Vehicle Collision Avoidance System by Blind Spot Monitoring and Drowsiness Detection in Automobiles

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***Abstract*: Driving a vehicle in the present traffic conditions is a great challenge for humans. So many automated techniques like auto braking, airbag exposure in case of collisions are introduced as vehicle safety systems. Driver's unawareness about the presence of a vehicle or obstacle in the blind spot area and distracted driving are the main reasons, which cause vehicle collisions in the present scenario. The aim of the project is to take preventive measures against the vehicle collisions using 1.Blindspot Monitoring and 2.Drowisiness Detection techniques. This system prototype is built on the base of embedded platform using RASPBERRY PI microcontroller with ARM11 processor.**

1. Blindspot Monitoring: This technique is used when there is an obstacle present in BSA and, during lane divergence; collision may occur in overriding situation. To avoid this phenomenon, ultrasonic sensors are used to detect the vehicles/obstacles in the blind spot region.

2. Driver Drowsiness Detection: The drowsiness of the driver is detected by capturing and processing image using MATLAB software. As soon as the driver feels sleepy, the microcontroller controls the DC motor connected to the wheels of the vehicle.

***Index Terms*: Blindspot area (BSA), drowsiness detection, Raspberry pi.**

I. Introduction

In the present scenario, the toll of road accidents has been in the increasing graph and many accidents are caused due to negligence of the driver. Most of the accidents also happen in the highway driving, where driver's have negligence during lane switching of vehicles. Thus, detecting the obstacle near the vicinity of our vehicle during lane switching or during highway driving is vital. The advanced automotive technology has been developing better systems to enhance the driver safety. The automotive technology is always on the thought of enhancing and, bettering the safety of the vehicles than their predecessors. Automobile manufacturers have proposed many safety schemes till date, like, collision forewarning technology, lane departure warning system (LDWS).

This paper describes about two vehicle collision avoidance techniques, which are as follows

1. Blind spot monitoring technique and
2. Drowsiness detection technique.

A. Blind spot monitoring technique

Blind spot[3] is the area where the driver cannot observe properly during driving, as mentioned in fig.1, due to many factors like head rest, pillar obstacle, passenger height etc., and many accidents occur due to sudden overriding of vehicles in the blind spot region. Hence this area needs to be monitored and obstacle needs to be detected.

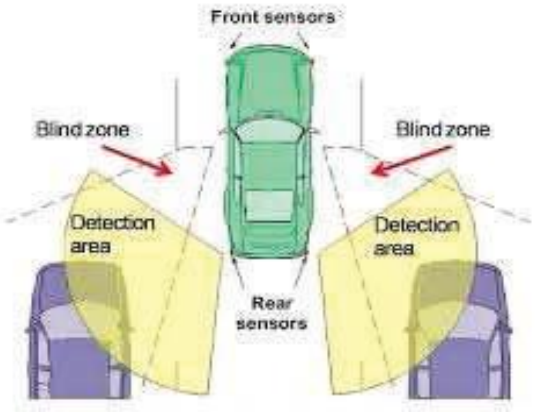

Figure 1. Blindspot Monitoring

Driver's negligence at the blind spot region needs detecting the obstacle and providing the image of the vehicle in order to warn and avoid the accidents. This system detects many obstacles, like pedestrian crossing suddenly, cars overtaking etc. and the driver is alerted. The system uses the ultrasonic sensor [3] to check the blind spot for an impending collision on the vicinity of the vehicle. The overtaking of vehicles is a big factor where accidents happen in the blind spot area. Mirrors become helpless during this situation and there could be a technology to avoid the collision on the blind spot during overtaking, lane switching etc. The system uses the ultrasonic sensors around the vehicle to detect the incoming obstacle in the specified range and sensor feedback is given to the raspberry pi microcontroller as to give the image of the vehicles to the driver, and warn by giving buzzer sound.

B. Drowsiness Detection Technique

Distracted driving as in fig.2 is one of the main causes of vehicle collisions. Passively monitoring driver's activities

constitutes the basis of an automobile safety system that can potentially reduce the number of accidents by estimating the driver's focus of attention[1].The driver's activeness will be detected by using MATLAB software[2] and the buzzer sound is produced as a warning to the driver by making the vehicle ignition system off.

The proposed system does not require any driver-dependent calibration or manual initialization, during day or night. We conducted a comprehensive experimental evaluation under a wide variety illumination conditions and facial expressions.

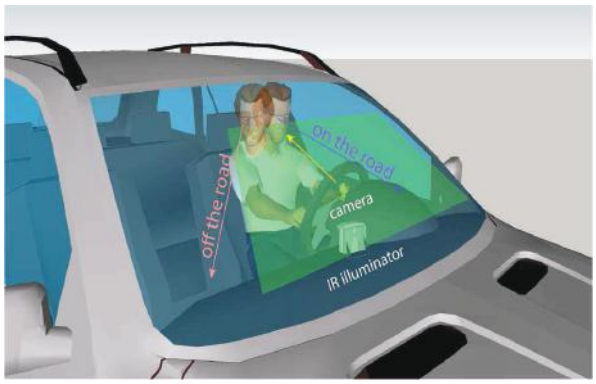

Figure 2. Drowsiness Detection

C. Block Diagram

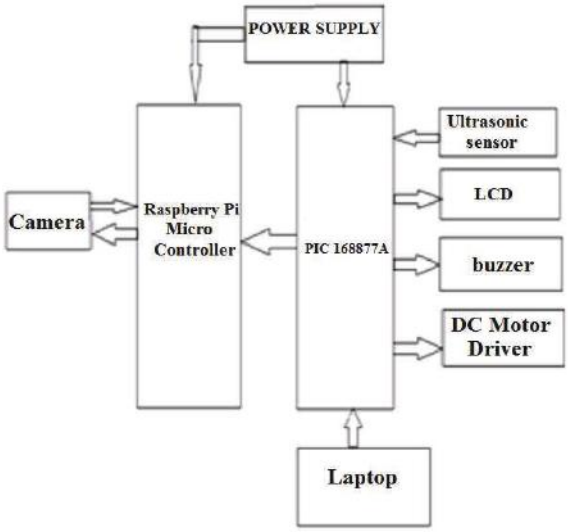

Figure 3. Block Diagram

The above fig.3 shows the block diagram[5] of the system prototype where the microcontrollers are interconnected to each other for communicating between themselves. Raspberry pi microcontroller is used to control the camera and to rotate it in the direction of the obstacle whenever, any obstacle is detected in the blind spot region.

II. METHOD

The schematic diagram fig.4 of explains the interfacing section of each component with PIC16F873A further to Raspberry pi and input output modules. PIC16F873A is used as the micro controller where it is interfaced with the ultrasonic sensor, crystal oscillator, IC L293D for controlling DC motor, buzzer, laptop, LCD, reset button, raspberry pi 3 B+ micro controller with ARM11 processor.

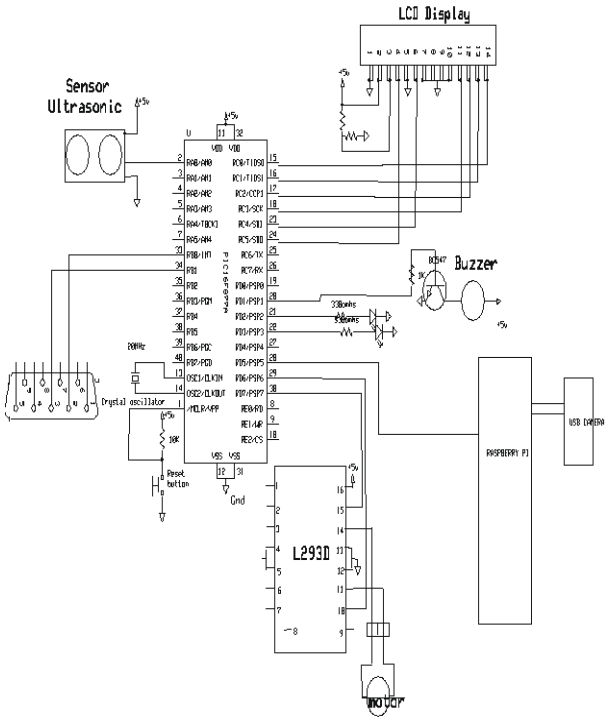

Figure 4. Schematic Diagram

A. Ultra sonic Sensor

It is connected to the pin2 (RA0) and works as input to PIC16F877A.When RA0=1 then, obstacle is detected.

B. Buzzer

Buzzer acts as the output module. It is connected to pin20 (RD1/PSP1) and works as output to PIC16F877A. When RD1/PSP1=0 buzzer gives sound indicating abnormal condition such as blind spot or drowsiness detected.

C. L293D

ICL293D acts as output of PIC Controller and as input for the DC Motors. It is connected to pins 29(RD6/PSP6) and 30(RD7/PSP7) works as output to PIC16F877A.It is used to control two motors where one for ignition system and the other for the camera rotation.

D. Laptop

Laptop acts as the input to the PIC Controller. Pins 2 and 3 of laptop are connected to the pins 33(INT/RB0) and 34(RB1) of PIC16F877A respectively. Laptop with MATLAB software is used to process the images of the face, detected by the camera, continuously in drowsiness detection system and to transmit information as 0 or 1 to controller.

E.LCD

Liquid Crystal Display acts as the output module. Pins 4, 6, 11, 12, 13, and 14 of LCD are connected to pins

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15(RCO/T1OS0), 16(RC1/T1OS1), 17(RC2/CCP1), 18(RC3/SCK), 23(RC4/SD1), and 24(RC5/SD0) of PIC16F877A respectively. These pins act as outputs to display text on LCD.The texts are displayed as follows

1. "system ok vehicle moving" when the vehicle is in normal movement.
2. "blindspot detected vehicle stop" when the obstacle is detected in the blindspot area.
3. "drowsiness detected vehicle stop" when the system finds that driver is sleepy.

F. Raspberry pi

Pin28(RD5/PSP5) of PIC16F877A is connected to raspberry pi as input to capture image of the obstacle detected in the blind spot region and to send to the respective mail id.

G. Flowchart for Blindspot Monitoring

Embedded C language is used as programming language and simulated using the proteus7 software on LINUX operating system. The flow of software execution is as shown in fig.5. The ultrasonic sensor is assigned to the pin2 (RA0) which detects the obstacle and passes the information to the PIC controller as follows.

When,

1. RA0=1, the obstacle is said to be detected.

The motor driver gets off giving buzzer sound.

The rotating camera stops, captures the image of the obstacle and sends to the respective mail id.

Red led will glow, then text will be displayed on LCD as "blindspot detected".

2. RA0=0, the obstacle is not detected.

The motor driver remains ON.

Green led will glow then text will be displayed on LCD as "system ok vehicle moving".

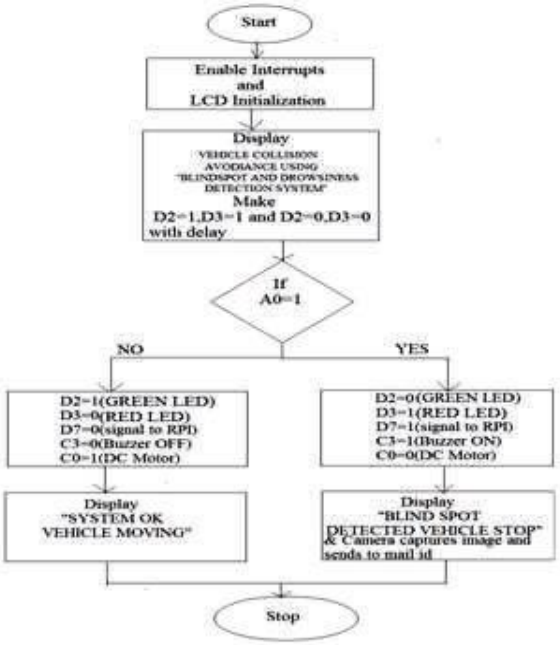

Figure 5. Flowchart for Blindspot detection

H. Flowchart for Drowsiness Detection

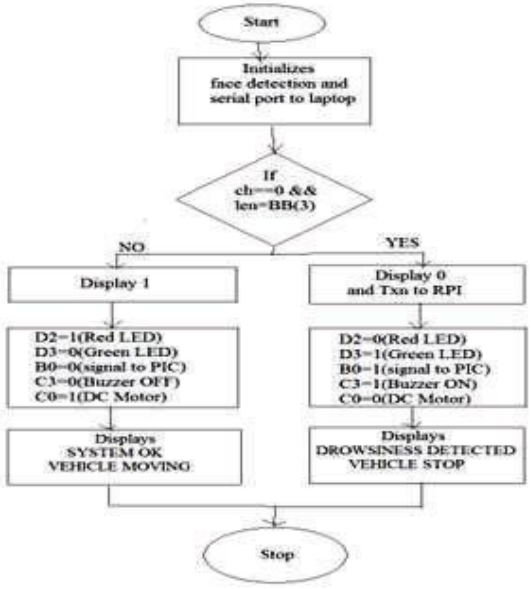

Figure 6. Flowchart for Drowsiness Detection

MATLAB software is used to implement the drowsiness detection method. The process of the face detection is as shown in fig.6, where the MATLAB programming is as follows,

1. Camera information[4] will be given as

Camera_name = winvideo,

Camera_id=1and

Format=YUY2_320X240.

2. Face detection with parameters as

Max size= [20 60]

Scalefactor=1.5 and

Merge threshold=10.

3. Initialization of serial with specified com port and checking for the condition of Ch==0 which indicates absence of face before camera to capture. This information is sent to raspberry pi to stop the motor driver.

4. The PIC controller takes the information as the external interrupt and stops the main programming execution and makes the ignition system off, since ch==o indicates the absence of driver before the steering.

III. RESULTS

The"Vehicle Collision Avoidance Using Blindspot Monitoring and Drowsiness Detection in Automobiles" is designed so that obstacles can be detected from distance and the presence of the driver while driving is observed to take preventive measures to avoid accidents. The project prototype is as below; when the system is normally moving then to indicate it text is displayed on LCD as "SYSTEM OK VEHICLE IS MOVING" as in fig.7.

Figure 7. System Prototype

A. Blindspot monitoring

When the obstacle is detected by ultrasonic sensor in the blind spot region, the buzzer sound is given as warning along with red LED, displays text on the LCD as "BLINDSPOT DETECTED VEHICLE STOP" and makes the DC Motor off as in fig.8.

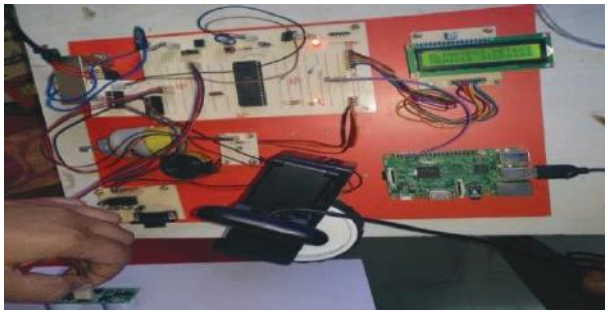

Figure 8. System when obstacle is detected in blindspot

Camera on RASPBERRY PI which is mounted on rotating DC Motor will rotate in the direction of the obstacle detected, and captures the image of obstacle and sends email successfully to the specified mail id as shown in fig.9, in order to make the driver aware of the obstacle in the blind spot.

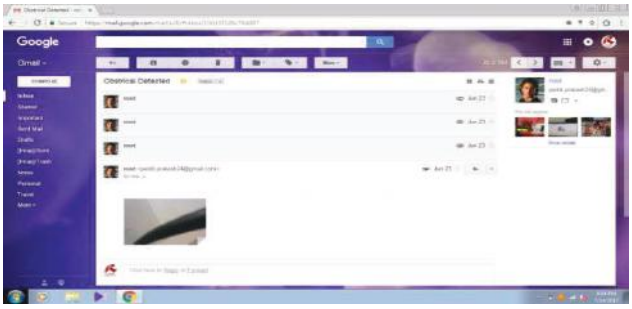

Figure 9. Captured image of obstacle in blindspot

B. Drowsiness detection

The USB camera keeps monitoring the face which is considered as the region of interest (ROI) and the image is computed using MATLAB to make sure about the presence of the driver in the position, indicating 1 when the face is found and indicating 0 when the face is not found, as shown in fig.10.

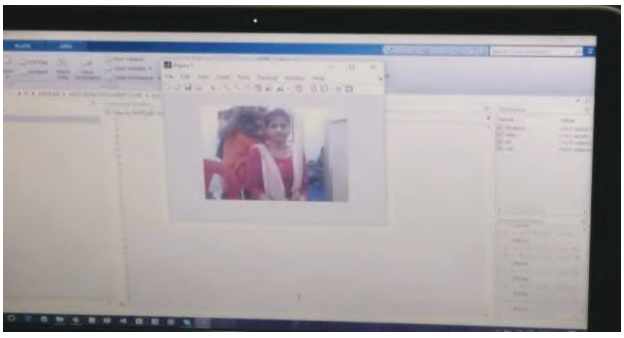

Figure 10. Image processing of face in matlab

When drowsiness of the driver is detected, the information from PC is sent to the controller through the serial communication; Then the driver is given buzzer sound as a warning and the DC Motor driver of vehicle will gets off displaying "DROWSINESS DETECTED VEHICLE STOP" as shown in the fig.11.

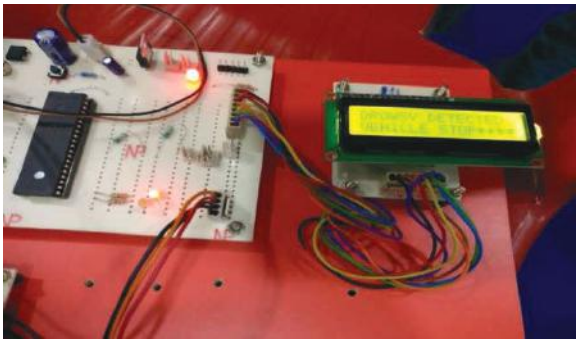

Figure 11. System when drowsiness is detected

In this paper "Vehicle Collision Avoidance Using Blindspot Monitoring and Drowsiness Detection in Automobiles" is mainly intended to control accidents using automated techniques with ARM11 processor. The project can be further extended by wireless modules using GPS.

The Blindspot monitoring is also made at night times using the night vision camera to capture obstacle at night times. The drowsiness detection could be extended as security system using the face detection technique in MATLAB software.

This paper can be extended using high efficiency GSM and GPS modules. We can find the location of particular object through SMS, so that sometimes we can easily identify the object time and place easily. And also by adding multiple sensors (like metal and obstacle sensors) to the system, we can use this moving robotic arm as multifunctional system used for finding the metal objects or bombs, further we can auto control robotic arm using obstacle sensor.

IV. CONCLUSIONS

In this paper we discussed the two automated preventive techniques to avoid the vehicle accidents with driver negligence while driving. The Blindspot Monitoring technique avoids accidents during lane divergences especially, for heavy vehicles like trucks and goods carrying

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vehicles. The Drowsiness Detection technique uses MATLAB for processing and, makes sure that driver's eyes are on the road while driving, to avoid collision. Integrating features of all the hardware components used, have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit.

Secondly, using highly advanced microcontroller i.e., Raspberry pi with the help of growing technology made our project highly reliable, the project has been successfully designed, tested and implemented.

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