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A Review on Real Time Rear Vehicle Monitoring & Detection

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Abstract: This paper presents a review on real time vision based system, which can identify vehicle approaching from the rear side and alert the driver in order to prevent a possible collision. Generally in all the paper which is discussed below follows a common setup, i.e., it consists of a camera which is placed at the rear side of the vehicle which captures the images at a frame rate of 30 frames/sec and sends it to the processor which calculates and decides whether the approaching vehicle is in a danger zone or not .If the vehicle is found to be in danger zone an alert signal is sent to the driver informing about the situation behind the vehicle. Hence such alert will greatly help the driver in taking a correct decision at the right time.

Keywords: Collision, Image processing, Obstacle detection Warning.

I. INTRODUCTION

The human population has dramatically increased over the past few centuries as shown in fig.1 and hence the number of vehicle on roads has also increased [1].Road accidents have become a serious issue in today's time. According to World health organization (WHO) road traffic injuries has caused 1.25 million death worldwide in the year 2010[2].Since large number of people have lost their life in road accidents; this inturn has impacted on the country's economy. According to United Nations economics and social commission for Asia and the Pacific (UNESCAP) India faces a loss of 3% of its GDP every year due to road traffic accidents [3].Without any action road accident are predicted to rise as the seventh most cause of road accident by 2030 which has been predicted by WHO [4].

The various factors which leads to road accidents are such as not following the traffic rules, non-visibility due to blind spots, drunken driving ,falling asleep on wheels ,bad roads conditions ,mechanical defects etc. Blind spots play a major role in various four wheeler accidents as the driver is unaware of the situation behind the wheel, even though mirrors exists they fail to cover the blind spots. In this paper we will be discussing various methodologies developed to overcome this problem.

This paper has been divided into 6 sections, section I provides a brief introduction to the problem statement. Section II discusses the various methodologies. Section III discusses the merits and demerit of the technology. Section IV provides a conclusion for the discussion. Section V provides the acknowledgment and Section VI ends up with references.

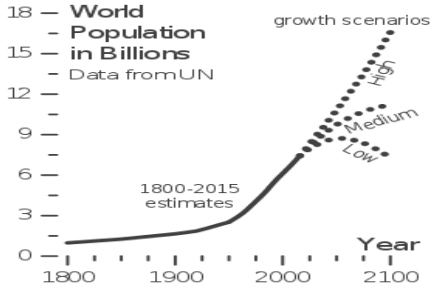

Fig 1. World population estimation from year 1800 to 2100

II. METHODOLOGIES

When the target vehicle is (10-40) meters away Ada-boost classifiers are utilized, and when the target vehicle is close to host vehicle another two techniques are used, one is the WACD technique which is used for distance range between (5-15) meters and the other is hough circle techniques which is used for distance range below 5 meter. As the vehicle move towards the extreme sides, the wheels of the target vehicle appear to be much more circular than eccentric, and hence hough circle determination techniques are easily applied, during such conditions Ada-boost are not used. The output efficiency achieved is 93%.

The paper [6] illustrates the identification of a vehicle in a region where shadows are present. Since shadow possess a major issue in identification of vehicle and in many cases a shadow is wrongly identified as vehicle. This paper presents an algorithm to eliminate such false positive errors.

The camera captures the images in quarter common intermediate format (QCIF- 176 X 144 pixels), since a small resolution leads to faster processing. The images

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are color converted to HSV from RGB format and then the S component is extracted from it using equation (1) – (3). Here the segmentation is performed using a different algorithm known as relative difference in intensity (RDI), rather than usual thresholding algorithm.

$$M=\max(R, G, B) \quad (1)$$

$$m=\min(R, G, B) \quad (2)$$

$$S = \begin{cases} 0, & \text{if } (M - m) = 0; \\ (M - m) / M, & \text{otherwise} \end{cases} \quad (3)$$

In relative thresholding algorithm two nearby pixel values are subtracted and compared with a threshold value □ (theta).If a vehicle is present in a shadow region there will be a sharp increase in the pixel value which will be greater than □, and hence will be detected easily. The success rate of this algorithm is 93%.

In paper [7] discusses both front and rear vehicle collision system. The front camera acquires images at a rate of 15 frames/sec whereas the rear camera acquires images at 21 frames/sec.

The images obtained are converted to gray scale format, and then the region of interest (ROI) is identified. The vehicle is detected in two steps: Hypothesis generation and Hypothesis verification. In Hypothesis generation (HG) the difference frame analysis method and convolution method with background modeling are used to extract the rear vehicle. In hypothesis verification confirmation of the HG analysis are done.

Once a vehicle is correctly identified a collision judgment algorithm is performed, where time-to-contact (TTC) is calculated using the formula (4), which predicts the possibility of collision. Once a danger is identified alert signal is send to the driver as well to the vehicle in front via DSRC (dedicated short range communication).The success ratio of this algorithm is 89.55%.

$$\text{TTC} = \frac{S(t)}{V(t)} \quad (4)$$

Where S(t) and V(t) represents distance and relative speed of the target vehicle respectively.

In paper [8] describes detection of vehicle during night, the vehicle at the rear are primarily visible by their headlights. This system uses a camera which captures the images with a resolution of 720X576 pixels. The camera exposure is kept at minimum in order to minimize the blooming of head light in the images. The on board processor such as a personal computer is used in processing of these images. A region growing technique is used to segment the bright region from the whole image. Using cross correlated bilateral symmetric analysis and lamp pairing techniques a four wheeler vehicle is identified. An average detection rate of 92.8631% is achieved.

The paper [9] discusses the possibility of collision with a reversing vehicle. The camera is mounted on the side window and also at the rear side. The camera obtains the images with a frame rate of 30frames/sec which are having a resolution of 760X420 pixels. A region of interest (ROI) is defined, and then the stationary vehicles are identified using histogram of oriented gradient (HOG) feature and support vector machine (SVM) based classification. The moving vehicle is identified using guassian mixture model (GMM). The path and speed of the moving vehicle is calculated and used for the prediction of possible collision. If the path of moving vehicle is in the same path of our vehicle then an alert is generated otherwise the moving vehicle is neglected. This algorithm provides satisfactory results under daylight scenarios only.

The paper [10] describes the use of android based smartphone in the detection of rear end collision and warning system. The only hardware used in this system is a smartphone which uses its own build-in camera, GPS-chip, accelerometer, speaker module, and also its own processor for computation purpose. The system consists of 3 main parts: lane detection, vehicle detection and vehicle distance estimation.

In the lane detection algorithm first the ROI is defined, and then using non-uniform B-spline interpolation or lane marking using a second order polynomial is defined. After which vehicle detection is performed in two steps: Hypothesis generation and Hypothesis verification. After which the distance is estimated using a set of formulas (5) – (7).

$$\Psi = \theta + \left(\frac{H}{2} - j\right) \times \frac{(FOVv)}{h} \quad (5)$$

$$Y = h \times \tan(\Psi) \quad (6)$$

$$Z = \sqrt{h^2 + Y^2} \quad (7)$$

where Ψ is vertical angle, θ is phone roll angle, H is image height in pixel, j is row number in pixels of the bottom of the vehicle, FOVv is the camera view finder in vertical angle, Y is vehicle absolute ground position, h is the height of the camera from ground, and Z is the distance of the vehicle from camera.

The program is written in C language and thus OpenCV libraries were used in developing the android application. The GPS-chip helps in computing the speed of the vehicle whereas the accelerometer computes the roll and pitch with respect to ground. The camera captured the images with a frame rate of 10 frames/sec and of resolution 640X480 pixels.

III. DISCUSSION

In paper [5] describes a novel methodology for detection and warning of rear end. The data set utilized in this project is only from the highways road condition, hence the algorithm may face challenges under urban and sub-urban traffic conditions. Since it uses three different algorithms at different range of distance of

target vehicle from the host vehicle the complexity of the overall system is increased and thus leads to system overhead. During low-light and bad atmospheric conditions this system fails to detect the vehicle.

In paper [6] it describes a method to overcome the problem faced in detection of vehicle under shadow regions. The algorithm makes great use of relative difference in intensity level of pixel elements. Hence the regions where pixel values are having a gradual increase are neglected and the areas where there is a sharp increase in pixel value are highlighted. This algorithm fails to detect the vehicles in poor lighting condition.

In paper [7] it describes a method for both front and rear vehicle collision warning system. The algorithm used here is quite complex and time consuming. There is a possibility of cross talk communication while using the dedicated short range communication (DSRC), hence leading to further confusion and ambiguity. The surety of receiving signals from correct vehicle is not guaranteed. During changes in environmental condition such as rain, fog etc. degrades the performance of the system.

In paper [8] it explains a novel methodology in order to detect vehicle during night time. This technique concentrates on the intensity of head light beam and judges whether the vehicle is near or far. In order to differentiate between the sources of the light, the system considers only the light beams which are in pair, and thus this system can only detect four-wheeler vehicle having a pair of headlight. Two-wheeler vehicle which have single head lamps are neglected by this system. Moreover all data processing is done on a personal computer instead of a embedded prototype.

In paper [9] explains a technique which helps in prevention of a potential accident by informing the driver of the same. The paper concentrate only on reversing motion, two camera covering different region have been used, thus processor needs to obtain images from both camera source thus leading to time delay. The trajectory prediction and speed estimation of moving vehicle requires complex computational algorithm and thus end up with higher processing time, which further adds up the delay.

In paper [10] describes a novel technique of rear end collision warning system as well as lane detection. The only hardware used here is a Smartphone, thus it greatly cut shorted the hardware requirements. The results obtained were also appreciable. The system could detect lane and inform the driver via an acoustic warning if it deviated from lane at a speed greater than 30km/h. Since the complete hardware such as camera, processor, GPS-module, accelerometer, speaker of the smart-phone was used simultaneously it leads to heavy battery drain and thus constant powering of the smart phone was needed.

IV. CONCLUSION

Thus real-time rear vehicle monitoring and warning systems will be a great boon in improving the safety of vehicles on road and also in reducing the number of road accident. Early intimation to the driver of a possibility of a dangerous situation can prevent a potential collision. The cost incurred in developing such vision based system is also low and could be widely implemented by all the vehicle manufacturers. These systems are compatible with any vehicle and thus could be implemented with ease.

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REFERENCES

[1] World population [Online] Available; https://en.wikipedia.org/wiki/World_population (URL)

[2] ETAuto (2016, November 30).India losses 3% of its GDP to road accident: UN study. The economics times Retrieved from: http://auto.economictimes.indiatimes.com/news/industry/india-losses-3-of-its-gdp-to-road-accidents-un-study/55700816

[3] List of countries by traffic related death rate [Online] Available; http://en.m.wikipedia.org/wiki/List_ of_ countries_ by_ traffic-related_ death_ rate

[4] WHO global status on road traffic injuries Nov.2016 [Online] Available; http://www.who.int/mediacentre/factsheets/fs358/en/

[5] Dooley. D;McGinley. B; Hughes. C; Kilmartin. L; Jones. E; Glavin. M; "A blind-zone detection method using a rear-mounted fisheye camera with combition of vehicle detection methods" IEEE transactions on intelligent transportation systems. 2015.

[6] Prasanth,C.R ; Sagar. T ;Bhat, N; Naveen, D; "Obstacle detection & Elimination of shadows for an image processing based automated vehicle" in International conference on advances in computing, communications and informatics (ICACCI), 2013.

[7] Ma. S ; Chu. S ; Chen. S,H ; Yang. C,S ; Pan. J,S ; "Vision based front and rear vehicle collision warning system" in Third International conference on robot, vision and signal processing, 2015

[8] O'Malley. R ; Glavin. M ; Jones. E ; "Vision-based detection and tracking of vehicles to the rear with perspective correction in low-light conditions" in IET International transport systems, Mar. 2,2010.

[9] Monwar. M.M ; Kumar. V.B.V.K ; "Vision-based potential collision detection for reversing vehicle" in IEEE Intelligent Vehicles Symposium (IV),2013.

[10] Tang. S,J,W ;Ng. K,Y ; Khoo. B,H ;Parkkinen. J ; "Real-time lane detection and rear-end collision warning system on a mobile computing platform" in IEEE 39th Annual international computers, software & applications conference, 2015.