Automated braking system for cars which accelerates and decelerates the car proportional to its stopping distance using ultrasonic distance sensor.

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Abstract: Rear-end collision is the most common type of vehicle accidents in which front of vehicle crashes into the rear of another vehicle. Increasing number of vehicles has promoted, lot such accidents in recent years. Although lot of driver assistance systems are developed which includes automatic breaking, rear-end collisions cannot be completely avoided. This paper aims to provide information about a new concept of automatic breaking in which the system uses ultrasonic distance sensor to detect the distance between the car and the vehicle in front of it, and in proportion to the distance between two it applies the brakes. The distance from which the system starts applying the brake is a pre-set value equal to the car's stopping distance. The sensor continuously detects the road and when a vehicle or obstacle comes in the range equal to the stopping distance of car, it starts applying the brakes so that the car comes to rest position before it hits another vehicle or obstacle. As distance between the two keeps on reducing the intensity of braking increases and when the distance between them increases, the system releases the brakes and accelerates the vehicle again.

INTRODUCTION:

Car's stopping distance is the distance which car travels in the time period between the moment the driver observes the obstacle, applies the brake and the moment, car comes to rest position. Stopping distance is the sum of Thinking distance and Braking distance.[1] Thinking distance is the distance the car travels when the driver observes an obstacle in his way and think of applying brakes. Braking distance is the distance the car travels after the driver starts applying the brakes and the car come to complete rest position. Stopping distance can be calculated by formula $D= S^2 / (250 X f)$, where "D" is stopping distance in meters, "S" is speed in km/hr ,"250" is fixed constant and "f" is coefficient of friction, usually 0.8 for dry asphalt roads [7]

METHODOLOGY:

This system is installed directly in legroom of the driver and it engages with the brake and clutch pedals of the car. Two servo motors (MG996r) are engaged with brake and clutch pedals through rack and pinion arrangement. The ultrasonic distance sensor (HC SR04) is installed in the front of the car. Both servomotors and ultrasonic sensor are connected to Arduino (Nano/Pro mini) which controls the entire system as shown in figure.1 the sensor

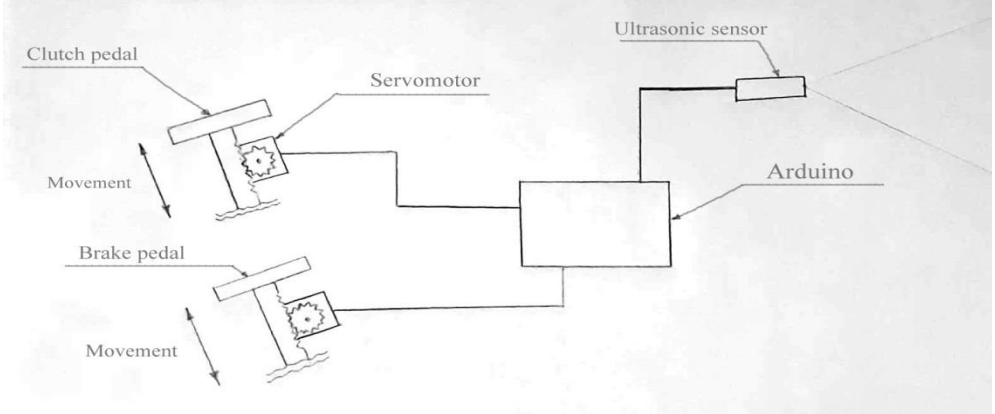
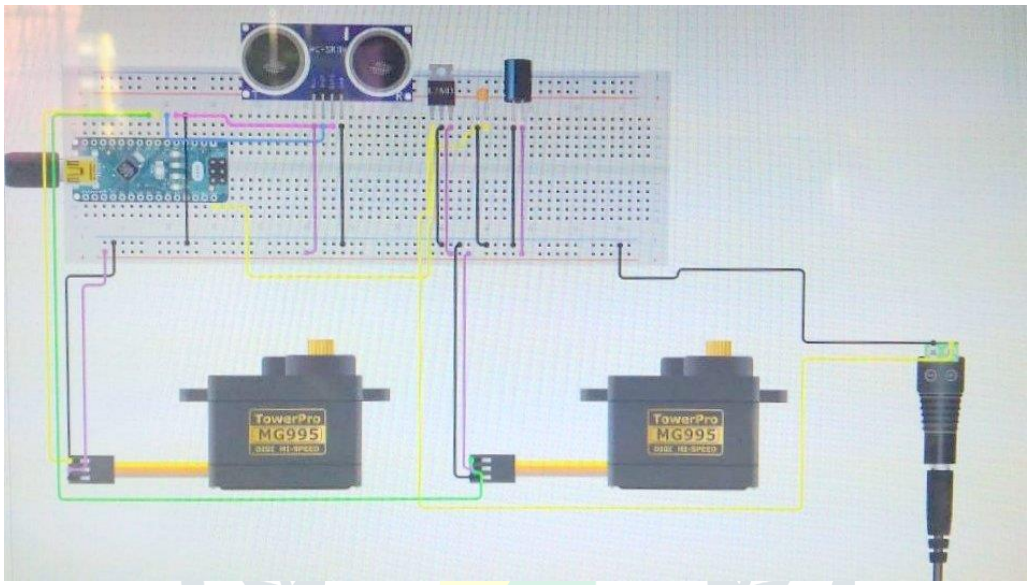


Fig. 1

Continuously senses the road in front of car as shown in figure 2. Whenever an obstacle or a vehicle comes in the range of ultrasonic sensor (range equal to stopping distance of a car) it gives signals to Ardunio and in turn arduino actuates the servomotors. The servomotors turn through certain angle (value of turning angle is a pre-set value equal to the intensity of breaking required proportional to the speed at which the distance is reducing between car and obstacle).The turning of pinion on motor shaft results in the vertical to and fro movement of brake and clutch pedals. The arduino first actuates the servomotor on the clutch pedal, The movement of motor

Circuit diagram of system



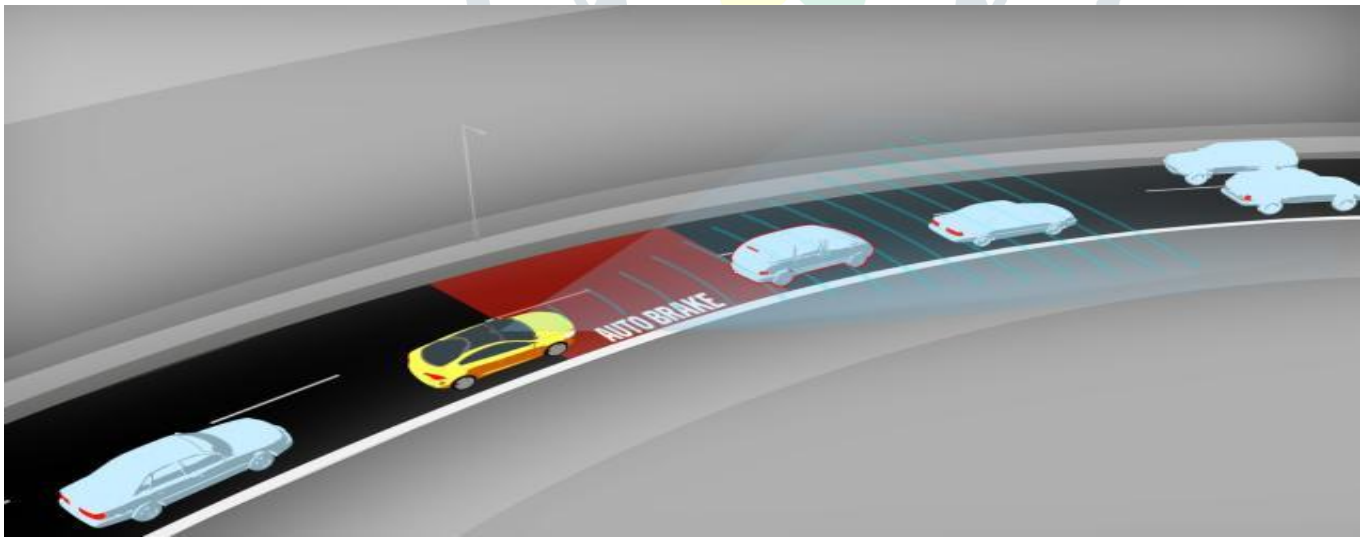


Fig.2

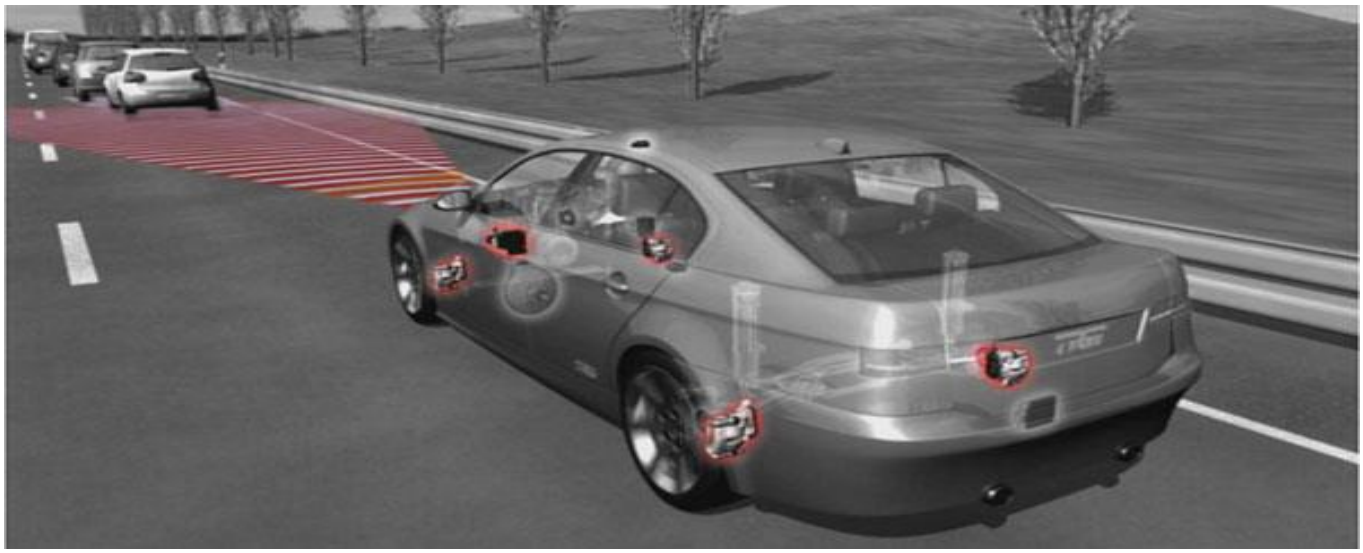


Fig.3

moves the clutch pedal downwards which result in disengagement of clutch and then the arduino actuates the motor on the brake pedal, the movement of motor moves the brake pedal downwards which results into application of brakes as shown in figure 3. And when the obstacle moves out of the range of ultrasonic sensor (as in the case when the vehicle in front suddenly applies brake, it comes in range of sensor of the car and when this vehicle in front depress the brake and accelerates again, it moves out of the range of sensor) the sensor send signals to arduino circuit in turn arduino actuates the motors resulting into release of brakes and then the engagement of clutch. A standard speed limits is to be fixed for this system to work on, otherwise the system will keep on fluctuating the speed of car for any range. This system can be programmed to be actuated when the certain speed limit has been crossed. Stopping distance for an average car running at 80km/hr is 10 meters. Thus this system can be programmed to get activated when the speed of 80 km/hr is crossed or reached. When activated at this speed, the sensor will send signals to central controller to apply brakes when any obstacle comes within the range of 10 meters in front of car.

An arduino program for above system is shown below-

```
const int trigPin = 9;
const int echoPin = 10;
int clutch_servo = 2;
int brake_servo = 3;
// defines variables
long duration;
int distance;

void setup() {
pinMode(trigPin, OUTPUT);  // Sets the trigPin as an Output
pinMode(echoPin, INPUT);  // Sets the echoPin as an Input
pinMode(brake_servo, OUTPUT);
pinMode(clutch_servo, OUTPUT);
}
void loop() {
// Clears the trigPin
digitalWrite(trigPin, LOW);
delayMicroseconds(2);
// Sets the trigPin on HIGH state for 10 micro seconds
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
// Reads the echoPin, returns the sound wave travel time in microseconds
duration = pulseIn(echoPin, HIGH);
// Calculating the distance
distance= duration*0.034/2;
```

```
if(distance<1000){            //turn on if distance is less than 1000 cm
distance = map(distance, 0, 1000, 255, 0);  //converts the distance to 8bit value
} else(distance = 0);  // if distance is > 1m, do nothing
if (distance >= 0 || distance <= 255){  //if distance is between 0-1m
  digitalWrite (clutch_servo, HIGH);  //activate clutch
  analogWrite (brake_servo, distance); // brake accordingly
}
else {              // else do nothing
  digitalWrite (clutch_servo, LOW);
  digitalWrite (brake_servo, LOW);
}
}
```

RESULTS: This system can be implemented in cars and it will provide an automatic breaking with greater accuracy thus providing better assistance to driver. Using the arduino as a central controller it is possible to design such a system .The method by which this system controls the speed of vehicle is its distinguishing feature.

FUTURE SCOPE: More refinements in the system design and programming can be done by using better controllers, processors and specially designed servomotors for this application. Same system can be designed with greater accuracy by which it senses the obstacle and applies the brakes; more research can be done on the same to improve the braking in various situations of driving, road conditions and during steering.

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