VEHICLES BLIND SPOT DETECTION AND WARNING SYSTEM

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“I hereby declare that I have read through this report entitle “Vehicle Blind Spot Detection and Warning System” and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Mechatronic Engineering.”

Signature: ………………………………………

Supervisor’s name: …………………………………………………..

Date: …………………………………….

I declare that this report entitle "Vehicles Blind Spot Detection and Warning System" is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature: ……………………………..

Name: ………………………………………………………...

Date: ……………………………

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ABSTRACT

Nowadays, the number of accidents involving motorized vehicles is increasing especially the side collision of the vehicles when the driver attempt to change from one lane to another either to left or right which is due to the carelessness of the driver and unsighted the blind spot. However, the cooperation of technology can overcome this problem. The key element is the ability to detect the incoming vehicle in the blind spot area. However, problems rises when the sensor used for the system only able to cover certain amount of area. The objectives of this project is to develop and implement a device that will warn the driver about the incoming vehicles in the blind spot area by blinking LED and to analyze the system in terms of the range and the position of the sensor used for the system. For the methodology, the main components chosen for the system is an Arduino UNO and SRF04 ultrasonic sensor. The first experiment is to make an analysis on the range measured by the sensor by using different materials that is moving towards the sensor at 2 different speed which is at 10km/h and 30km/h. The second experiment is carried out is to make an analysis on the time response of the system with two different position of the sensor which is above the rear tire and under the side mirror with 45º slant. The third experiment is carried out to analyze the time response of the system with two different position of the sensor which is above the rear tire and under the side mirror with 45º slant with the sensor is moving at certain constant velocity. The result shows that the sensor placement above the rear tire is better than under the side mirror.

ABSTRAK

Pada masa kini, bilangan kemalangan yang melibatkan kenderaan bermotor semakin meningkat terutama perlanggaran sampingan kenderaan apabila cubaan pemandu untuk menukar dari satu lorong yang lain sama ada ke kiri atau ke kanan yang disebabkan oleh kecuaian pemandu dan kawasan yang tidak dapat dilihat. Walau bagaimanapun, kerjasama teknologi dapat mengatasi masalah ini. Elemen utama adalah keupayaan untuk mengesan kenderaan yang masuk di kawasan blind spot. Walau bagaimanapun, masalah timbul apabila sensor yang digunakan untuk sistem ini hanya dapat meliputi kawasan kawasan yang tertentu. Objektif projek ini adalah untuk membina alat yang akan memberi amaran kepada pemandu mengenai kenderaan yang masuk di kawasan kawasan bintik buta dengan LED yang berkelip dan untuk menganalisis sistem dari segi jarak dan kedudukan sensor yang digunakan untuk sistem. Untuk metodologi, komponen utama yang dipilih untuk sistem adalah Arduino UNO dan sensor ultrasonic SRF04. Eksperimen pertama adalah untuk membuat analisis mengenai pelbagai yang diukur oleh sensor dengan menggunakan bahan-bahan yang berbeza yang bergerak ke arah sensor pada 2 kelajuan yang berbeza iaitu pada 10 km / j dan 30km / j. Eksperimen kedua dijalankan adalah untuk membuat analisis kepada sambutan masa sistem dengan dua kedudukan berbeza sensor yang di atas tayar belakang dan di bawah cermin sisi dengan kecondongan 45 º. Ekeperimen ketiga dijalankan untuk menganalisis tindak balas masa sistem dengan dua kedudukan berbeza sensor yang di atas tayar belakang dan di bawah cermin sisi dengan 45 º condong dengan sensor yang sedang bergerak pada halaju malar tertentu. Hasil kajian menunjukkan bahawa penempatan sensor di atas tayar belakang adalah lebih baik daripada di bawah cermin sisi.

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CHAPTER 1

INTRODUCTION

1.1 Motivation

There are a lot of accidents happen between vehicles which is caused by the carelessness of the driver when he or she change from one lane to another. According to the traffic safety facts report of National Highway Traffic Safety Administration, there were more than five million motor vehicle crashes reported occurred in the United States in 2011 [1]. There are three times more likely a driver to involve in an accident when changing lanes compared to continuing driving in the same lane [2]. The average of drivers to change lanes is once every 2.76 miles and this frequency increases in suburban rush hour time [3]. A driver that spend 2 seconds to turn his or her head which is travelling at 70 mph (112.65kmh^{-1})has travelled about 205ft (62.484m) unattended [4]. One out of 25 accidents on the highways in the US today is due to dangerous lane changes and merges which is about 630 thousands collision every year [5]. There are 726 deaths which is caused by collisions due to erroneous attempt of lane change and merging [6]. Therefore, something perhaps a device should be designed, developed and implemented on motor vehicles in order to overcome this problem.

1.2 Problem statement

Human beings are aided with the eyes to see and navigate the surroundings. However, the stereoscopic human vision has its own limit of sight. There are certain areas that can’t be seen without moving the head to left or right. The area is so called as the blind spot area. So as the driver in a vehicle, they have their own blind spots which means that the area that is blocked by the part of the body of the vehicle. Therefore, the driver cannot see and know what is happening at the blind spot area.

Changing into another lanes without knowing any information about the situation can be very dangerous. The presence of vehicles in the blind spot area while shifting lanes can cause accidents which also may lead to injuries or death of the driver or the passengers. This is also may due to the drivers usually assumes that there are no vehicle in that area or they think the incoming vehicle may apply brakes to avoid collision. This negative assumption is one of the main cause of accidents.

Thus, normal vehicles nowadays are aided with side mirrors which are mounted on the left and right side of the vehicles to widen the vision of the driver and reduce the blind spot area at the same time. The side mirrors help the driver to know the situation at the blind spot area. However, the side mirror is not able to allow the driver to monitor the blind spot area as it is. Therefore, it is still not enough to ensure the safety of the driver especially during changing and merging into another lane.

In this research, the main design parameter that is to be focused is the area covered by the sensor used. The performance of the sensor is also determined by the position of the sensor.

1.3 Objectives

1. To develop and implement a device that will warn the driver about the incoming vehicles in the blind spot area by blinking LED.
2. To analyze the system in terms of the range and the position of the sensor used for the system.

1.4 Scope

1. The experiment is done for two different position of sensor.
2. The speed of the vehicles are 20kmph, 40kmph and 60kmph only.
3. The sensor is implemented to cover the blind spot region of a sedan car.
4. The experiment is done on vehicles that moving at a constant velocity.
5. The vehicles moving forward in the experiment are not affected by hilly area.

CHAPTER 2

LITERATURE REVIEW

2.1 Background of blind spot detection

This research purpose is to bring intelligence into vehicles by providing the ability of obstacles or objects detection in the blind spot area of the vehicle. Thus, an ultrasonic ranging module with microelectronics, will be designed and prototyped into vehicles. This project will use Arduino microcontroller as the main rather than usual Peripheral Interface Controller (PIC) as Arduino provide s flexible, complete, and easy hardware and software platform unlike PIC.

2.2.1 LaRASideCam

A method that is used to detect the incoming vehicles is by using a camera. A program that detects vehicles in the blind spot are which use video data taken from the side mirror of the vehicle is developed. A camera with 320 x 240, 30 fps resolution is mounted on the left wing of the car. It provides YUV444 color frames but the entire algorithm is based on grayscale images. The program is written in C++ language by using the Ecole des Mines' Camellia image processing library and LaRA perception development of work [7][8]. It was implemented on an embedded system so that its core did not use floating-point, dynamic memory allocation or the C++ standard template library. It complies with the ANSI C++ standard and is tested by using Valgrind software [9]. The implementation on the LaRASideCam is shown as in the figure below:

Figure 1.0: Implementation of LaRASideCam on a Citroen C3 [8].

The algorithm is divided into two parts. The first part of the algorithm is used to detect the characteristics on the front of the vehicles. It then uses Support Vector Machine (SVM) artificial learning. Whereas the second part of the algorithm intends to detect the wheels of the vehicles. The system which uses image processing system can be achieved in several ways such as optical flow analysis and pattern recognition [10, 11, 12]. A common and good way to detect incoming vehicles from rear and front sides is to look for the horizontal edges in the picture [13]. Warping the image to align the horizontal edges of the vehicle with the picture borders is the first method used in LaRASideCam.

Figure 1.1: Picture taken from the left wing mirror camera with the warping region in the red box area [8].

Figure 1.2: An image after being warped [8].

The most overt solution to detect the edges on the picture is by using an operator that selects the horizontal edges only but in practice, all the vehicles do not have equal orientation on the image so that such an operator is too restrictive.

Its first characterization algorithm which its purpose to compute each peak and used to characterized vehicle is not portable to any hardware configuration because its parameters has to rely on many factors such as the resolution of the image and the optic parameters of the video camera. The noise at the edges of the peak may become a great disturbance to the system. The camera itself will become a disturbance to the driver since some space is required to mount the camera on the left or right side of the vehicle.

2.2.2 SideEye: Mobile assistant for blind spot monitoring

This system uses smartphones in order to assist the driver to detect the incoming vehicles from the blind spot area. It seems that more than 60% of mobile phones subscribers in the United States are using smartphones and people are already using smartphones to assist them in their navigation [14].

SideEye contributes an alternative for monitoring function for bringing the blind spot that is approximates the same safety feature of luxury vehicles to economy vehicles. SideEye helps to identify the situation very accurately and it then will warn the driver in real-time. Computer vision related technologies is used in SideEye to scrutinize the scene in the blind spot area.

Although the blind spot areas present on both left and right side of the vehicle, the proposed area to be monitored by SideEye is only on one side which is at the driver side since the risk to cause injury or death once a collision happens on the driver-side is more critical and in more instance there are no other passengers in the vehicle. So, the safety of the driver will be focused more.

The smartphones is mounted on the windshield or on the dashboard which is in front of the driver in order to allow the front camera of the smartphones to monitor the blind spot area. The region of interest (ROI) which is the lane on the side of the driver is the region that the SideEye will monitor covers the blind spot of the driver. The SideEye will alert the driver as soon as possible once it detects vehicle in the ROI to improve safety. The system will also be able to work as a daemon thread with other smartphones applications especially navigation applications. The system will only alert the driver when it detects something critical I the ROI. It will alert the driver in several ways such as showing a warning icon or give an audio warning.

Figure 1.3: A smartphone that is mounted on the windshield [5].

The system uses camera to monitor the ROI and then processes the information in the video frame. Computer vision based techniques is employed by the developer to perform this task. The developer explore two approaches to detect the presence of vehicles in the ROI which is by checking the intensity of the image within the ROI and by the knowledge of the shape of the vehicles.

In the intensity based scheme, the intensity distribution of the pixel of the ROI could be different when there are no vehicles or obstacles on the road. The difference between the intensity of the pixel distribution is utilized to identify the presence of vehicles in the ROI. Another way to distinguish between a vehicle and an empty road is by the intensity variation which means that the intensity variation of the region is observed. The variation of intensity is calculated and a threshold is used in order to distinguish between empty road and occupied road. Normally, most of the pixels concentrated around one peak when the road is empty. The peak may shift once the texture of the road changes but most of the pixels are still concentrated around that region. Once a vehicle enters the region, the pixels will spread and other local peaks will occur. This characteristic is used as a hint to inform the driver about the presence of the vehicle in the blind spot area. The region is warped so that it gives an even distribution of pixels in order to make the system able to detect incoming vehicle as soon as possible.

However, this system has its own advantages. It depends on the camera of the smartphones itself which means the system will become less efficiency if the resolution of the front camera of the smartphone is low. It does help the driver to navigate the blind spot when the smartphone is placed in front of the driver which is on the dashboard or on the windshield. But some drivers may feel uncomfortable with the presence of the smartphone in front of them because the device itself is blocking the drivers view. The system also may not last long as the smartphone itself uses its own battery to power up. More energy will be required and wasted once the driver have to let their smartphones to be in standby mode as the system require the phone to be turn on [5].

2.2.3 Active Blind Spot Crash Avoidance System

An active blind spot crash avoidance system has been develop at Kattering University, Michigan, USA in order to address the concerns of vehicles collisions and accidents that happen during the drivers changing the lane. The system will detect the presence of vehicles in the blind spot of the driver and what lane they are travelling in. The system provides a force on the steering wheel if the driver tend to change lane to where a vehicle is present in the blind spot area so that side collision can be avoided while simultaneously providing an opposite force on the pedal to avoid frontal collision.

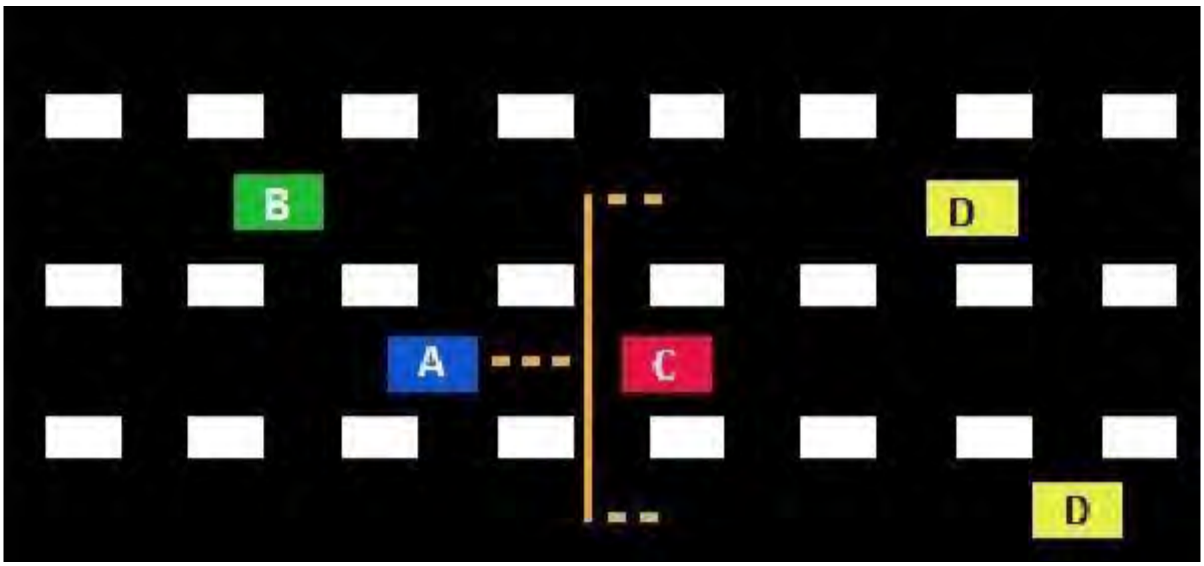

Figure 1.4: Illustration of the driving scenario [6].