

Arduino Based Anti-Collision and Automatic Braking System for Vehicles

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Abstract— This system is proposed to reduce number of road accidents which have been increased drastically over the past years. Majority of road accidents are due to collisions with stationary objects or moving objects. The task of collision avoidance system here is to track objects of potential collision risk and determine an action to avoid collision. The basic idea here is to improve the safety measurements of the vehicle by using advanced systems available in the field of electronics and automobile. This is an Atmega328P microcontroller based system which uses ultrasonic sensor and IR sensor for braking mechanism. The controller of the vehicle measures the distance ahead continuously using the ultrasonic module. Further the system checks measured distance against the respective car's ahead distance through wireless module, simultaneously IR sensor checks the RPM of wheel, which then is converted into speed (km/hr). If the received distance found to be less than a particular limit and its corresponding speed limit satisfies the condition of collision then this system provides a warning to the driver when there is an imminent collision. When the distance between car and obstacle goes beyond limit with respect to the speed, then the braking system gets activated. Here, the servo motor performs mechanism to apply the brakes on wheels by rotating its shafts, thereby stopping the vehicle.

Keywords: Collisions Avoidance System; ATmega328P microcontroller; Ultrasonic Sensor; IR Sensor; RPM of wheel

I. INTRODUCTION

Driving is a common activity for most of the people. The number of vehicles are increasing day by day. Now-a-days, the technology has got vast changes which leads increase in speed. The speed plays vital role to maintain time for longer distances. But, this speed is getting a major problem which causes road accidents. Accidents may occur everywhere and cause worst damage, injuries also.

Causes of Road Accidents are:

- **Over Speeding:** Most of the fatal accidents occur due to over speeding. Increase in speed multiplies the risk of accidents and severity of injury during accident.
- **Distraction to Driver:** Though distraction while driving could be minor but it can cause major accidents. Distractions could be outside or inside the vehicle. Talking on a mobile phone while driving, adjusting mirrors while driving and stereo in vehicle may leads to cause accident.
- **Road and Weather Condition:** Heavy rainfall, windstorms and fog are responsible for more weather related crashes. Poor road conditions like potholes, diversions and damaged road can lead to car accidents. Accidents are mostly caused by the delay of the driver to hit the brake.

To prevent the accidents, the designing of anti-collision and automatic braking system is as follows:

In collision avoidance system, warning will be given to driver in the form of sound signal. There is a threshold safe distance calculated by the system and if the driver fails to respond even when the vehicle crosses that region, then only brakes will be applied automatically. This automatic braking system allows the vehicle to brake without support of the driver. This is a technology for automobiles to sense an imminent forward collision with another vehicle or obstacle. This system includes ultrasonic sensor which measures distance between vehicle and obstacle with the help of ultrasonic waves and slot type IR optocoupler sensor which measures RPM; which is then converted into speed. The microcontroller is used to control the servo motor based on detection of pulse information and the servo motor in turn automatically controls the braking of the vehicle. Thus, this system is designed to solve the problem if driver doesn't apply brake manually at the required time but vehicle will stop automatically by automatic braking system. To develop such a system ultrasonic sensor is used to measure distance and it is interfaced with Arduino UNO and through PWM signal input will be given to servo motor which applies brake automatically.

II. PROPOSED STRUCTURE

Everyone do not have perfect driving skills and this can cause road accidents. Many people die in road accidents per hour in India. One could do a lot to make the road safer, that's why there is a need for developing a system to avoid road accidents. "Anti-collision and Automatic Braking System for vehicles" reduces possibility of collision. This system helps to control speed of vehicle. This system may increase safety of both the driver and the passengers. Basically, this collision avoidance system reduces the possibility of collisions and number of road accidents. Road Transport is the primary mode of transport which plays an important role in conveyance of goods and passengers and linking the centers of production, consumption and distribution. It is also a key factor for promoting socio-economic development in terms of social, regional and national integration. The road transportation increases year by year, but the rate of road crashes also increases with it. India is one of the developing countries, where the rate of road crashes is more than the critical limit. Road accidents are a human tragedy which involve high human suffering. Road collisions are the second leading cause of death for people between the ages of 5 and 29 and third leading cause for people between 30 and 44. Every year 1.24 million people die in road accidents around the world. Therefore, there is an alternative solution for this known problem by developing low cost domestic anti-collision warning system model that would be mounted on the existing car models and alert the driver in danger zone.

The main components of Anti-collision and Automatic Braking system for Vehicles are ultrasonic sensor,

slot type IR optocoupler sensor, Microcontroller and Servo Motor. The block diagram is as shown (Fig.1) below:

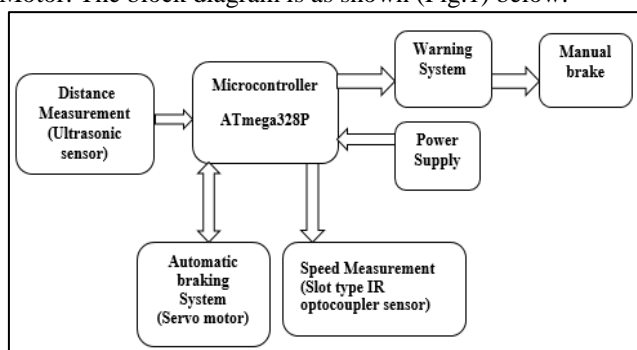


Fig. 1: Block Diagram

In this system when ultrasonic sensor senses an obstacle, then it executes the operation in two modes. In collision avoidance system, sensors detect the possibility of collision with respect to threshold distance and its corresponding speed, which is calculated using slot type IR optocoupler sensor, but will not take immediate action. A warning will be given to the driver through buzzer and display. There is again threshold safe distance (stopping distance) calculated by system which is less than first threshold distance and if driver fails to respond, when the vehicle crosses that distance, then only brakes will be applied automatically. Here, the decision to apply brakes is left with the driver and brakes are applied automatically only in emergency situations. The main aim of this system is to avoid any sort of collision due to negligence of the driver, this will be completely avoided by this braking technique.

ATmega328P Microcontroller is the central processing unit of system. It accepts all the inputs and take corresponding action. Distance measurement block calculates the distance between the vehicle and the obstacle which is in the forefront direction of the vehicle with the help of ultrasonic sensor HR-SC04. Speed of vehicle is calculated with the help of slot type IR optocoupler sensor, which measures the RPM of wheel and this RPM is converted into speed with the help of a formula. Automatic braking system gets activated when the vehicle crosses a particular threshold distance. Servo motor is used to stop the wheels of vehicle by moving its shaft. Warning system carries out the work of alerting the driver with help of buzzer and LCD. The buzzer provides an audible sound with respect to conditions of speed and the distance while LCD displays a warning message. Altogether, when these components are assembled, the blocks performs as a system. It takes inputs from sensors, executes different actions with respect to given conditions and provides warning or applies brakes as per the instruction given by the microcontroller.

This procedure is explained using following flowchart (Fig.2).

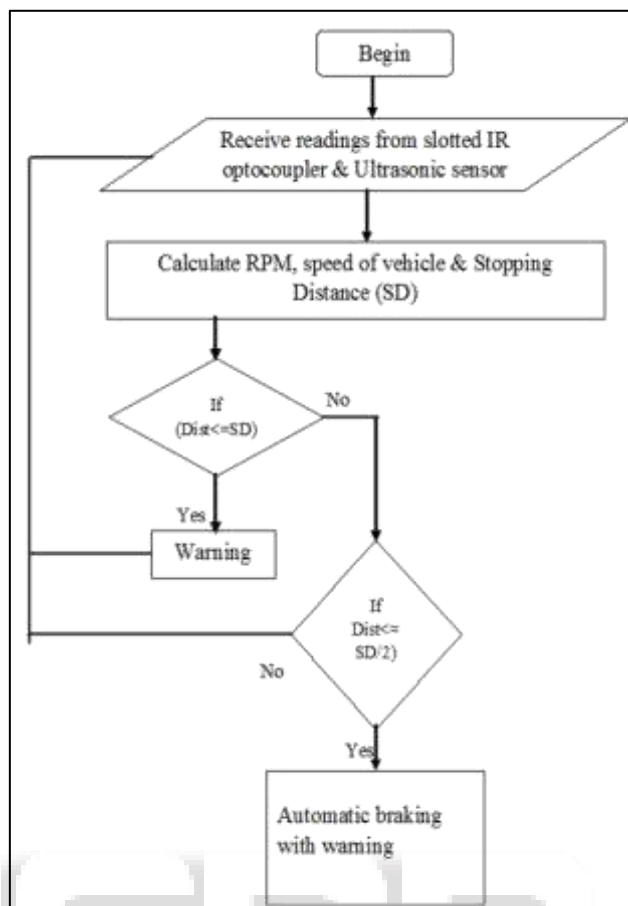


Fig. 2: Flowchart

The Arduino Integrated Development Environment - or Arduino Software (IDE) is used for programming a microcontroller. It contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them. The Arduino IDE software is easy to install and is has very simple user interface which makes it easy to understand. Also, some sample programs are available in it which makes it user friendly software.

III. RESULTS AND DISCUSSION

The motive behind this project is to analyze the causes of road accidents and providing a solution over it so that the possibility of collision gets reduced. Anti-collision device is a distance detection device meant to be incorporated into vehicles safety. This system serves a warning which indicates that conditions of collision are detected. These conditions are derived from the inputs of ultrasonic sensor and slot type IR optocoupler sensor. The system is developed with help of ATmega328P microcontroller. Braking system comes into the picture when conditions of imminent collision gets detected. Servo motor is used for stopping the wheels and thereby acting as the braking system for vehicles.

Once the robot is ready, with all the components mounted on it, it will behave as per the following steps:

A. Step 1: Initial Stage

Initially, the robot is in steady state. When power supply is provided to the system, it will start receiving inputs from sensors. (Shown in fig.3 Initial Stage)



Fig. 3: Initial Stage

B. Step 2: Warning stage

At this stage, the condition for warning is fulfilled which is the distance between robot and car is less than or equal to 50 cm. Here, a buzzer noise is observed as warning which is used to alert the driver. (Shown in Fig. 4 Warning Stage)



Fig. 4: Warning Stage

C. Step 3: Breaking stage

Here, breaking mechanism which is served by servo motor, gets activated. The servo motor gets rotated by 40 degrees, applies brakes to wheels, thereby stopping the vehicle. (Shown in Fig. 5 Breaking Stage.)



Fig. 5: Braking Stage

This system performs according to the three stages which are initial stage, warning stage and breaking stage. The different results and actions are taken with respect to the conditions which are provided these stages.

IV. CONCLUSIONS

This was a proposed idea for the system that represents anti-collision and automatic braking system for forward collision avoidance. This system consists of sensors namely ultrasonic wave emitter and receiver that is ultrasonic sensor, which is basically used for measuring distance between obstacle and the car. The ultrasonic sensor is interfaced with ATmega 328 (arduino UNO) where different conditions of speed gets checked with the help of slot type IR optocoupler sensor. According the conditions of distance and its respective speed, when distance between car and obstacle is less than a threshold value, first it gives a warning using display and buzzer. Secondly when the distance between car and the obstacle is beyond threshold value the system automatically applies brakes with the help of servo motor. Thus this system reduces the chances of collision on roads. Hence this system not even saves lives but also it reduces economic losses which may happen due accidents. This solves the problem of safety in case of the obstacle is in forward direction of the car.

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