Signs with Smart Connectivity for Better Road Safety

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, haarlike, 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 License plate recognition.

2. VEHICLE DETECTION METHOD

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 traditional 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.

3.A rapid learning algorithm for vehicle classification

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 a Haar-like feature pool which has 2D Haar functions on a 32x32 gray scale image patch. 'Integral image' concepts provide a high set of Haar-like features. 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.

4. NUMBER PLATE RECOGNITION METHOD

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 grayscale image. Firstly, the input image is converted from RGB to Grayscale. 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 Grayscale 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.

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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