REVIEW ON VISION BASED METHODS TO DETECT OBJECTS ON HIGHWAYS

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ABSTRACT

Small objects appearing on the highways are one of the major security risk for moving vehicles in highways. As well as overall statistics of pedestrians getting hit by high speed vehicles is increasing day by day, the need for automatic pedestrian detection is becoming more and more appealing. So, in order to detect objects in highways, stereo vision based methods are employed. Since camera can generate dense information about the objects. The vision based objects detection provides objects behavioural information's and is an intuitive detection method similar to human visual perception.

Keywords- object detection, stereo vision, vision based methods

I. INTRODUCTION

The object detection in highways is one of the crucial task since the objects as well as the camera is moving. Due to the relative motion between them, a motion blur will occur, it is an environmental sensing task too. There are many challenges faced during this detection process. Conventional methods use RADAR, LiDAR and laser based methods which provide high resolution images. Here we discuss stereo vision based methods as a solution which provide low resolution images thus increasing the area of capture and reduce false detection rate.

II. LITERATURE REVIEW

Object detection plays an important role in highways. From the viewpoint of safety in automotive applications, it is important to detect objects that come in the pathway of vehicles.

III. METHODS FOR OBJECT DETECTION

For moving vehicles, the detection of objects in the path of vehicle is an essential one. Especially when small objects are present in highways are not noticeable. So it is important to detect small objects on the road which may be dangerous to the host vehicles. So for the precise detection of small objects, stereo vision can be employed, which reduces the false detection rate. If the object of interest is not visible in one view, it may appear in another view. So the false detection rate can be minimized.

According to the work done by Kazuhisa Ishimaru, Long Qian, Seiichi Mita [1] ;they solve the problem of detecting the small objects by using the dense information available using stereo vision. For this a stereo camera is placed on the top of the vehicles to acquire stereo image pairs. In order to exploit the depth information about the corresponding stereo pair, multipath viterbi algorithm is used. Based on that information, the road surface is extracted by finding the v-disparity and then the object is extracted using the road information.

In the work done by H. G. Jung, Y. H. Lee, B. J. Yoon and J. H. Kim [2], they propose a collision avoidance system with distance measurement. In this work they extend the disparity histogram based method which is used for stop and go applications. It is one of the stereo based methods to detect obstacles in automotive applications. This system consists of a stereo vision based obstacle distance measurement, collision avoidance algorithm, a dynamic model of egovehicle and human machine interface. According to the current state of host vehicle and obstacle, the collision avoidance algorithm will measure the risk of collision and then corresponding commands will be sending to the braking system which is able to generate the required braking force without any human aid. The stereo vision based distance measurement mainly consists of a hypothesis generation step and hypothesis verification step. The hypothesis generation step consist of travelling lane recognition, ROI establishment, Edge- feature based stereo matching, Disparity histogram generation, peak detection and validation. The hypothesis verification consists of edge feature correlation based candidate verification.

The travelling lane based ROI replace fixed ROI in disparity histogram based ROI inorder to cope up with highway applications. So to detect the lane, several assumptions are made and implemented using four steps ie. Inverse perspective warped image generation, lane marking template matching, lane marking grouping and curve fitting. In edge feature based stereo matching, a pixel based classification and similarity based matching is done. In pixel classification, the intensity difference between a pixel and its connected neighbours are taken and a class value is assigned to the pixel which reflects s the intensity configuration. The pixel classification will make the stereo matching fast and robust to the noise. The pixels corresponding to vertical edges are considered for matching. In the same pixel class correspondence test will be done. Then the total similarity is the product of class similarity and color similarity. If the highest total similarity is lower than a certain threshold, the pixel fails and get ignored.

The disparity value for near and far away objects will be varying. So if a constant threshold is chosen; ie. False rate at large disparity values increases as the constant threshold is too low and when the threshold is set to too high for avoiding false detection rate, the preceding vehicles might be missed. For threshold line based peak detection and peakness evaluation, a threshold line passing through the origin with slopes calibrated empirically is defined where the constant slope is justified by the feature ratio maintenance in the feature detection phase. Then hypothesis verification is done. The result of this method is compared with the radar based methods. Although the distance measurement was not perfect, for collision avoidance and warning it is proved to be sufficient. But this method requires additional computation loads thus requires high cost when comes to implementation in real time.

Human lives are precious ones. So from the safety viewpoint it is necessary to detect the obstacles in the pathway of vehicles. As per the work done by Xia Liu and Kikuo Fujimura [3]; they considered the movement information about the pedestrians and suggest a method to detect objects at night time. The human vision is weaker at night than the day, so this is a beneficial one for safe and assistive driving. Infrared sensitive cameras are employed here since during night time the exposed part of the human body appears as a hotspot in the heat sensitive infrared vision and these characteristics is used to detect the pedestrians on the road during the night time. At first correspondence matching between the stereo image pairs in frame ‘i’ is established. Then object correspondence match between frame ‘i’ and frame ‘i+1’ is established. Then corresponding decision is taken. If scene is simple, a blob level correspondence is required other ways a second level correspondence with gray scale patches is necessary since blobs are not sufficient to establish correspondence as the difference in the appearance of objects in the left and right images due to occlusion, blur, etc. Thus the two stage technique can be helpful to speed up the process as it reduces the computation time since the only objects selected from the first stage requires gray scale matches in the second stage.

The overall statistics of pedestrians getting hit by the high speed vehicles is increasing day by day. So there is a need for automatic pedestrian detection for safe and assistive driving. In the work done by Brojeshwar Bhowmick, Sambit Bhadra and Arijit Sinharay [4], they use viola jones methodology where the cascaded classifiers are trained with Haar like features using Adaboost algorithm. For this they used several datasets and train the classifiers. The classifiers are trained with positive images as well as negative images. It gives good detection rate along with high false detection rate .So the images are trained with portions that gives false detection as negative sets, it reduces the false detection rate but some correct detection get missing. So as a solution, a stereo vision based method is employed. Thus the probability of pedestrians being detected in both cameras simultaneously or in a span of few frames is high and low probability of false detection in both cameras. After detection object can be tracked accordingly based on the pedestrian detected on either cameras or either one of the cameras.

Tracking reduces false negative error while assistive decision making reduces false positive errors.

For image acquisition, active sensors as well as passive sensors can be used. Active sensors are used by Radar, Lidar or laser based devices. They gives high resolution images but the cost of implementation is high compared to passive devices. Passive devices provide low resolution images thus the area captured by then is large. According to the work done by Huei-Yung Lin, Khun-Jhin Li, Chia-Hong chang [5]; they use passive camera to capture images which is affected by motion blur effect for the measurement of speed. Here the camera is considered to be stationary and object is considered to be moving. Due to the relative motion between the camera and the object, during the time which the camera is exposed, motion blur will occurs in the dynamic region of the image captured by the passive camera. In this work, first the region of interest is extracted and motion blur estimation is done on the motion blurred sub image and then motion deblurring is done with the help of wiener filtering. Here the author provides a link to establish the relationship between motion blurred images and corresponding 3-D reconstruction. According to the pinhole camera model the speed of the vehicle is detected. The major limitation of this method is that in the motion blurred image, they made assumption that there are detectable sharp edges. This method can be used for the purpose of traffic speed law enforcement which is currently achieved by radar or laser based methods.

By comparing all the methods mentioned above, stereo vision based methods can be efficiently used for detecting objects in highways. In the above mentioned methods, most of them do not address the issue of motion blur. By estimating the motion blur effects more precise result can be obtained.

IV. CONCLUSION

The object detection in highways is one of the crucial task since the objects as well as the camera is moving. Due to the relative motion between them, a motion blur will occur. Also it is an environmental sensing task. There are many challenges faced during this task. Conventional methods use RADAR, LiDAR and laser based methods which provide high resolution images. Here stereo vision based methods are adopted as a solution which provide low resolution images thus increase the area of capture and reduce false detection rate.

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