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Arduino Based automatic Vehicle Control

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Abstract:
The objective of this research is to develop a system to keep the vehicle secure and protect it by the occupation of the intruders. The aim is automatically controlling the speed of vehicle and accident avoidance using arduino and ultrasonic sensors. Arduino mega 2560 is used to create the path through programing. The programed path is fed into the Arduino which is followed by the vehicle. Whenever any obstacle is detected by the running vehicle, depends on distance automatically control the speed of vehicle. The ultrasonic sensor system continuously sends signals and monitors any car or other obstacles are in front of vehicle. The distance up to which ultrasonic sensor can work may be up to 4 m. When any obstacle or vehicle is detected by ultrasonic sensor system, it will send signal to the embedded board. After receiving this signal embedded board sends a signal to the motor to reduce the vehicle speed automatically which can control vehicle speed immediately. Vehicle is controlled automatically without any manual operation when the obstacle is at 4 m distance away from the front vehicle. In critical cases, if vehicle is met into accident GSM send a message to the user.

Keywords: Arduino mega 2560, automatic vehicle control, Infrared Sensor (IR) sensor, Ultrasonic sensor Global System for Mobile communication (GSM)

1. Introduction

An automatic vehicle control system is designed to reduce the severity of an accident. Also known as pre-crash system, forward collision warning system or collision mitigating system. It uses radar and sometimes laser sensors to detect an imminent crash. Once the detection is done, it takes action autonomously without any driver input (by braking).

The path planning problem is one of the most interesting research topics. The aim of the path planning is to search a safe path for the automatic vehicle. Also, the path is required to be optimal. In this project work, an algorithm is developed based on free segments. Also, a turning point strategy for solving the problem of path planning in a static environment is presented. The aim of the turning point approach is to search a safe path for the automatic vehicle, to make the automatic vehicle moving from a starting position to a destination position without hitting obstacles. This proposed algorithm handles two different objectives which are the path safety and the path length. Finally, code results show that the developed approach is a good alternative to obtain the adequate path.

The main objectives of this research work are as follows. To design a program-based path following vehicle using Arduino mega 2560 with collision avoidance system.

To develop an automatic speed control of vehicle and accident avoidance.

To design a path for the automatic vehicle using Arduino mega 2560.

To develop a prototype for the proposed model.

Section 2 describes the components and their specifications of the proposed model.section 3 illustrates the software implementation of automatic vehicle using Arduino mega 2560.section elucidates the hardware implementation of the proposed model.section 5 briefs about the conclusions and future scope.

2. Components

Solar panel

The term solar panel is used colloquially for a photo-voltaic (PV) module. Photo-voltaic cells use sunlight as a source of energy and generate direct current electricity. A collection of PV modules is called a PV Panel, and a system of panels is an Array. Arrays of a photovoltaic system supply solar electricity to electrical equipment. The figure 1 shows the solar panel.The specifications of solar panel is represented in table 1 .

Table 1 Specifications of solar panel

Voltage	12 V
Power	2 Watts

Figure 1: Solar panel

Motor

DC motor is any of a class of rotary electrical motors that converts direct current electrical energy into mechanical energy. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current in part of the motor. DC motors were the first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems. The figure 2 depicts the DC gear motor. The specifications of DC gear motor is represented in table 2 .

Table 2 Specifications of DC gear motor

Motor Type	DC with Gear Box, Metal Gears
Base Motor	DC 3000 RPM
Shaft Type	6mm Dia 23 mm shaft Length
Maximum Torque	~3 Kg-cm at 12V
RPM	100 RPM at 12V
Weight	130 Gms
Max Load Current	~330mA at 12V

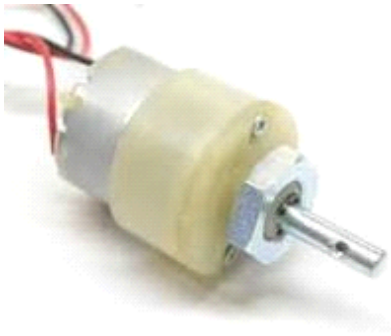

Figure 2: DC gear motor

Sensor

A sensor is a device, module, machine, or subsystem whose purpose is to detect events and send the information to other electronics, a computer processor. A sensor is always used with other electronics.

(a) Ultrasonic Sensor (HC-SR04)

Ultrasonic sensors measure distance by using ultrasonic waves. The sensor head emits an ultrasonic wave and receives the wave reflected back from the target. Ultrasonic Sensors measure the distance to the target by measuring the time between the emission and reception. The figure 3 depicts the ultrasonic sensor. The specifications of ultrasonic sensor is given in table 3 .

Table 3 Specifications of ultrasonic sensor

Power Supply	+5V DC
Quiescent Current	<2mA
Effectual Angle	<15°
Ranging Distance	2cm – 400 cm
Trigger Input Pulse width	10uS

Dimension	45mm x 20mm x 15mm

Figure 3: Ultrasonic sensor

(b) IR Sensor

An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called a passive IR sensor. The specifications of IR sensor is given in table 4.

Table 4 Specifications of IR sensor

Operating Voltage	3.0V – 5.0V
Detection range	2cm -30cm
Current Consumption	3.3V : ~23 Ma 5.0V : ~43 mA
Active output level	Outputs Low logic level when obstacle is detected.

(c) Vibration Sensor (SW-420)

A vibration sensor is a transducer used to detect abnormal vibration of an industrial machine that may be indicative of mechanical problems. The piezo vibration sensor or charge mode accelerometer measures vibration based on the piezoelectric effect. The specifications of vibration sensor is given in table 5.

Table 5 Specifications of vibration sensor

Operating voltage	3.3V / 5V
Interface	Digital
Size	L: 40mm W: 20mm H: 10mm
Weight	4.3g

GSM (800A)

GSM is a mobile communication modem; it stands for global system for mobile communication (GSM). GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands. The figure 4 depicts the GSM module. The specifications of GSM module is given in table 6.

Table 6 Specifications of GSM module

Weight	40 gm
Input Voltage	9V-12V DC
Dimensions	100 x 53 x 15 (L x W x H)mm.

Figure 4: GSM module

Arduino

Arduino refers to an open-source electronics platform or board and the software used to program it. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online.

Arduino Mega 2560

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560 (datasheet). It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. The figure 5 depicts the pin configuration of ARDUINO Mega 2560 board.

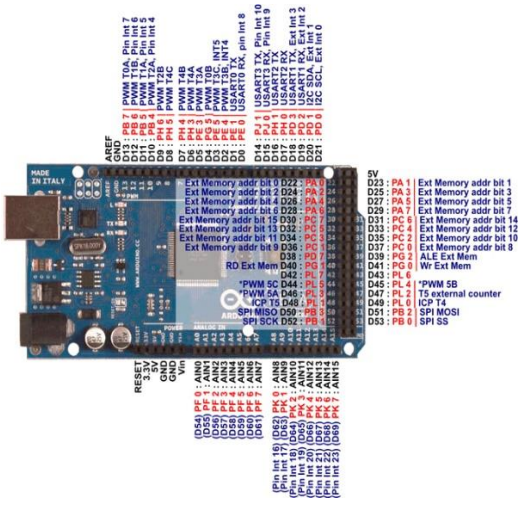

Figure 5: ARDUINO Mega 2560 board

Relay

A relay is an electrically operated switch. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals. Relays are switching that open and close circuits electromechanically or electronically. Relays control one electrical circuit by opening and closing contacts in another circuit. The figure 6 depicts the pin diagram of relay. The specifications of relay is given in table 7.

Table 7 Specifications of relay

Voltage	5V
Rated Load	7A/250V
Number of Pins	5
Contact	SPDT
Switching capacity	7A

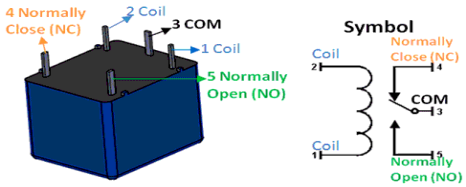

Figure 6: Pin diagram of relay

3. Software Implementation

This section illustrates the software implementation of automatic vehicle control using Arduino Mega 2560.

Program Used To Avoid Collision

The components which are controlled by this code are:

- Ultrasonic sensor
- Vibration sensor
- GSM module
- Buzzer
- Relay circuit

Program

```
#include <SoftwareSerial.h>

SoftwareSerial mySerial(9,10);//tx,rx

int vib_pin1=4;

int led_pin=13;

int vib_pin2=5;

int trigPin1 = 11;    // Trigger

int echoPin1 = 12;    // Echo

int trigPin2 = 42;    // Trigger

int echoPin2 = 43;    // Echo

long x,y,cm;

void setup()

{

  Serial.begin (9600);

  pinMode(trigPin1, OUTPUT);

  pinMode(echoPin1, INPUT);

  pinMode(trigPin2, OUTPUT);

  pinMode(echoPin2, INPUT);

  pinMode(trigPin3, OUTPUT);

  delay(100);

}

void loop()

{

  if(cm1<=20)

  {

  Serial.print(cm1);

  Serial.print("cm");

  Serial.println();

  }

  if(cm2<=20)

  {

  Serial.print(cm2);

  Serial.print("cm");

  Serial.println();

  }

  delayMicroseconds(250);

  digitalWrite(trigPin3 , LOW);

  delayMicroseconds(5);

  digitalWrite(trigPin3 , HIGH);

  delayMicroseconds(10);
```

```
 digitalWrite(trigPin3 , LOW);
 pinMode(echoPin3 , INPUT);
 if(cm3<=20)
 {
 Serial.print(cm3);
 Serial.print("cm");
 Serial.println();
 }
 delayMicroseconds(250);
 digitalWrite(trigPin4 , LOW);
 delayMicroseconds(5);
 digitalWrite(trigPin4 , HIGH);
 delayMicroseconds(10);
 digitalWrite(trigPin4 , LOW);
 if(cm4<=20)
 {
 Serial.print(cm4);
 Serial.print("cm");
 Serial.println();
 }
 if( ( val1 == 1) &&( val2 == 1 ) )
 {
  digitalWrite(led_pin,HIGH);
  SendMessage();
  delay(2000);
 }
  else
  digitalWrite(led_pin,LOW);
  delay(100);
}
void max4(int a, int b, int c, int d)
{
int min0, max0, max1, max2, min1, min2;
if (a > b) // 1
{
   max1 = a;
   min1 = b;
}
else
{
   max1 = b;
   min1 = a;
}
if (c > d) // 2

else
   max0 = max2;
if (min1 < min2) // 4
   min0 = min1;
else
   min0 = min2;
if((min0<10)&&(min0>= 0))
 {
   digitalWrite(led, HIGH);
 }
 if((min0<20)&&(min0>= 10 ))
 {
delay (1000);
}
```

Code Description

The above code is used to detect and to warn the obstacle to move away from the path, if the obstacle isn't moving away from the path of the vehicle using the relay circuit, the movement of the vehicle is stopped.

By the use of relay circuit we are avoiding the collision and warning sound is also given by the vehicle, to make the obstacle to move away from the path of the vehicle.

An 24V Intermittent Buzzer is used as horn to warn the obstacle, with the help ultrasonic sensor(HC-SR04) the distance between the obstacle is been

measured and further calculate in centimeters and then the calculated value is compared with the predetermined value.

```
duration= pulseIn(echoPin1,HIGH);
cm= (duration /2) / 29.1;
if(cm4<=20):
```

If the calculated value is less than the predetermined value, the Intermittent Buzzer is triggered using the relay circuit until the obstacle moves away from the path of the vehicle, if still the obstacle is on the path of the vehicle and the obstacle become closer to the vehicle, the complete motion of the vehicle is stopped by triggering the relay circuit where the overall supply to motor is stopped.

3.3 Program Used To Determine The Path

3.3.1 Components

The components which are controlled by this code are:

- IR sensor
- Motor
- Relay circuit

3.3.2 Program

```
int ir1=7;
int ir2=8;
int led1=12;
int led2=13;
int count1=0;
int count2=0;

void setup()
{
Serial.begin(9600);
pinMode(ir1, INPUT);
pinMode(ir2, INPUT);
}

void loop()
{
int a=digitalRead(ir1);
if (a == HIGH)
{
   count1++;
   Serial.print("Count: ");
   Serial.println(count1);
   delay(135);
 }
int b=digitalRead(ir2);
if (b == HIGH)
{
   count2++;
   Serial.print("Count: ");
   Serial.println(count2);
   delay(135);
 }}
 /*
 if(count1==15)
 {
  digitalWrite(led1,HIGH);
 }
 if(count2==20)
 {
  digitalWrite(led1,LOW);
 }
 if(count1==30)
 {
  digitalWrite(led1,HIGH);
 }
 if(count2==40)
 {
  digitalWrite(led1,LOW);
 }
 if(count1==45)
```

```
  {
   digitalWrite(led1,HIGH);
  }
  if(count2==60)
  {
   digitalWrite(led1,LOW);
  }
  if(count1==60)
  {
   digitalWrite(led1,HIGH);
  }
  if(count2==80)
  {
   digitalWrite(led1,LOW);
  }
}
  digitalWrite(led1,HIGH);
    }
    else
```

Collision Avoidance System

The collision avoidance system is shown in figure 8. The ultrasonic sensors are connected to arduino mega 2560 board. The algorithm for collision avoidance is uploaded in the arduino mega 2560 board.

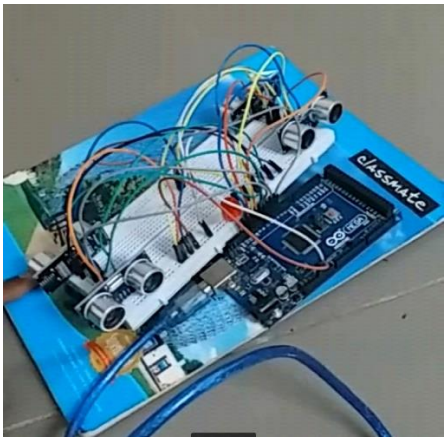

Figure 8: Collision avoidance system

GSM Module

```
    {
    digitalWrite(led1,LOW);
  }
```

Thus, the path following algorithm with collision avoidance is developed. The advantage of the developed algorithm is that the automatic vehicle always move from the initial position to the target position safely, and also without any accidents.

4. Hardware Implementation

This section explains the design and implementation of hardware setup of automatic vehicle control using Arduino Mega 2560.

Relay Circuit

The figure 7 depicts the relay circuit. The relay circuit is used to stop the motor or to indicate any vehicle is in the path (with an horn sound).

Figure 7: Relay circuit

In figure 9, gsm module and vibration sensors are used to indicate if there is any emergency situation like the vehicle is crashed. It intimates the situation by sending a message to the user.

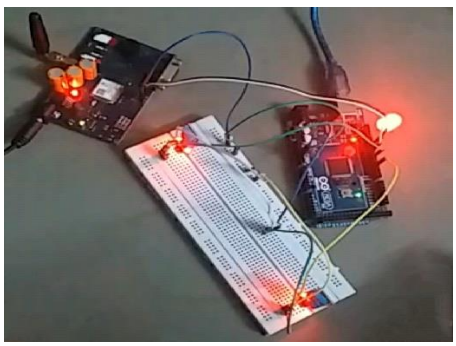

Figure 9: GSM module and vibration sensors

Thus the hardware setup for automatic vehicle control is successfully implemented using Arduino Mega 2560.

5. Conclusion And Scope

The project "Automatic Vehicle Control" using arduino Mega 2560, ultrasonic sensors, IR sensor has been successfully designed and tested.

Integrating features of all the hardware components have been used. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Secondly, using highly advanced IC's and with the help of growing technology the project has been successfully implemented.

The advantages such as low cost, less complexity, easy speed control, reliable and easy to impleme

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