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Object Scanning based Road Obstacles Detection using Weighted Sum Method-A Review

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Abstract-- This study presents an image processing vehicle detection and tracking algorithm for smart vehicle vision system. The algorithm applies in two stages of vehicle detection. At first stage, we generally find all the edges which is there in the camera window but considering of over segmentation concept so that not to leave any vehicle behind even if that vehicle is very much similar in intensity with the background and even of low intensity too. At the second stage, we apply Weighted Sum Method along with the intensity and texture consideration to merge internal edges with in the AOI (area of interest) so that we will get vehicles segmented in the current image. After that, we will count vehicles using block wise counting analysis.

Keywords—Road Obstacle Detection, Weighted Sum Method.

I. Introduction

Intelligent transportation systems (ITS) are divided into intelligent vehicle systems and intelligent infrastructure systems. Intelligent vehicle systems are typically classified in three categories, namely 1) Collision Avoidance Systems; 2) Collision Notification Systems 3) Driver Assistance Systems. Obstacle detection is one of crucial tasks for Collision Avoidance Systems and Driver Assistance Systems.

Obstacle detection systems use vehicle mounted sensors to detect obstructions such as other vehicles, bicyclists, pedestrians, road debris or animals in a vehicle's path and alert the driver. Obstacle detection systems are proposed to help drivers see farther and therefore have more time to react to hazards of road. These systems also help drivers to get a large visibility area when the visibility conditions are reduced such as night, fog, snow, rain etc. It is clear now that most obstacle detection systems cannot work without vision. Typically, vision-based systems consist of cameras that provide gray level images. When visibility conditions are reduced (night, fog, twilight, tunnel, snow, rain) vision systems are almost blind. Obstacle detection systems are less robust and reliable. To deal with the problem of reduced visibility conditions, infrared or colour cameras can be used.

Every minute, on average, at least one person dies in a vehicle crash. Auto accidents also injure at least 10 million people each year and two or three million of them. It is predicted that the damaged property, hospital bill and other costs will add up to 1-3 percent of the gross domestic product in the world. With the aim of reducing injury and accident severity and pre-crash sensing is becoming an area of active research among automotive manufacturers and suppliers and universities in the world. Several national and international projects have been launched over the past several years to investigate new technologies for improving safety and accident prevention.

Vehicle accident statistics disclose that the main threats a driver is facing are from other vehicles. The developing on-board automotive driver assistance systems aiming to alert a driver about driving environments and possible collision with other vehicles has attracted a lot of attention to aware. In these systems, robust and reliable vehicle detection is the first step of this system. Vehicle detection and tracking has many applications including platooning (i.e., vehicles travelling in high speed and close distance in highways) stop and go (vehicles travelling in low speeds and close distance in cities) and autonomous driving.

In vision-based on road vehicle detection systems where the camera is mounted on the vehicle rather than being fixed such as in traffic/driveway systems of monitoring. Vehicle detection using optical sensors is very challenging due to huge within class variability's in vehicle appearance. Vehicles may vary in shape, size and colour. The appearance of a vehicle depends on its pose and is affected by nearby objects. Complex outdoor environments (e.g. illumination conditions, unpredictable interaction between traffic participants, cluttered background are difficult to control it. On-road vehicle detection also requires faster processing than other applications since the vehicle speed is bounded by the processing rate.

Another key issue is robustness to vehicle's movements and drifts of vehicle. More general overviews on various aspects of intelligent Transportation systems (e.g., infrastructure-based approaches such as sensors detecting the field emitted by permanent magnetic markers or electric wires buried in the road) as well as vision-based intelligent transportation systems e.g., driver monitoring, pedestrian detection and sign recognition etc. can be found in. Several special issues have also focused on computer vision applications in intelligent transportation systems.

Vision-based vehicle detection for driver assistance has received considerable attention. There are at least three reasons for the blooming research in this field:

1) The startling losses both in human lives and finance caused by vehicle accidents
2) The availability of feasible technologies accumulated within the last 30 years of computer vision research
3) The exponential growth in processor speeds have paved the way for running computation-intensive video-processing algorithms even on a low-end PC in real time.

With the ultimate goal of building autonomous vehicles there are many government institutions, automotive manufacturers and suppliers and R&D companies have launched various projects worldwide which involving a large number of research units. These efforts have produced several prototypes and solutions which are based on rather different approaches and Looking at research on intelligent vehicles worldwide. The Europe pioneers the research which are followed by Japan and United States.

II. Literature Review

The objective of the literature review is to find and explore the benefits of road detection algorithms and their role in traffic systems and also what are the different problems in existing techniques and algorithms. The main goal of this literature review is to find the gaps in existing research and methods and also what will be the possible solutions to overcome these holes.

Khalid, Z. et al. (2013), in their paper titled "Stereo vision-based road obstacles detection" presents a fast road obstacle detection system based on stereo vision and this algorithm contains three main components: road detection, obstacle detection and tracking of obstacles. The road detection is achieved by using a small rectangular shape at bottom centre of disparity image to extract the road disparities. The roadsides are located by using morphological processing and Hough transforms. The objects can be easily located by the process of segmentation in the obstacle detection process. The obstacles' tracking is achieved by the discrete Kalman filter. [1].

Hung, C.W. et al. (2013), in their research paper titled "Road Area Detection based on Image Segmentation and Contour Feature" developed two procedures to extract road area. It uses initial road detection and continuous image tracking to reduce computation cost. Experiment using three difference environments to verify that this algorithm is can be realized. [2]

Wang, B. and Fremont, V. (2013) in their research paper titled "Fast road detection from colour images" presented a method for drivable road detection by extracting its intrinsic features of secular. The resulting detection is then used in a stereo vision-based 3D road parameters extraction algorithm process. A substantial representation of the road surface is called axis-calibration and is represented as an angle in log chromaticity space. The approach is combined with a stereovision based method to filter out false detected pixels and to obtain precise 3D road parameters. [3]

Haq,E.U. et al.(2012) their research paper titled "Image Processing and Vision Techniques for Smart Vehicles" presented a new algorithm for mono-camera based vehicle detection systems, by incorporating different low level (edges) and high level features (Bag-offeatures). To extract edge information flawlessly, presented a new edge detection method, namely Difference of BiGaussian (DoBG). [4]

Kuo, Y.C. et al. (2010) in their research paper titled "Vision-based Vehicle Detection in the Night time" present a vision-based vehicle detection method for collision warning of driver assistance system on highway in the night time. The major function of work is to find preceding vehicles in the dynamic background of objects. The system captures the image of road environment by a camera mounted on the windshield of the test car and uses multi-level image processing algorithms to extract taillights of preceding vehicles and identify the proceeding vehicles by taillight clustering processing. [5]

III. Obstacle Detection

The obstacle detection algorithm developed here simplifies the task of detection. Further certain justifiable assumptions are made to speed up the system of detection. These assumptions make the system amenable to real time and real world situations. In this section we first describe the assumptions and then the system requirements and finally the detection algorithm.

Assumptions of Obstacle Detection:

The basic assumptions that underlie the Obstacle detection algorithm:

- Obstacles can be defined as objects protruding sufficiently high from the ground or crevices sufficiently deep in the surface. For the system described here, obstacles are restricted to objects that are at least k feet above the ground-plane and the system is not designed to detect crevices (as explained at the end of this section).
- Flat Ground: It is assumed that the ground can be locally represented by a plane. The assumption is justifiable on the basis that the area where a big vehicle can be safely driven is more or less locally flat.
- Object boundaries form good features: Obstacles are assumed to be visually distinguishable from the background in the intensity image since local intensity discontinuities form the basis for matching across stereo image pairs. Note that most correlation based techniques make this assumption.
- Epipolarity: Image matching is a two dimensional search that can be reduced to a one dimensional search if constraints imposed by epi-polar geometry inherent in an oriented image pair [25] are met. The detection algorithm exploits the epi-polarity constraint by employing cameras with identical focal lengths that are aligned up to a scan line.
- Identical camera/Digitizers: Identical cameras and digitizers are assumed to simplify the task of finding correspondences and processing intensity images. A difference in focal lengths of the stereo camera lenses introduces 2D an affine transform and obtaining correspondences becomes more complicated results. There are some differences in the dynamic response of the sensors to incident light and scaling or offset of the input signal by the digitizers requires costly and time consuming intensity normalization.

Weighted Sum Method

The Weighted Sum Method is the simplest approach and probably the most widely used classical method. This method scalarizes the set of objectives into a single objective by multiplying each objective with a user supplied weight. It introduces a non-simple question: What value of the weights must be used? The answer depends on the relative importance of each objective.

Formulation:

F(**x**) $=\sum_{m=1}^{M}$ wmfm(**x**)

G(**x**) = [g1(**x**), g2(**x**), . . . , gJ (**x**)] ≥ 0

H(**x**) = [h1(**x**), h2(**x**), hK (**x**)] = 0

$xi^{(L)}$ **≤ xi ≤**$xi^{(U)}$**, i=1, N**

- Where the objectives are normalized.
- wm 2 [0, 1] is the weight of the m-th objective function.

CONCLUSION

In this paper, we have developed an algorithm that detects and tracks road obstacles; our algorithm is proposed to detect and to track road obstacles using scanned objects which are obtained from cameras installed at a moving vehicle. The proposed obstacle detection algorithm can be used for the development of driver assistance system and autonomous vehicle systems. Firstly, the road obstacle detection process will be carried out to segment the road by using a slope of the geometry road to extract road disparities. Secondly, the obstacle detection process used to retrieve all objects found it in the road. Then the weighted sum method is used for tracking these objects. The obtained results are better and satisfactory.

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