Real Time Obstacle Detection for an Automotive Vehicle

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Abstract -- **This paper presents a method for detecting vehicles as obstacles in real road scene using a single onboard camera for an automotive vehicle. Vehicles are detected by finding region of interest (boundary detection) using morphological operation in image captured by camera. When a vehicle is found in front of travelled vehicle then the driver assistance system gives warning to the driver to give attention for avoiding collision. Experimental results are given for real time on road vehicle detection.**

Keywords: Obstacle detection, Image processing, Vision system.

I. INTRODUCTION

OBJECT detection and tracking are important in many computer vision applications. In this paper, we propose a purely vision-based approach for real time obstacle detection for an automotive vehicle designed to provide automotive safety purpose. Our proposed system uses as input the video streams from a synchronized, forward-looking camera. To analyze this data, the system combines visual object detection and warning system. These systems consist of low cost USB camera, warning system device and computer system. USB camera is most suitable because of its low cost and ranging capability. According to the present invention, the object scene captured by low cost camera which is located at the head of an automotive vehicle. Camera captured the images as RGB images which is converted in to the grayscale images by some image processing algorithms. These grayscale images are used to process the object scene, for predicting that an obstacle is approaching the vehicle using MATLAB environment. As a result, Warning system connected to the microcontroller which in turn will be connected to the computer via serial port, provides an alert message and indication to the driver of the automotive vehicle on recognizing the object. According to this project the obstacle passing through the vehicles is surely and stably detected and avoid any traffic accident. In this work, the computer program for image processing and for alerting, all are implemented in MATLAB environment. The purpose of this work is to reduce driver error by providing information about the task situation using obstacle detection. The paper is structured as follows: section II reviews related work.

Section III gives an overview of the different components of our vision system with a focus on vehicle detection, Implementation details are given in Section IV. Finally, we present experimental results in Section V and the paper is concluded in Section VI

II. RELATED WORK

Obstacle detection and avoidance is one of the central capabilities of an intelligent vehicle transportation system .Various techniques for detecting obstacles on the road have been proposed. They use various sensors including as Most of them use a fixed camera and use background subtraction [1] and [3]).Ulrich and Nourbakhsh [2] suggested as obstacle detection system also designed on the basis of as ground has a constant colour distribution and obstacle information

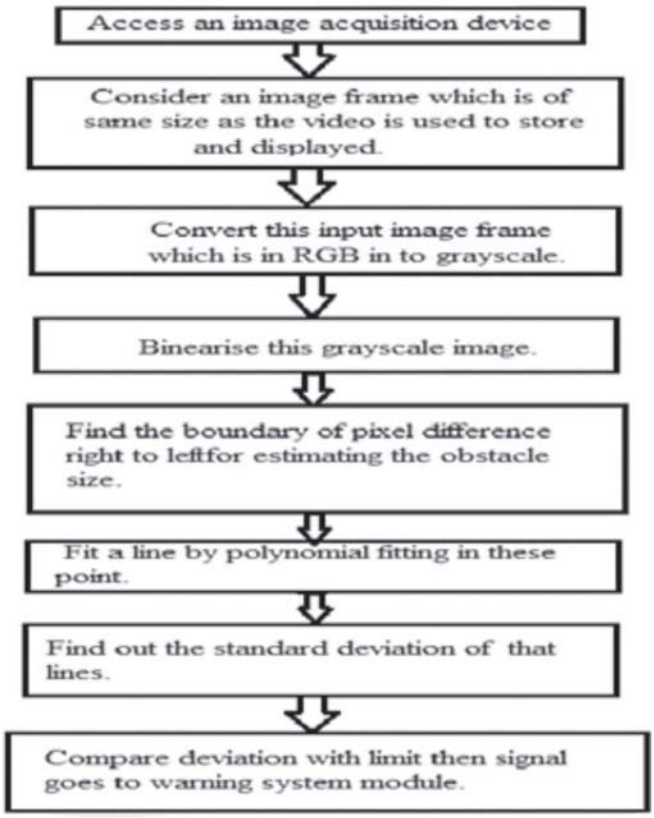

Figure 1. Obstacle Detection Module.

extracted by matching a colour of images captured by a monocular camera. Haruya Kyutoku, Deguchi and Tomokazu [5] propose a method for detecting general obstacles on a road by subtracting present and past in-vehicle camera images. In this method first realizes a frame-by-frame correspondence between the present and the past in-vehicle camera image sequences, then performs a road surface registration between the corresponded frames. Obstacles are detected by using the difference of the road surface regions.

The main contribution of this paper is to show that vision based obstacle detection has progress for such a system to become realizable. Specifically, we focus on obstacle detection of vehicles on road, as this is an especially difficult at high speed but very important application area of future automotive systems.

III. SYSTEM

Our vision system is designed for an automotive vehicle on road equipped with forward looking camera on vehicle. This can be broken down into two main modules:

1. Obstacle detection module
2. Warning system module

The task of Obstacle detection module in the algorithm is to analyze the frames of video captured by the USB camera. Fig.1 gives an overview of the proposed vision system.

For each frame, the blocks are executed as follows. It calculate the object by finding boundary as right and left both side of image, then apply some set point on these boundaries compared with it to threshold level. According to this object recognized then the Warning system module in this project, provide an alert message, a warning indication to driver for getting attention to avoid collision or accidents on the road at traveling which is shown in Fig 2.

Obstacle hypothesis and validation algorithm:

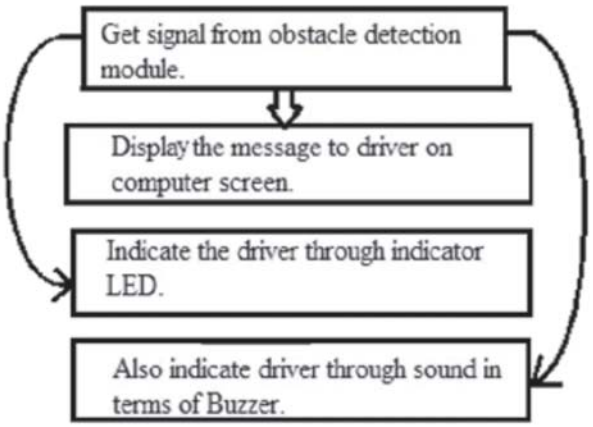

Figure 2. Warning System Module.

From these figures, Warning system module alerts vehicle driver through message, buzzer and indication, on the basis of object recognition which is done by obstacle detection module. Firstly obstacle detected because their luminance substantially differs from background, therefore two module form the system as

(a) boundary detection algorithm is used to reduce search area (region of interest ROI) where obstacle can be found. (b) Obstacle hypothesis and validation algorithm is used to checks the correctness of detection by recognizing object.

Boundary detection algorithm:

Basically this algorithm performs a region growing approach which as starting from the region of image just in front of vehicle and extends up to end on the road surface (Fig 3). The boundary detection used to define area of interest where obstacle appears. For this region of interest (ROI) find the mean pixel luminance on each row of image between boundaries left and right borders respectively.

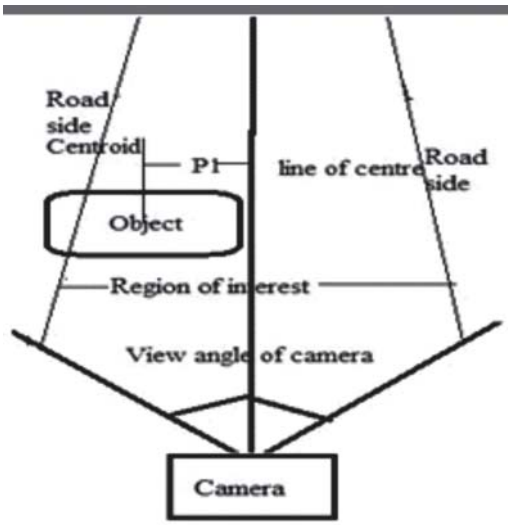

Figure 3. The Region of Interest Definition.

Basically this algorithm process frame of image to detect the obstacle and its validation. Obstacles are perceived because their luminance differs from the road surface or background. For this, firstly image enhance using grayscale conversion. Then the feature extraction techniques applied to validate object (Fig5).The luminance of pixel inside the boundary is used to predict region of interest (ROI) points as 'road' or 'no road'. From (Fig 3), the area of object is larger due to presence of object is nearest to the centre of line and lie in the region of interest (ROI). If this object is lying far to the centre of line and having a maximum distance of camera's view range according to algorithm, then the area of object is smaller as compared to approximated area range. When obstacle hypothesis algorithm formulated with in ROI, the obstacle found using morphological operation in terms of size. For validation approach, a line fitted

in region of interest used to validate the object. If the object lie in region of interest, then fitted line deviate from assumed position and its deviation of data vector x, calculated as

$$G = \{\frac{1}{(n-1)} \sum_{i=1}^{n} (x_i - x)^2\}\frac{1}{2}$$

$$\text{Where, } x = \frac{1}{n} \sum_{i=1}^{n} x_i$$

Here, X is an image matrix, then G returns a row vector containing the standard deviation of the elements of each column o X. On comparing G value to threshold level, warning system modules works. Warning system provides a message, indication to driver for having attention to avoid collision or accidents. it compose of serial port (RS232) which provide the data to the LED (green and red), relay and buzzer for indicating to the driver to protect from accidents.

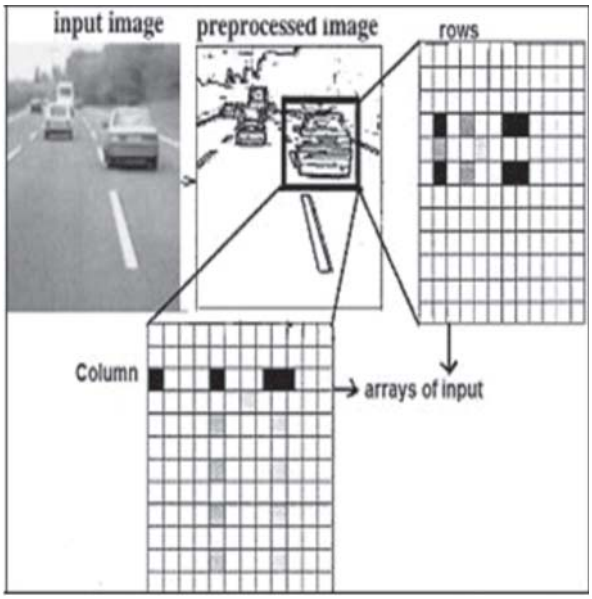

Figure 4. Processing of Image Frame.

IV. IMPLEMENTATION

Our vision system received input from camera align in front placed on the vehicle head, are transmitted through an analog transmitter- receiver pair. These images are received at the processing unit. Images are processed to calculate the obstacle in front of and in side-of vehicle which travels on the highways or road with high speed using MATLAB algorithm and hence the warning system alerts to the driver about obstacle. The outputs as display message of alertness to the driver, displayed on the laptop screen and red indication on the warning device through red LED, Green LED and Buzzer. The message displayed as with obstacle detect image with alerting (red) or goes up (green) background is shown on a laptop screen in frame size.

The proposed system has been tested on real time on road vehicle detection. The video images captured by CCD camera (2/3"sensor & 16mm lens) placed on the head of automotive vehicle. The resulting image size as similar of captured video image is 160x120 pixel. Fig 5(a,b,c) shows the vehicle approaching a rickshaw on road, an obstacle detection and hypothesis algorithm starts when vehicle is at 70m, while the warning system module works and provides message at 50 m. The obstacle detection algorithm processed about 50 frames / second, being relative speed of 30km/h. This algorithm is quite simple in order to satisfy real time requirements and this criteria is sufficient to warn a driver about conditions.

Figure 5 (a).

Figure 5 (b).

VI. CONCLUSION

We can see that the proposed algorithm processes video captured by a single monocular camera. We make the assumption for object detection, camera placed at front of vehicle. The user should start the MATLAB program on laptop

Figure 5 (c).

and according to the algorithm obstacle detects, then the warning system indicated the driver. Implementation of warning system for the driver gives improper results and failure sometimes due to some processing delay. Practically, this project needs a proper lightening and object in background when we run this project on the road. In such practical conditions this technique is giving exact results. There are threshold values used in MATLAB program to recognize the objects and provides the alertness to the driver. There are many aspects related to object recognition which is not considered like if object is not in the camera range.

VII. REFERENCES

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