.
2. Optical Character Recognition (OCR): This technique is second most widely technique used for alphanumeric character recognition. This method has the ability to translate the scanned characters into ASCII codes or other character codes.
3. Neural networks: This method deploys machine learning process to recognize the patterns and can be classified as feed-forward, feed-back and recurrent networks. Usually, Multi Layer Perceptron (MLP) is used for character recognition. It is applied on a computing architecture that consists of massively parallel interconnection of adaptive neural processors. Because of its parallel nature, it can perform computation at a very higher rate. The data can be manipulated dynamically while the process is running. There are various approaches for training neural networks like error correction, Boltzmann, and competitive learning.

4. LPR System: License Plate Recognition system is one of the most widely and newest used technique in number plate detection system. It plays a significant role in many applications related to transportation systems such as traffic management and analysis, speed control, automobile theft prevention, parking lot management etc. Primarily, an LPR system has two objectives: to detect the license plate location, and to recognize the alphanumeric characters on the plate.

B. Related Studies

Chang et al. proposed ‘ Automatic License Plate Recognition’ by utilizing Optical Character Recognition (OCR). The input images were binarized and then OCR computed the topological features of characters for further recognition. The authors performed self-organized template test to match the input character to the database and hence found the best match. The trial experimentation was performed on 1601 images and the success rate achieved was 95. 6%. Anagnostopoulos et al. proposed ‘ A License Plate Recognition Algorithm for Intelligent Transportation System Applications’ wherein binarization was done using Sauvola Method by using Sliding Concentric Windows (SCWs) segmentation technique so as to detect the region of interests (ROI) faster. Later, trainable OCR System based on Neural Networks was taken into account which used the approach of Probabilistic Neural Network (PNN) with two individual probabilistic networks one for the alphabet and other for the number recognition. The authors performed the trial experiment on 1334 images and achieved the segmentation of around 96. 5% along with recognition rate of 89. 1%. The overall success rate was

86. 0% which was improved to 90-95% by restricting some conditions like distance of plate captured, angle of plate viewed, illumination conditions and low background complexity.

Anagnostopoulos presented a survey on License Plate Recognition from Still Images and Video Sequence wherein ROI was extracted using edge statistics, morphology and connected component analysis (CCA). Segmentation was performed using Histogram Processing and Mathematical Morphology and finally, characters were recognized using statistical/hybrid classifiers, Pattern or Template Matching. The authors achieved better results using neural networks and statistical classifier approach but a large amount of learning training sample were needed for the further improvement. Babu et al, presented ‘ A feature based approach for license plate-recognition of Indian number plates’ wherein the images were pre-processed to improve the image quality and were processed using median filters for noise reduction. For image segmentation, Otsu method was used to threshold the plate values and later, statistical feature extraction was implemented for the character recognition. The success rate of character recognition was 82%. Kocer et al, presented ‘ Artificial neural networks based vehicle license plate recognition’ using local Otsu and improved Bernsen algorithm for license plate location, CCA for plate detection, horizontal and vertical correlation for segmentation and feature extraction using support vector machine (SVM) for character Recognition. The trial experiments showed an accuracy rate of 97. 16% for locating the plate, 98.

34% for segmenting the characters, 97. 88% recognizing the characters achieve, and 93. 54% Overall recognition.

Chang et al. presented ‘ Real-time vehicle tracking mechanism with license Plate recognition from road images’ in which plate location was detected using vertical edge techniques and then detected lines were binarized. Further, the license plates were recognized on 250 images and accuracy rate was 92. 4%. Xie et al presented ‘ License Plate Automatic Recognition System Based on MATLAB-GUI’ in which images were pre-processed using edge detection techniques and morphological processing was used for license plate location w. r. t features like shape and size of numerals. Further, characters were recognized using neural networks and the entire process was implemented the GUI interface of MATLAB. Agrawal et al presented the design of automatic license plate recognition using Raspberry Pi. This design utilizes OCR for character recognition however, it doesn’t incorporate sensor for power consumption and emphasizes the use of memory card to store database.

Proposed Design

The proposed design makes use of an on-board computer, which is commonly termed as ‘ Raspberry Pi’ processor. This on-board computer can efficiently communicate with the output and input modules which are being used.

Raspberry pi module contains a 40 GPIO pins and it operates on 5V of operating voltage. Its processor is based on the ARM architecture. It is a low

cost device which is interfaced using programming languages (mainly python). This board will be used to interface the digital camera in order to capture the image and further process it.

The digital camera will acquire the input images only when the sensor activates it i. e. if sensor input is high, the Raspberry Pi will send a control signal to digital camera to capture image of vehicle. The placement of cameras for the same. The sensors are the key components in proposed design which will decrease the power consumption of the system. Under normal scenario, the camera will be in sleep mode, but the moment any vehicle comes into its proximity, the sensors will detect it and will notify the camera which will then capture the image.

After the image is acquired, it will be processed using Python programming language. The coding results are also controlled under Raspberry Pi and the obtained results will be stored in the form of database or on cloud using IOT.

For the detection and recognition of characters on captured images, an image processing based algorithm will be used. After reviewing various researches, the finalized stages of proposed algorithm for this design are explained with the help of a flowchart given in Fig 4 below. The stages of this flowchart are explained as under:

1. Image Acquisition: Different approaches can be used to acquire an image to the system- analog camera or digital camera can be used. However, for trial experimentation, internet database will be used.

2. Pre-processing: The images will be pre-processed to improve their brightness and contrast. Further, the colored images will be converted to grayscale to reduce the computational complexity.
3. Image Segmentation: Capturing the whole image of the license plate also encloses the background of vehicle body. So, this step will decide whether the extracted region contains a license plate or not. In order to extract features, aspect ratio (Width/Height) and Edge density (to quantize local variance) are determined.
4. Character Recognition: Before recognizing, the characters are segmented by decomposing an image of a sequence of characters into sub images of individual symbols. Later, the characters will be recognized using OCR.
5. Display of result: After recognizing, the result will be displayed over screen and will be compared with original image to measure system's accuracy.

Conclusion

This paper reviews various studies related to automatic vehicle license plate recognition, in which it is observed that the existing techniques doesn't pay much attention towards improving system's efficiency in terms of its power consumption. As the objective in our proposed design is to reduce power consumption of the system, the successful implementation of the same will play a very important role in traffic management and security systems such as automobile theft prevention, parking lot management etc. Initial implementations of the software algorithm have shown promising results.

As of now, the design model and software algorithm stages have been finalized. Firstly, the implementation will be done on test images of database and later, the software code will be tested in conjunction with external camera and Raspberry Pi. After successful implementation, a sensor will be interfaced to the design to decide the activation of camera only in the presence of vehicle.