

COLLISION AVOIDANCE SYSTEM USING ULTRASONIC SENSOR

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ABSTRACT

This paper describes automobile collision avoidance system by using of an ultrasonic sensor for a vehicle. We utilize the electronic systems application embedded in car that is anticipated to minimize the disaster of car accident. This paper is concentrating on developing a model of rear end car collision avoidance system that detects the gap among motors moving in the identical lane, inside the identical direction and alert the driver each time she or he is in danger range by using a microcontroller. The gap is measured via an ultrasonic sensor used to experience the obstacle beforehand.

KEYWORDS: collision avoidance system, ultrasonic sensor, microcontroller

1. Introduction

The enterprise approach for automobile safety structures has been evolving over the last two decades. To begin with, character passive devices and functions including seatbelts, airbags, knee bolsters, crush zones, and so on, were developed for saving lives and minimizing accidents while a twist of fate happens. Later, safety measure which include enhancing visibility, headlights, windshield wipers, tire traction, etc., have been deployed to lessen the chance of entering into an twist of fate. Now, we are on the stage of actively warding off accidents as well as providing most protection to the car occupants and even pedestrians. The systems which can be below severe improvement consist of collision avoidance systems (Megha & Srivani, 2016; Nyamati,

Chaudhuri & Jayavel, 2017). In this paper, we deal with advanced thoughts which include pre-crash sensing, an ultrasonic sensor is used to experience the item in front of the vehicle and gives the signal to the microcontroller unit. Based totally on the signal received from the ultrasonic sensor, the microcontroller unit is sending a signal to the braking unit for applying the brake automatically.

A vehicle or vehicle accident is a street traffic incident which typically involves one avenue vehicle being in collision with, either another car, or every other road user, or a desk bound street side object, and this may result in death, damage and/or belongings harm (Joukhadar, Issa & Kalaji, 2018; Sanjana, Wahid, Habib & Rumel, 2018).

It's far a famous truth that the socio monetary, physical and psychological crisis as a result of car accidents needs to be handled significantly. Diverse studies and research must be carried out to conquer this hassle (Hang, Han, Chen & Zhang, 2018).

This study is devoted to strive alternative solution for this recognized hassle by means of developing low value home anti-collision warning machine version that would be installed on the present automobile fashions and alert the motive force in danger zone. Consequently, rather than putting apart inbuilt energetic protection gadget development to the car producers, the person shall find ways to remedy the problem by growing home lively safety gadget model that could be advanced later to be fitted to street automobile despite their version and twelve months of making. The scope of the paper

entails designing, programming and implementing a vehicle collision avoidance system that is able to stop the vehicle before it hits an obstacle. A program is to be written to make sure the vehicle responds in real time. The work is implemented using a toy car.

2. System Design

The collision warning system designed in this paper consists of hardware and software parts. The hardware consists of construction of the paper circuit. The software part deals with the programming part of the paper.

The research consists of five units that is the power supply, the microcontroller, obstacle sensor, warning system and the motor driver system. The block diagram in Figure no. 1 shows the different units.

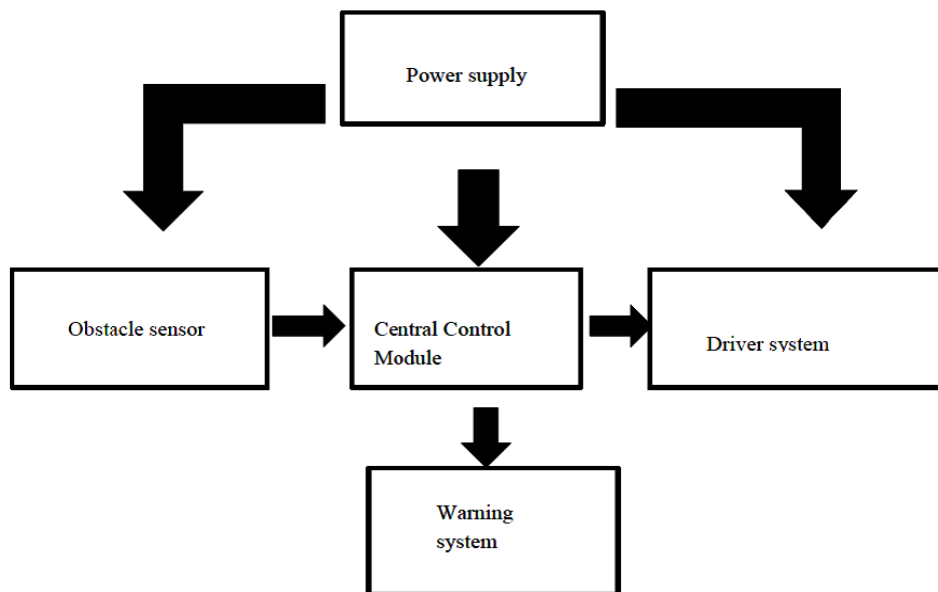


Figure no. 1: *Block diagram of control system*
(Source: Megha & Srivani, 2016)

2.1. Central Control Module

The microcontroller used is Atmega 328P. The interrupt pin one is used to receive the echo pulse from the sensor unit and the bit 1 pin of register is used to send the 10μs trigger pulse.

The external interrupt is activated when there is a change in the rising and falling edge.

This microcontroller is chosen because it is cheap and locally available. Figure no. 2 shows the pinout of the Atmega 328P.

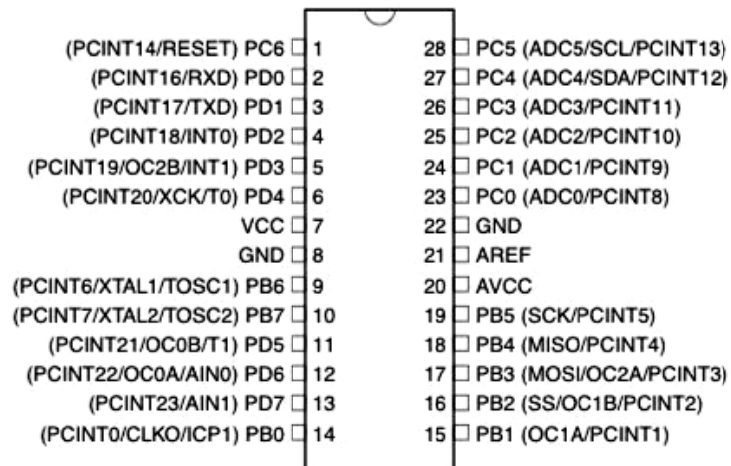


Figure no. 2: *Atmega 328P pinout*
(Source: Joukhadar, Issa & Kalaji, 2018)

2.2. Driver Circuit

The driver circuit consists of the following components:

- 9v battery
- H-bridge
- DC Motor

The DC Motor is already included in the toy car that draws a current of 0.08ms. The tip 122 is used to design the H-bridge because it has its own internal diodes. The maximum collector current allowed for tip122 is 5A. Thus, it is sufficient to drive the motor. The diagram in Figure no. 3 shows the driver circuit.

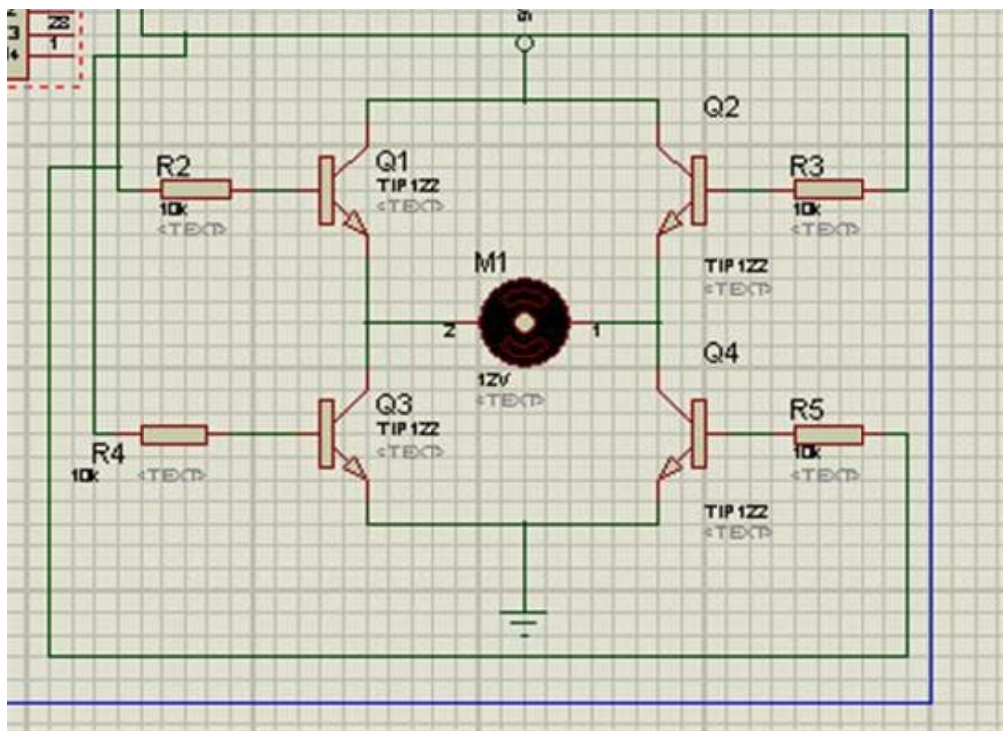


Figure no. 3: *Driver system*
(Source: Megha & Srivani, 2016)

2.3. Obstacle Sensing Unit

To make a successful obstacle sensing unit, the block diagram shown in Figure no. 4 is used.

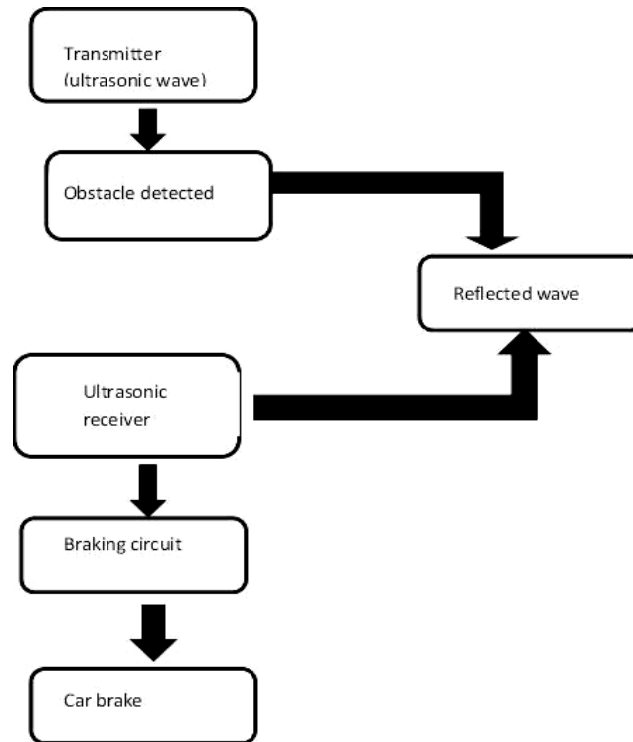


Figure no. 4: Block diagram of ultrasonic sensor
(Source: Nyamati, Chaudhuri & Jayavel, 2017)

The sensor has four pins that is VCC, ground, echo and trigger pulse. VCC and ground are connected to the respective pins in the microcontroller. The trigger pulse is connected to pin1 of PORT D while the echo pin is connected to pin 3 of PORT D. The operation of the sensing unit is as follows:

- Send a short, but long enough 10 μ s pulse on the trigger pin (module automatically sends eight 40KHz square wave);
- Wait for the echo line to go high;
- Time the length of the pulse that stays high.

The length of the pulse is directly proportional to distance. The range is then calculated using the following formula:

$$\text{Distance in centimeters} = \mu\text{s}/58$$

2.4. Warning System

The caution device used includes a Light Emitting Diode (LED) and a buzzer. The LED is utilized as pinnacle distance warning and comes with the aid of connecting an LED to the microcontroller output pin thru a series resistor of 220 Ω . The LED is consuming 20mA for regular brightness and the voltage drop across LED is about 2V. But the voltage at the microcontroller output is about 5V when the port is at logic one. As a result, a resistor is required to be linked in series with the LED. Hence, there may be a necessity to calculate a current limiting resistor value. Hence, if the output voltage of the port is 5V, to have a voltage drop of 2V, we need to drop 3V across the resistor. If we anticipate the current thru the LED to be 20mA, the resistance value may be determined as:

$$R = (5\text{v} - 2\text{v}) / 10\text{mA} = 150\Omega$$

The buzzer is used for the low level distance warning. It is connected directly to the microcontroller output pin.

2.5. Software Design

The software should be able to acquire data from the sensor, analyze the data and send the data to the peripheral devices. The software should be integrated into the microcontroller. The language used to program the microcontroller is C++. The program is written in AVR Studio.

2.5.1. Programming Environment

The programmer of choice is AVRISPmkII. This programmer is easy to use and very effective. Figure no. 5 shows the AVRISPmkII. This is the programmer that is used to load the program file to the microcontroller. Figure no. 6 shows the pinout of AVRISPmkII. The AVRISPmkII pins are connected to the corresponding pins in the ATMEGA328P microcontroller.



Figure no. 5: *AVRISP mkII programmer*
(Source: Nyamati, Chaudhuri & Jayavel, 2017)

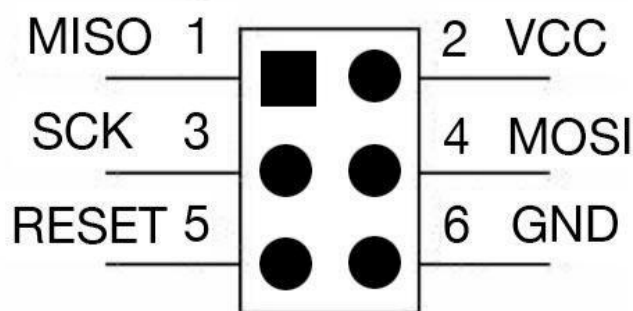


Figure no. 6: *AVRISPmkII pin out*
(Source: Megha & Srivani, 2016)

2.6. Final Design

The schematic of the circuit in Figure no. 7 is constructed on a breadboard and tested to meet the design specifications.

Once it is verified as working on the breadboard, a Printed Circuit Board (PCB) layout shown in Figure no. 8 is designed using PCB design software called Proteus.

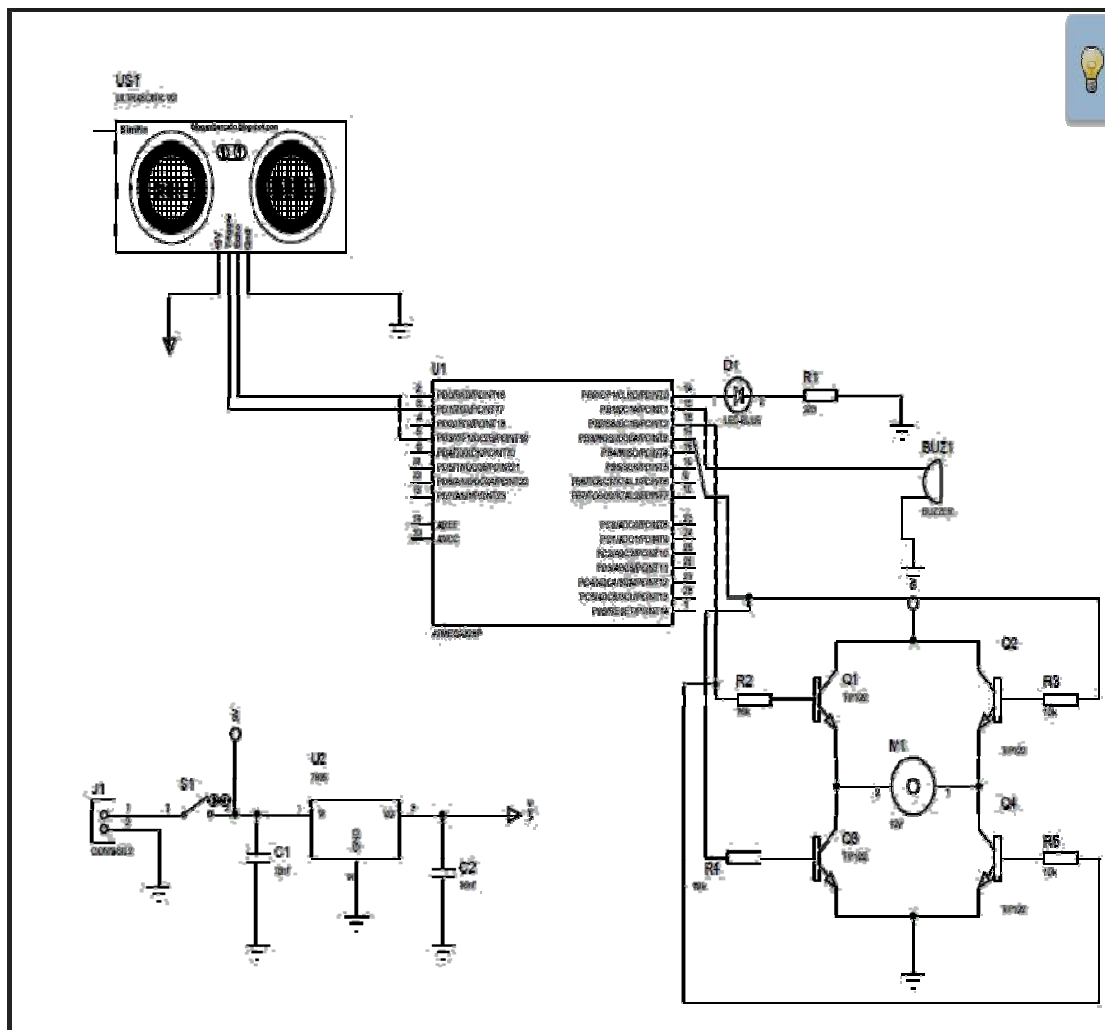


Figure no. 7: *Schematic of the system*
(Source: Author)

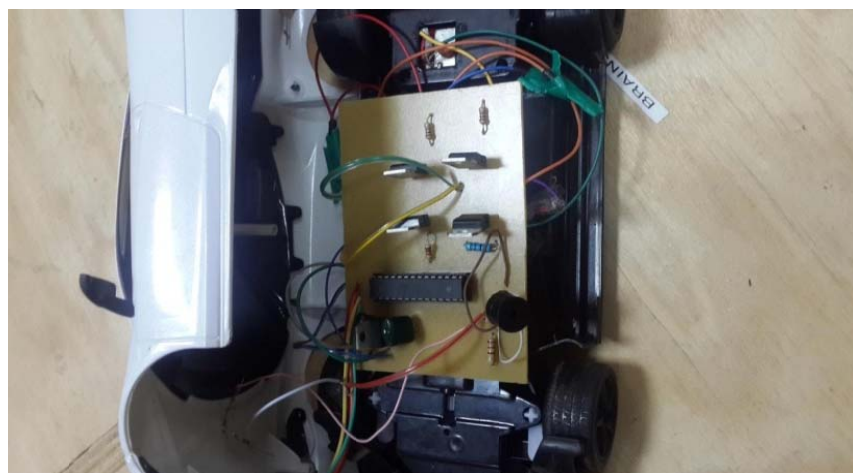


Figure no. 8: *Component view of PCB*
(Source: Author)

3. Results

3.1. Simulation of the Obstacle Sensor

The ultrasonic sensor is simulated by using a digital oscilloscope and a signal generator as shown in Figure no. 9. The signal generator simulator simulates the incoming square wave that the echo pin will receive. The incoming square wave that comes into the microcontroller is about 5V. The waves entering the trigger pin and

echo pin are observed in the oscilloscope. At the beginning, when the frequency is high, the motor rotated clockwise as the frequency is increased slowly, the LED goes ON simulating the top distance warning. As the frequency is continued to be increased, the buzzer goes ON simulating low level distance warning. Finally the motor stops rotating at high frequency simulating the distance that is less than 20 cm.

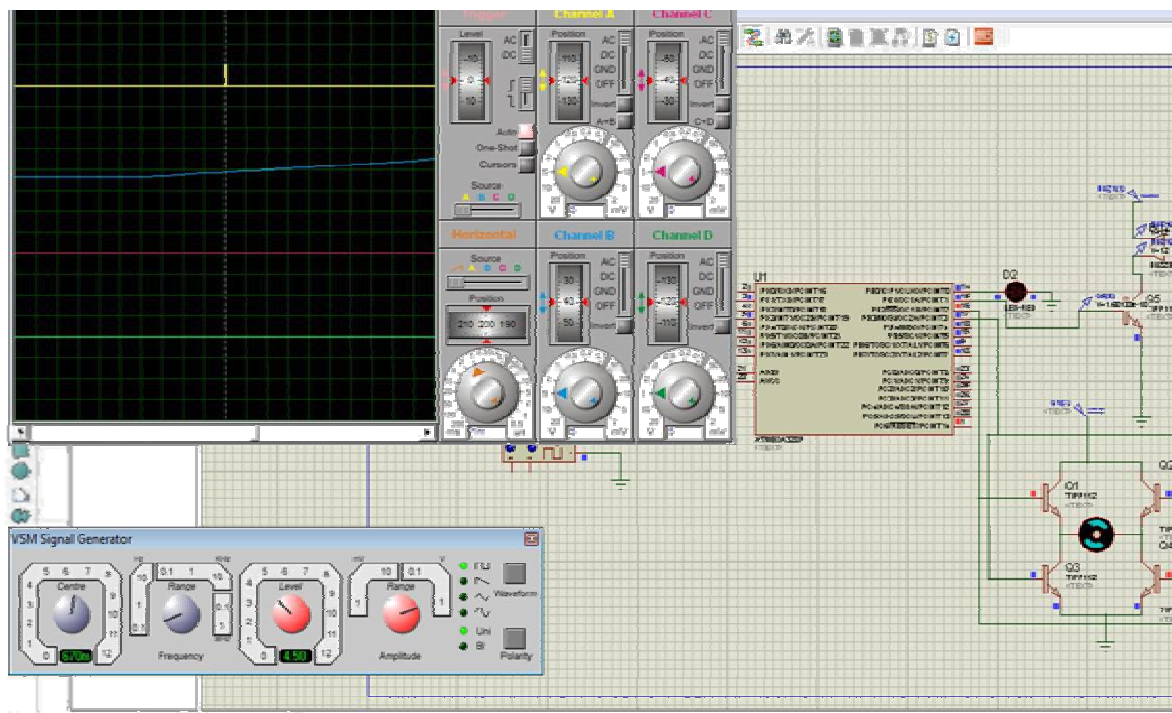


Figure no. 9: System schematic diagram
(Source: Authors)

3.2. Observation

Table no. 1 shows the observations that are made after the circuit mounted on the PCB.

Table no. 1
Observations

Distance	Observation
$\leq 100\text{cm}$	LED lit
$\leq 50\text{cm}$	Buzzer went ON
$\leq 20\text{cm}$	Motor stopped and changed direction

4. Conclusion

A rear end anti-collision warning system was constructed and mounted on a very simple and easily understandable model constructed to demonstrate the system and it was found functional. The sensor was able to read distances that are at shorter range accurately. The system was not real time because there were incidences where the microcontroller didn't

receive any feedback. This is due to noise from the environment. A distance sensor that detects objects at long distances is needed to apply on a real vehicle. Hence, if the right materials are collected, it is possible to enhance its features so that it can be used in vehicles. This model is also a good tool to use for demonstration for anti-collision warning system research.

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