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Research paper

Reactive Braking System

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Abstract

This paper is based on the simplifying technique of the existing technology called Autonomous Emergency Braking (AEB) by using a simple electronic setup which can be easily installed in all the existing four-wheelers without changing its existing working system. By using this technology, the number of accidents due to human errors can be avoided in large scale for both the drivers and the pedestrians. This project aims to reduce the errors caused by the improper braking of the driver.

Keywords: *Arduino; Board coding; Emergency Braking; Human error; Sensor.*

1. Introduction

We are born in a world where the inventions are deficient, and accidents caused by them are sufficient. So, it is the responsibility of an engineer to develop a safety measure for the all defect causing inventions. Taking that responsibility in mind we are developing a gadget for all four wheelers to ensure the safety of the passengers and for the society by them. Autonomous emergency braking is the next in lane safety precaution for both the passengers and pedestrians and the concept that we are working on is to ensure the safety and also to make it reach every person's car.

This can be achieved by using a portable device or might as an attachment that can be fitted in your vehicle. It uses motors that control the vehicle's clutch and brake pedals in responding to the output of the sensors fitted on the vehicle. It comes as an external attachment to the vehicle and the technology is also cheap when compared with the cars that already come with Autonomous Emergency Braking system. No man or women want to spend his whole time traveling so he invented wheels. This has been growing till today with its full thrust to the latest car that has been launched in the market. A car has become so common. The present market scenario is that the manufacturers are concentrating on vehicle economy and its appearance. Its performance is being given a large priority compared to the assurance of safety in everyone buy. On the other hand, safety is nowadays offered only on the basis of price tag. This is not good for the vision to make a safe society. Thus, taking that in hand we are introducing a well-known system which can get used in each and every four-wheeler on road.

This may be a well-known system but this technology hasn't reached to everyone to its full potential. Thereby we take the responsibility to build an Autonomous Emergency Braking System for all the four wheelers possible. It comes as an external attachment to your already bought car. Cars that come with pre-installed Autonomous Emergency Braking are found to be very costly and it is only in higher ranged cars such as Benz and Volvo. This project will solve this problem, it not only reduces the cost, and it also makes itself available for all ranges of cars. All you've to do is buy the equipment and install it and it, in turn, ensures the safety of the driver and the passengers. The equipment is easy to install and use. It ensures your safety

2. Experimental Methodology

The process that we do to achieve AEB is pretty much simple and this setup makes use of both electrical and mechanical departments. We use two DC motors of 24 Volts to control the clutch and brake pedals. In this paper, we achieve braking action by controlling the brakes pedals instead of controlling the brake circuit. This is because controlling the circuit would require a larger accuracy than controlling the brake pedals. The normal act of braking involves a procedure in all the geared vehicles. So in order to obit that procedural braking the clutch pedal is also controlled along with the brake pedal. This project makes use of two DC motors of 24 Volts to control the clutch and brake pedals. The input for the motors comes from the motor driver which is in turn commanded by the Arduino boards that act by the input achieved from the distance sensors that is the ultrasonic sensors set in the vehicle.

The process is simple; the sensors measure the distance and give as the input to the Arduino boards which in turn activate the motors that control the clutch and braking pedals, based upon the distance between the vehicle and the obstacle different pressures are applied on the pedals due. This different pressure to the pedals is been achieved by giving different input powers to the motor at different distances between the car and the obstacles.

As the project makes use of the Arduino board to act as a controller for this setup this has to be fed up with a coding or a command.

Fig. 1: Flow chart of Ultra-sonic sensor coupled with Arduino board

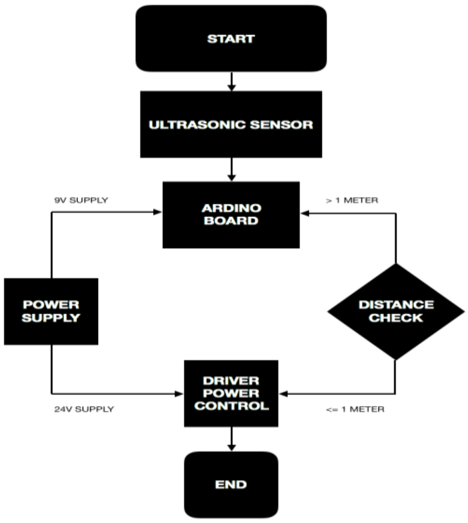

Fig.2: Flow chart for working of Reactive Braking System

3. Results and Discussion

Experimentation is done using Arduino board coding. The coding is similar to that of C language. The experimentation on the coding has been performed for many number times in order to calculate the proper results.

3.1. Evaluation using Arduino Board Coding

```
Const int DIR1 = 7;
Const int DIR2 = 8;
Const int PWM1 = 10;
Const int PWM2 = 9;
Const int trig1Pin = A0;
Const int echo1Pin = A1;
Long duration1 = 0, cm1 = 0;
Char flag2 = 0;
Void setup ()
{
Serial.begin (9600);
pinMode (DIR1, OUTPUT);
digitalWrite(DIR1, LOW);
pinMode(DIR2, OUTPUT);
digitalWrite(DIR2, LOW);
analogWrite(PWM1, 0);
analogWrite(PWM2, 0);
}
Void loop ()
{
pinMode(trig1Pin, OUTPUT);
digitalWrite(trig1Pin, LOW);
delayMicroseconds(2);
digitalWrite(trig1Pin, HIGH);
delayMicroseconds(10);
digitalWrite(trig1Pin, LOW);
pinMode(echo1Pin, INPUT);
duration1 = pulseIn(echo1Pin, HIGH);
cm1 = microsecondsToCentimeters(duration1)
If ( (cm1 >= 0) && (cm1 < 25) )
{
If (flag2 == 0)
{
flag2 = 1;
Serial.print ("1"); Serial.print ("1->");
Serial.print("100"); Serial. Print ("2->");
Serial.println("100"); digital Write (DIR1, LOW);
digitalWrite(DIR2, LOW);
analogWrite(PWM1, 255);
analogWrite(PWM2, 255)
Delay (1000);
Serial.print(" 1 "); Serial.print("1->");
Serial.print("000"); Serial.print(" 2->");
Serial.println("000"); digitalWrite(DIR1, LOW);
digitalWrite(DIR2, LOW);
analogWrite(PWM1, 0);
analogWrite(PWM2, 0);
Delay (1000);
Serial.print(" 0 "); Serial.print("1->");
Serial.print("100"); Serial.print(" 2->");
Serial.println("100"); digitalWrite(DIR1, HIGH);
digitalWrite(DIR2, HIGH);
analogWrite(PWM1, 255);
analogWrite(PWM2, 255);
Delay (1000);
Serial.print("0"); Serial.print("1->");
Serial.print("000"); Serial.print("2->");
Serial.println("000");
digitalWrite(DIR1, HIGH);
digitalWrite(DIR2, HIGH);
analogWrite(PWM1, 0);
analogWrite(PWM2, 0);
}
}
Else if ((cm1 >= 25) && (cm1 < 50) )
{
Serial.print("1"); Serial.print("1->");
Serial.print("100"); Serial.print("2->");
Serial.print("050");
digitalWrite(DIR1, LOW);
digitalWrite(DIR2, LOW);
analogWrite(PWM1, 255);
analogWrite(PWM2, 128);
Delay (1000);
flag2 = 0;
}
Else if ( (cm1 >= 50) && (cm1 < 75) )
{
Serial.print(" 1 "); Serial.print("1->");
Serial.print("050"); Serial.print(" 2->");
Serial.print("025");
digitalWrite(DIR1, LOW);
digitalWrite(DIR2, LOW);
analogWrite(PWM1, 128);
analogWrite(PWM2, 64);
Delay (1000);
flag2 = 0;
}
Else if ((cm1 >= 75) && (cm1 < 100) )
{
Serial.print (" 1 "); Serial.print ("1->");
Serial.print ("025");
Serial.print(" 2->"); Serial.print ("000");
Digital Write (DIR1, LOW);
Digital Write (DIR2, LOW);
Analog Write (PWM1, 64);
Analog Write (PWM2, 0);
Delay (1000);
flag2 = 0;
}
Else if (cm1 >= 100)
{
Serial.print (" 1 "); Serial.print ("1->");
Serial.print ("000");Serial.print(" 2->");
Serial.print ("000");
digitalWrite(DIR1, LOW);
digitalWrite(DIR2, LOW);
```

```
analogWrite(PWM1, 0);
analogWrite(PWM2, 0);
flag2 = 0;
}
Serial.print(" "); Serial.println(cm1);
}
Long micro seconds To Inches (long microseconds)
{
// According to Parallax's datasheet for the PING))),
There are
// 73.746 microseconds per inch (i.e. sound travels at 1130 feet per
// second).  This gives the distance travelled by the ping, outbound
// and return, so we divide by 2 to get the distance of the obstacle.
Return microseconds / 74 / 2;
}
Long micro seconds To Centimeters (long microseconds)
{
// the speed of sound is 340 m/s or 29 microseconds per centime-
ter.
// the ping travels out and back, so to find the distance of the
// object we take half of the distance traveled.
Return microseconds / 29 / 2;
}
```

3.2. Coding Details

DIR	= Direction
PWM	= Pulse Width Modulation
LOW	= Clockwise direction
HIGH	= Anticlockwise direction
Delay	= Time to be delayed
M1	= Clutch control
M2	= Brake control

3.3. Code Description

The code is designed and formulated according to the available range of sensor i.e. 1 meter. Let us discuss it in detail about the function of the code. Initially, we have decided the directions to be controlled along with the Pulse with Modulation (PWM). Then the ranges are set as 1, 0.75, 0.5 and 0 meters. For each range, the limits are designed in a manner by which the pedals are to be controlled. It is to be noted that the end results from these codes are used to control two motors used in this project. These motors, in turn, take control of the brake and cutch pedals directly.

Consider an object that is far away from the sensor i.e. above one meter, then the board will not allow any type of power supply to the motors. There by the both the pedals are at ideal stage. Now when the obstacles are around the range distance in between 1 meter to 0.76 meters, then the board will send the power supply to the motors. The power supply is given in a manner by which M_1=25% and M_2=00%. It is also given a delay time of 1 second to stop the further movement beyond the limit necessary. This delay time could be calibrated according to the necessary point.

Similarly, the code has been developed to send different capacity of power at a different distance. In order to avoid the malfunction or error caused by excess rotation, the delay period has been assigned. This delay period also can be calibrated.

When the obstacle is removed the motor is allowed to rotate in opposite direction in order to release the attached string to the pedal. This is also controlled with the help of the delay time which can also be calibrated as per requirement.

3.4. Working of Reactive Braking System

The setup consists of three important components that include two Sewing motors, an Arduino board with a motor driver and a switched mode power supply and ultra-sonic distance sensors that are set in the required positions of the vehicle. Based on the distance between the obstacle and the sensor set in the vehicle signals are sent to the Arduino board and they, in turn, activate the motor driver which drives the motor.

M_1 is the motor that is connected to the clutch pedal and M_2 is the motor connected to the brake pedal. When the obstacle is probably coming near sensor motor M_1 is activated and the clutch pedal is gradually pressed and after the obstacle comes very close M_2 is activated and in turn brake pedal is pressed. As the distance between the obstacle and the vehicle decreases the force applied on the pedals increased and after applying the full force and after the vehicle comes to a halt the pedals return back to their original position as the motors activating them are Sewing motors and they work that way.

The code is designed and formulated according to the available range of sensor i.e. 1 meter. Let us discuss it in detail about the function of the code. Initially, we have decided the directions to be controlled along with the PWM. Then the ranges are set as 1, 0.75, 0.5 and 0 meters. For each range, the limits are designed in a manner by which the pedals are to be controlled. It is to be noted that the end results from these codes are used to control two motors used in this project. These motors, in turn, take control of the brake and cutch pedals directly. Consider an object that is far away from the sensor i.e. above 1 meter, then the board will not allow any type of power supply to the motors. There by both the pedals are at ideal stage. Now when the obstacles are around the range distance in between 1 meter to 0.76 meters, then the board will send the power supply to the motors. The power supply is given in a manner by which M_1=25% and M_2=00%. It is also given a delay time of 1 second to stop the further movement beyond the limit necessary. This delay time could be calibrated according to the necessary point.

Similarly, the code has been developed to send different capacity of power at the different distance. In order to avoid the malfunction or error caused by excess rotation the delay period has been assigned. This delay period also can be calibrated. When the obstacle is removed the motor is allowed to rotate in opposite direction in order to relax the attached string to the pedal. This is also controlled with the help of the delay time which canals be calibrated as per requirement. This is the basic working of this AEB setup we call it Reactive braking system. It is very cheap compared to other AEB's that come pre-installed in high-end four-wheelers.

4. Performance Analysis

The braking has been successfully achieved within the stopping distance. This is how Arduino board combined with Arduino software and with help of sewing motors can be used as a reactive braking system.

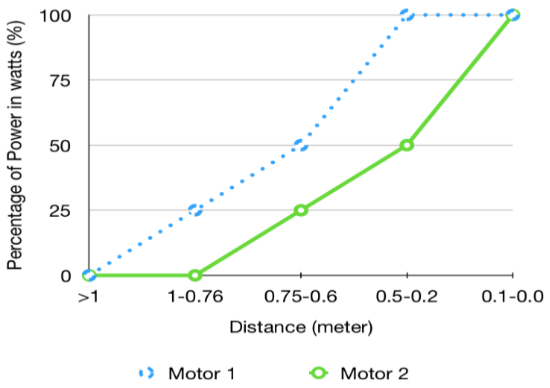

Fig. 3: Graph between Percentage of power and distance

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5. Conclusion

The Reactive Braking System (RBS) works properly and tested by using an obstacle right in front of the sensor. The sensor accordingly measured the distance between the intended object and the vehicle and sent out proper commands to the Arduino setup, which in turn activated the motors that stops the vehicle.

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