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NIGHT TIEM VEHICLE DETECTION USING IMAGE PROCESSING AND LINEAR SVM

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ABSTRACT

This Many detection and tracking methods are able to detect and track vehicle motion reliably in the daytime. However, vehicle detection and tracking in video surveillance at night remain very important problems that the vehicle signatures have low contrast against the background. Traditional methods based on the analysis of the difference between successive frames and a background frame can not work. This paper presents a method for vehicle detection and tracking at night in video surveillance. The method uses Histograms of Oriented Gradients (HOG) features to extract features, and then uses Support Vector Machine (SVM) to recognize the object. In tracking phase, we use Kalman filter to track the object. As shown in experiments, the algorithm can exactly detect and track moving vehicles in video surveillance at night.

INTRODUCTION

With the rapid economic development, motor vehicles increase sharply in urban. In order to manage the traffic flow of our cities, we need to extract some information from the roads, information extraction is an increasing demand for applications such as traffic lights control, population evacuation, or to reduce traffic issues including congestion, pollution, and accidents. So the traffic video surveillance is increasingly important. Now a lot of researches have done for daytime vehicle surveillance at home and abroad, however traffic video surveillance should be normally and effectively worked in different environments, weathers and light conditions, so it is necessary to improve the performance of the traffic video surveillance at night to complete real-time monitoring. Due to the insufficient light intensity, poor contrast, most of the daytime vehicles' characteristic information is not available in the night.

Vehicle detection and tracking with complicated illumination conditions have always been a difficult problem at night. Many different approaches for vehicle detection and tracking have been proposed in the literature. R. Taktak. and al. [3] thought the headlights could be used as the most obvious characteristics of vehicles at night, extract the headlights as a car for vehicle detection. Separate the two headlights of a car according to the same relationship between the headlights to detect the traffic flow. OU Zhifang and al. [7] presented a methodology for night-time vehicle detection using D-S evidence theory.

It paired the rear lamps using taillight clustering algorithm to get vehicles candidate hypothesis, using D-S evidence theory and fusing the feature information to find a belief threshold to set to verify the vehicle hypothesis. These papers [5][6][10] also used car light to detect objects. Kaiqi Huang and al. [13] presented an algorithm which is based on contrast analysis to detect moving objects in outside night surveillance. In this paper we present a new method that consists of detection and tracking vehicles at night by using HOG features [1][4][9] and Kalman filter [14][15] techniques. Because of using proper algorithm, the method improves the detection and tracking performance and reduces the processing time.

LITERATURE REVIEW

How to improve the HOG detector in the UAV context

The well known HOG (Histogram of Oriented Gradients) of Dalal and Triggs is commonly used for pedestrian detection with 2d moving embedded cameras (driving assistance) or static cameras (video surveillance). In this paper we show how to use and improve the HOG detector in the UAV context. In order to increase the elevation angular robustness we propose to use a more appropriate training dataset and sliding windows. We show results on synthetic images.

1.1Detection with background substraction

The detection of moving objects is obtained by the difference between the current frame and a reference frame, often called background image. The moving regions are analysed in order to classify the moving objects. The analysis can be done using a visual codebook (Zhou and Hoang, 2005), by using a contour shape matching (Toth and Aach, 2003) or by using other complementary information such as a depth-map and perform tests to reject objects not looking and not behaving like a human being (Xu and Kikuo, 2003). In complement to motion the thermal imagery is an interesting cue to identify human beings (Han and Bhanu, 2007). Hoewever, these methods are not suitable for human detection when the camera is moving.

1.2 Visible-only detection

Human detection is also possible with only the visible information of one camera. Gavrila and Giebel (2002) proposed to use a hierachy of human contour templates obtained after a training. This hierachy is used with the chamfer matching algorithm to detect people. More discriminative methods based on powerful descriptors have also been developed. Descriptors permit to locally extract visual information. The collected information is compared to a general model of the object with the help of a classifier. Papageoriou and Poggio (2000) were among the first to propose such

Analysis and inspection of road traffic using image processing

A methodology using image processing to detect vehicles on highways is presented in this paper. Vehicle detection is done in two stages. In stage one, the dimensional and morphological study of the analyzed highway is carried out in order to model and calibrate the vision system. In stage two, vehicles are detected owing to the method of matching clear and dark blobs. These are extracted by mathematical morphology techniques and bright headlight images by using pattern recognition techniques. The position of the vehicle allows access to spatial-temporal information which characterize traffic flow and permit automatic traffic control.

M2M Telematics for Vehicle Detection Using Computer Vision

This paper after a brief survey of computer vision in telematics, describes the various steps involved in vehicle detection through image processing. The paper also covers Monocular and stereo based vision for image detection and also discuss about how the system can work under various lighting conditions (day and night) and different approaches adopted to achieve it. And finally end with the recent development and implications of computer vision in telematics.

Increasing collaboration between vehicle manufacturing companies and telematics vendors is one of the major reasons contributing to the growth of telematics services industry. Next generation vehicle telematics application such as automatic vehicle identifier systems, fleet operation management systems, remote vehicle diagnostics, incident detection systems, and in-vehicle terminal assistance are expected to increase the demand of telematics services in vehicle manufacturing industry. Rising awareness amongst consumers over the need and importance of telematics services will drive the market demand in upcoming years.

Review on Vehicle Detection Technology for Unmanned Ground Vehicles

Unmanned ground vehicles (UGVs) have great potential in the application of both civilian and military fields, and have become the focus of research in many countries. Environmental perception technology is the foundation of UGVs, which is of great significance to achieve a safer and more efficient performance. This article firstly introduces commonly used sensors for vehicle detection, lists their application scenarios and compares the strengths and weakness of different sensors. Secondly, related works about one of the most important aspects of environmental perception technology—vehicle detection—are reviewed and compared in detail in terms of different sensors. Thirdly, several simulation platforms related to UGVs are presented for facilitating simulation testing of vehicle detection algorithms. In addition, some datasets about UGVs are summarized to achieve the verification of vehicle detection algorithms in practical application. Finally, promising research topics in the future study of vehicle detection technology for UGVs are discussed in detail.

The Proposed Approach

The proposed vehicle detecting algorithm has two modes: training and detection. The training mode is where some of the collected images are employed to train a classifier so that it can be used to detect headlights in the detection mode. The overall block diagram representing the algorithm including both modes and their respective modules is given in Figure 1. 3.1 Input

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Stage Videos for training and testing were collected from a moving vehicle in central Sweden by using a Sony HDR-CX115E video camera. The camera was pointed towards the direction of the vehicle's motion from which the videos were collected. Night Time Vehicle Detection 147 In total 15 videos were collected and a total of 7179 frames were produced from these videos. The videos were invoked in the training and testing of the proposed system. Objects extracted from these videos were employed to train the shape classifier. To test and validate the proposed system 1410 frames were invoked.

VEHICLE DETECTION BASED ON HISTOGRAMS OF ORIENTED GRADIENTS (HOG) FEATURES

In vehicle detection phase, the key components are HOG features extraction and SVM classifier training. First, the input image is represented as HOG features which are later used as linear SVM classifier. Using the classifier perform a dense multi-scale scan reporting preliminary object decisions at each location of the test image. These preliminary decisions are fused to obtain the final vehicle detection. HOG features combined with SVM classifier have been widely used in image recognition, especially got a great success in object detection. Figure 1 shows algorithm flow of vehicle detection.

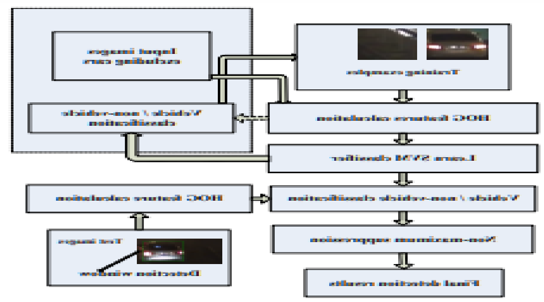

Figure 1. Algorithm flow of vehicle detection

Support Vector Machine (SVM)

The classification problem can be restricted to consideration of two-class problem without loss of generality. The goal is to separate the two classes by a function which is induced from available examples and produce a classifier that will work well on unseen examples. Support Vector Machine (SVM) [2][9][11] is a kind of algorithm based on the principle of structural risk minimization, which has advantages in solving the small sample, nonlinear and high-dimensional pattern recognition problems. SVM is to find an optimal separating hyper plane which maximizes the distance between two classes to separate two classes with the largest interval.

In this paper, we take the method based on the SVM with HOG features to realize classification and recognition. We make manually 5829 positive samples and generate automatically 64060 negative samples by using image frames without vehicles. All the samples are scaled to the size of 64*64 (widthheight) for training. Extract HOG features from all the training data, obtain high-dimension feature vectors and then train the linear SVM classifier using these vectors. Then scan the test images and find the possible areas including cars.

III. VEHICLE TRACKING BASED ON KALMAN FILTER

Kalman filter was proposed by Rudolf Emil Kalman who is a mathematician of United States in 1960. Kalman filter is the best linear filter in the minimum mean square error, which means that it makes mean square error which between the system state vector and the predictive value of state vector be minimum. The thought of Kalman filtering algorithm is continuously iterative update by forecast and update time sequence, making the error which is caused by system noise and observation noise gradually reduced, to get the best state parameters. The Kalman filter uses the state-space model that includes the state equation and observation equation to describe the filter. According to the criteria of linear unbiased minimum mean square error estimation, the best estimate give the state variable by using the recursive nature of state equations and a set of recursive algorithm. The Kalman filter model is as follows: !! + " !! 11,11, = #

• S S Wkkkkkkk (7) +VSHZ kkkk=

• (8) Where k S is the n-dimensional state vector, " kk !1, ( ) n is the n!n-dimensional state transition matrix, " kk !1, is the n!p-dimensional noise input matrix, Wk!1is the p-dimensional system process noise, Zk is the mdimensional observation sequence, Hk is the m!ndimensional observation matrix, Vk is the m-dimensional observation noise sequence. The core of Kalman filter is the evaluation model which is also one of recursive algorithms, the state estimates and the current observed values determine the state estimation value. It is problem of Kalman filter that the linear minimun variance estimation S ,nj ! of the state j S is calculated based on observed value ( )11 , nn ! ,...ZZZ .

The minimun target is as follows: ! " # $ % & ' ( ) * + , - $ % & ' ( ) = * . . nj j T nj j , SSSSEJ , (9) When j = t the formula (7) is Kalman filter, when jt the formula is predictor. The important equation of Kalman filter is as follows: 1 1, 1, ! " ! ! " = # k kk S kk S ! " # $ % & += ' ' (' ((1, kk 1, kkk kkk SHZKSS [ ] 1 1, 1, ! = ! ! + k T kkkk T kkkk RHPHHPK (10) P kk ! = $ ## !!! + Q "" kkkkkkkkkk !!! 1,11,1,11,1, [ ] "k = ! PHKI kkkk !1, The formula 10 describes the observation update process of Kalman filter, from the priori estimates (!1, " S kk) and the prediction error covariance matrix P(n).

The first equation of formula 10 is the method that the k state is estimated by the k-1 state, the second equation update estimation (S k !) of the state vector (k S), the third equation calculates the optimal gain factor (Kk), then the new observation vector (Zk) will calculate the updated parts (! " # $ % & ' ' (kk 1, kkk SHZK), As for the quality of forecasts, the fourth equation makes a quantitative description. The other equations are used to calculate the rectification value of time-updated, the rectification value reduce from the quality of time update (P kk !1,), the quality of observing information (Rk), the relationship between observation and the state (Hk) and the specific observation information (Zk). The purpose of all equations is to ensure that observation information is correct and rational used. According to the principles of Kalman filter, we can predict the position of the object in the next frame. In this way, we improve the accuracy of tracking and decrease the rate of the object undetected.

CONCLUSION

In this paper, we propose a method for vehicle detection and tracking at night in video surveillance. Our system makes use of HOG features to extract vehicle features and SVM to realize classification and recognition. Then uses Kalman filter to track vehicles. The method effectively overcomes the shortcoming of insufficient light at night. Experimental results show that the system is effective and accurate, the system can achieve high vehicle detection rate at night.

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