AUTOMATIC EMEGENCY BRAKING SYSTEM

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3rd year	*3rd year*	*3rd year*	*2nd year*	*2nd year*	*2nd year*	*2nd year*
Mechanical	*Mechanical*	*Mechanical*	*Mechanical*	*IT*	*ECE*	*Mining*

I. Abstract

There are increasing number of accidents due to over speeding and sometimes due to unavoidable circumstances like panic and failure of driver to apply brake suddenly . To curb this, automakers tried to design a system which would warn the drivers if its is on a collision path and also react on its own if driver fails to do so. Automatic Emergency Braking System (AEBS) is a safety system that can identify when a possible collision is about to occur and responds by autonomously activating the brakes to slow a vehicle prior to impact or bring it to a stop to avoid a collision. The technology commonly uses radar, cameras, or LiDAR to identify threatening situations.

II. Introduction

Automatic Emergency Braking System (AEBS) is a safety system that uses signal transmission to detect and locate possible obstacles ahead and assist the driver in applying brakes. It is very necessary now a days due to the increasing number of rear-side collisions due to over speeding and sometimes due to unavoidable circumstances such as pedestrians, cyclists and stray animals. It is better to have a safety measure ready to go in case the driver fails to detect the obstacle or unable to apply the brake manually.

III. Problem Statement

Our goal is to create a smart functional braking system , which assists the driver in detecting the obstacle ahead and if required also helps in braking if the driver fails to do so. The process might involve sudden braking and there by chances of the passengers experiencing jerk , but that is not our matter of concern as our main goal is to save lives rather than providing comfort.

IV. Literature Review

The Idea of the project was inspired by a research paper produced by Department of Electronics and Communication Engineering,Amrita School of Engineering,Coimbatore, Amrita Vishwa Vidyapeetham, AmritaUniversity, India . In that paper the autonomous emergency braking using two radar sensors with different angle of coverage was implemented. The synthetic radar data is generated by radar detection generator block available in AEBTestBench simulation module. AEBTestBench is autonomous emergency simulation module available in Matlab 2018b version under ADAS toolbox. The research paper aimed to calculate the distance between two veichle , one in front of other by sending and receiving radar signals. Using some particular decelaration value of cars , the stopping time and minimum stopping distance was calculated. Car going beyond minimum stopping distance results in automatic braking.

Our project uses ultrasonic sensors to detect approaching obstacle and codes involved in the project allow it to react accordingly(transition between Manual and Automatic braking) depending upon the speed of car , obstacle distace and status of applied brake.

V. Working of AEBS

The AEBS setup has an Ultrasonic Sensor which detects for any obstacle in the way . Incase the obstacle comes critically closer to the vehicle it warns the driver by visual audio signals. If the manual brake is applied by the driver is enough to stop the vehicle there is no need for the AEBS system to function further. But if the manual brake is not applied sufficiently or not applied at all, in that case the AEBS comes into picture and applies the brake automatically. Application of manual or automatic brakes are recognized by different visual(LED) and audio(buzzer) signals.

VI. Methodology

To undertake this project, complete understanding of working of AEBS was needed. For that, examples from real life was taken. For e.g., Volvo has employed this system in their trucks and we saw several footages of how this system works, both inside the vehicle cabin as well as outside. To implement this on a small scale, Arduino microcontroller was used. This is one of the easiest ways to implement such small- scale automated projects.

To do this project, it was divided into two main parts: first part being to create the simulation on Tinker CAD and the second part being to implement that on a physical model.

(1) Tinker CAD was used to simulate the Arduino board. A servo motor was used for implementing brake system and some LED's which let us know about the status of AEBS either engaged or disengaged. Virtual Breadboard was used for connecting wires , LEDs , Ultrasonic sensors. The ultrasonic

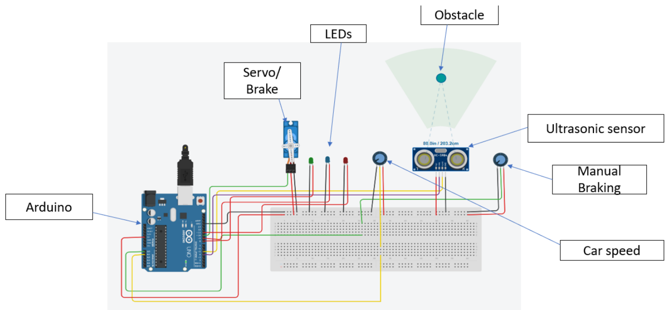

Fig. 1. Tinker CAD simulation model

sensor in Tinker CAD simulation has a range of 350 cm . Also speed and Braking of the car was controlled by potentiometer having range from 0-179 . Thus the speed of operation (0-100 kmph) and stopping/threshold distance was scaled to match the Tinker CAD simulation environment.

(2) In physical model implementation, servo motor was not used, instead direct supply cut to motors. Also, more no. of LED's are attached to easily know the status of the car's functioning. Buzzers were also used for audio signals. The physical model code was designed to controll the motors by bluetooth module , where the speed and braking can be controlled from mobile app. Real arduino and breadboard was used for connection. LEDs and buzzers were connected for signals. Batteries were coonected to power the wheel motors and also the arduino.

VII. Working of Simulation Model

In our Tinkercad code we have divided the car speed in to different ranges like 1-5, 6-15, 16-30, ..., 91-100.

We apply switch cases for this ranges to obtain minimum required value of stopping distance, the warning offset distance . In each case we deal with several conditions like

i) Warning from an offset distance

ii) If the brake is applied or not

iii) If it is applied , whether to maximum or not

iv) is there need of EBS or not...etc..

We use LEDs to notify each separate condition.

Let's say car is given some speed 4 kmph. In our code it lies in the range 1-5 , for which the warning distance is 16.5 and braking distance is 15. If the obstacle enters within the warning distance the warning LED starts blinking ,prompting the driver to apply brake.

CASE 1: If the manual brake is applied completely enough, the Manual LED turns on and AEBS is not used.

CASE 2: If even after the warning the manual brake is not applied and object comes within braking distance, then the AEBS is applied and the corresponding LED turns on.

CASE 3: If the manual brake is applied but not completely, the rest is done by AEBS. So in this case both Manual and AEBS work together to stop the vehicle.

VIII. Building Physical Model

AIM:

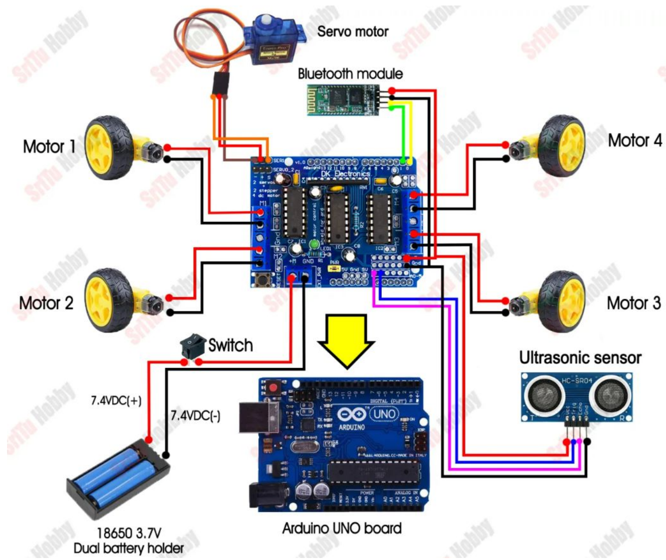

Fig. 2. Circuit Diagram of Physical Model

To build a fully functional working model of the simulation model we had made earlier.

COMPONENTS AVAILABLE:

- An ultrasonic sensor to measure the distance to an obstacle
- A set of LEDs
- A buzzer to provide visual and audio feedback to the driver
- A motor controller to control the movement of the car.

CODE: Code should be able to drive the motors and servo for speed and braking force.

LIBRARIES NEEDED:

- AFMotor library for the motor controller
- Servo library for the servo motor.

SOFTWARE SETUP:

It then defines various pins and variables, including the trigger and echo pins for the ultrasonic sensor, the motor pins for the motor controller, and the LED and buzzer pins.

In the setup() function, the code sets the various pins as inputs or outputs and initializes the serial communication.

1)The code checks for input from serial communication and stores it in a variable.

2)If input is 'F', the car moves forward; if input is 'B', it stops.

3)Ultrasonic sensor measures distance to obstacle and stores it in a variable.

4)Potentiometer determines car speed and a switch statement checks if it's between 1 and 5 kmph.

5)If distance to obstacle is between 10 and 15 cm, the code warns driver with LED blink and low-frequency alarm.

6)If distance is less than 10 cm and car speed is less than or equal to 5 kmph, it simulates automatic braking with LED blink and high-frequency alarm.

7)Two functions sound low- and high-frequency alarms using a buzzer.

8)forward() function moves the car forward; brake() function stops it and sounds an alarm.

HARDWARE SETUP:

1) A piece of wooden plate of suitable length and breadth was cut and filed properly in the workshop to act as chassis of the car .

2) Motors and breadboard were attached to it by glue gun. Holes were drilled for proper wire connections . Wheels were attached to motors.

3) Ultrasonic sensor was attached in the front to detect obstacles.

4) LEDs and Buzzers were connected for visual and audio signals.

5) Bluetooth controller was connected for controlling the speed and braking directly from mobile.

IX. Novelity

Besides producing a life saving system like AEBS our project was also able to achieve another milestone called ADAS LEVEL-1 .Advanced Driver Assistance System. To achieve this 3 ultrasonic sensors were attached , one in the front , other two on each sides. Whenever car detects an obstacle applying brake may not be best idea every time because it comes with the risk of following cars to collide to the rear. So the sensors on the sides check for any obstacles present or not , if not the car turns from the original straight line path (by changing rpm of the obstacles) and cross the obstacle from the sides. If the sides are packed then it has to brake.

X. Future Work

The possible future work in this project may be implementing more advanced technology like ADAS LEVEL-2 , which will make the car more automatic and self operating . This autopilot like features will make driving easy for the driver and a lot of lives can be saved each year.

XI. References

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