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Smart Surveillance System -Literature Survey

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Abstract - *The ever increasing rate of traffic signal violation has become a major issue in India. As a solution, surveillance systems are installed at street intersections. A surveillance system is an integral part of road safety and security. This paper aims to study the different segments in the current surveillance systems located at traffic signals. It further elaborates on object detection techniques which includes feature extraction and classification, red light violation detection systems (RLVD) which includes detection of stop line and deriving occlusions and automatic number plate recognition techniques which includes character segmentation, optical character recognition, and template matching.*

Key Words: Vehicle detection, RLVD, ANPR, Adaboost, haar-like, Optical Character Recognition(OCR), Template matching.

1. INTRODUCTION

There is a massive increase in the use of vehicles on road in India. Subsequently, there is an increase in red-light violations. Such violations lead to more accidents on roads. Hence, CCTV cameras are placed at traffic signals to monitor and control the traffic. Developing an automated Red Light Violation Detection (RLVD) system can be considered as the main component of the Smart Surveillance System. This research work aims to develop an automated system that could not only localize, but also automatically recognize the vehicle license plates. In 2019, Delhi police along with Maruti Suzuki Foundation implemented a system to track these violations with the use of sensors, cameras, and manual tracing. The current surveillance system implemented in few other developed city areas also includes the use of sensors and electronics to turn on cameras during red light and image processing or sensors to detect red light runners. This interdependency between sensor networks and video processing techniques makes the system more complex. Thus, to eliminate this problem, the surveillance system is studied based on video processing techniques.

This paper provides image processing techniques mainly divided into three categories - Vehicle detection, Red light violation detection and Licence plate recognition.

2. VEHICLE DETECTION METHOD

2.1 Vehicle Detection and Attribute based search of vehicles in video surveillance system [1]

This paper states that vehicle identification is the primary step for having observation and control over the traffic. Current surveillance systems contain low-resolution cameras yet some traditional techniques such as number plate identification or classification of vehicles may fail at low-resolution cameras.

As traditionally background subtraction technique is used, many factors such as person intervention or vehicle overlapping may reduce the efficiency of this technique. This paper introduces a training based method for feature selection and classification. Haar based feature extraction method is used for vehicle detection. For generating a boundary around the vehicle, component analysis algorithm is used. Adaboost algorithm is used as a classification methodology for training the models. To obtain strong classifiers, it also combines the performances of weak classifiers based on weighted versions of data samples. Further, searching for any particular vehicle is done using various attributes. The attributes include date and time, color, speed and direction of travel. These attributes provide precise information that displays a reduced list of detected vehicles.

2.2 A rapid learning algorithm for vehicle classification [2]

For vehicle detection, vision-based techniques must be used as it contains huge variability. The vehicle appearance does depend upon the nearby objects which include cluttered background, the shadow of vehicles and environmental conditions. Hence, the most recommended technique for vehicle detection is Adaboost. Adaboost is used for training data samples and incrementing the weights. But the main disadvantage of this technique is high training period. This paper overcomes the limitation by proposing a rapid incremental learning algorithm for vehicle classification. At first, standard feature extraction algorithms such as Principal Component Analysis (PCA) and Gabor Filter were used but their computational time was very high. This paper uses Haar-like feature pool which has 2D Haar functions on a 32x32 grey scale image patch. 'Integral image' concepts provides a high set of Haar-like feature. To increase the training speed of the classifier, the sample key feature value

is paired with its class label. The fundamental approach is to generate new key Haar-like features from new training data and add them to previously generated key Haar-like features. This improves the performance of the algorithm drastically. The experimental results illustrate a better accuracy rate which can be further utilized in real-time applications.

3. RED LIGHT VIOLATION DETECTION METHOD

3.1 Development of an Automated Red Light Violation Detection System (RLVDS) for Indian vehicles [3]

This paper addresses the Integrated Traffic Management Systems (ITMS) that are now been used in India. The main focus of ITMS is road safety and regulation. The core part of ITMS is the automated Red Light Violation Detection System (RLVDS). This paper proposes a system that provides the list of all vehicles that violate the rule. This method first captures background images from the videos obtained by the surveillance cameras. It is an adaptive method where if the new image obtained for comparison is itself a background image, then it is added to the background image stack. Then the average of those images is considered for violation detection. Using the background subtraction technique, the system analyzes the potential occlusions that occurred over the stop-line. A virtual stop line is created over the zebra-crossing line. Moreover, 5 imaginary lines are considered on both sides of the stop line, which acts as a threshold. If the subtracted image contains an object over the stop line, then it is verified whether the object is a vehicle or not. Further, if it is a vehicle, then the system identifies the vehicle license plate using the Optical Character Recognition technique. The system can successfully evaluate up to 92% of the vehicles accurately.

3.2 Traffic Violation Detection and Penalty Generation System at a Street Intersection [4]

The major problem associated with traffic jams and accidents at street intersections is violation of red light traffic signals. It can occur due to the limited allocation of traffic police at every intersection. Based on video processing techniques, this paper suggests an automated traffic rule violation detection system. The system acts as an individual system without taking any help from other external systems such as traffic signal control box. The system can detect red light and lane change violations. The system first detects red light through video processing techniques. An image is captured and the red color matrix is extracted from the RGB layer. This image is subtracted from the grey frame and is converted into a binary image. Using the Blob algorithm, a bounding box is generated around the red signal. If the signal detected is red, then vehicles are detected using the Hue algorithm based on HSV color space. As a means of proof, the system saves a snapshot of the violation and extracts the vehicle license plate using the Optical Character Recognition method. With the use of the android application, a penalty can be charged by the authorized officer using the identified license plate.

4. NUMBER PLATE RECOGNITION METHOD

4.1 An efficient approach for automatic license plate recognition system [5]

Once the vehicle is detected, the next important step is recognizing its number plate. To retrieve the information of the vehicle owner, automated number plate recognition using image processing is important. Various factors like a brief period for image retrieval, quality of image, affect the precision of the system. Thus for automatic number plate recognition, the paper divides it into 3 parts. They are Character segmentation, Optical character recognition, and template matching. For character recognition, the paper suggests Gabor filtering in a greyscale image. Firstly, the input image is converted from RGB to Greyscale. Then linear Gabor filtering technique is used to displace the noise in the image. It helps in nullifying the clamor and saves the edges. Character segmentation is applied to the Greyscale image. It separates the license number into individual characters. Then pixel by pixel correlation is applied to the characters by comparing formats. It is observed that the methodology proposed gives satisfying results where OCR uses less time and produces more accuracy.

4.2 An effective method for plate number recognition [6]

This paper introduces a new number plate algorithm named Secondary Positioning (SP). The first and difficult step is to retrieve the position of the number plate which is done by checking redlight regions in the HSV region. A binary image is generated by identifying red pixels. Further, with the help of vertical edges, the actual position is found. For recognizing the individual characters, template matching and Artificial Neural Networks (ANN) are implemented. A Correlation Coefficient is used to estimate the correlation between testing and template images. This incorporates the correction coefficient between tests and actual images. A traditional method called pixel subtraction is also performed. A total of 120 images when used for license plate localization gives 75% accuracy and 80 images when used for license plate recognition produces 70% accuracy. The results obtained from the algorithm are fairly satisfying than expected.

5. CONCLUSIONS

This paper provides a comprehensive study of current surveillance systems and various methodologies available for object detection, red light violation detection, and number plate recognition. It is found that the detection of vehicles is accurate when Haar-like feature extraction is used and Adaboost is used for classification. Background subtraction derives accurate occlusions for the red light violation system and OCR gives the best results for the number plate recognition system. Future research should

also focus on day-night images and shadows for vehicle detection and automatic penalty generation systems.

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