

Study of Vehicle Park Assist & collision warning system using Ultrasonic Sensor

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Abstract- The technology of electronics plays a major role in the field of automation and modern machine shops and space robots. The aim is to design and develop a control system based intelligent electronically controlled automotive bumper activation called ELECTRIC BUMPER. The Ultrasonic sensor senses the obstacle & if there is any obstacle closer to the vehicle (within 90cm), the control signal is given to the control unit and bumper simultaneously. The bumper comes forward. Adjustable Bumper system is provided for protection of the vehicle from damage. The structures and interiors of modern motor vehicles are designed to prepare for a crash full time, although crashes are relatively rare events. Full time readiness for a crash has imposed stringent restrictions on the styling, design and utility of motor vehicles. With the advancement in sensing technologies, a new class of safety features called crash preparation features, has shown great potential in relieving the design restrictions. "Crash preparation" is the timely reconfiguration of a vehicle's structure and interior to the crash-ready state before an imminent crash. If the threat of a crash subsides, the vehicle reverts to its normal driving state, i.e., a "less" crash-ready state. Crash preparation can offer the needed crash protection while allowing new styling, design and utility previously not possible due to the needs for crash protection.

I. INTRODUCTION

Actuators are an essential part of electronic control systems in commercial vehicles. It is their job to convert the electrical signals from the control unit into an action. Most actuators are electric motors or electro-magnetic valves. This paper consists of ultrasonic transmitter and receiver circuit, control unit, pneumatic bumper system. The sensor senses the obstacle. If there is any obstacle closer to the vehicle the control signal is given to the bumper activation system. The electric bumper is used to protect the man and vehicle. This bumper system is only activated when the vehicle speed is above 30 -40 km per hour. The ultrasonic sensor senses this vehicle speed and this signal is given to the control unit and pneumatic bumper system.

Need for the new system

When the driver sees the obstacle or any vehicle in front of his driving vehicle, he gets irritated or becomes mazy. Due to this the driver fails to give the proper input to braking system and proper stoppage does not occurs. In addition, the driver may not able to pay the full attention during night travelling so there are many chances of accidents. After the accident occurs, there is no any provision to minimize the damages of vehicles. In currently used vehicles, generally bumpers used are of rigid types. These bumpers have specific capacity and when the range of the accidental force is very high then the bumpers fails and these forces are transferred towards the passengers. Therefore, this system never reduces the damage of both

vehicle and passengers. As motor vehicles have become more compact to meet the ever-stringent fuel efficiency requirements, the available crush space of motor vehicles has been involuntarily reduced. The E/R bumper is the only known safety feature that could provide the desired crush space only when a need appears. The additional crush space would allow the extended bumper structure to absorb additional crash energy to reduce the severity of the crash. The bumper automatically retracts when the risk subsides. In this paper the proof of concept of the E/R bumper and its potential benefits are discussed in detail.

II. LITERATURE SURVEY

Safety system –

Automobile safety is the study and practice of design, construction, equipment and Regulation to minimize the occurrence and consequences of automobile accidents. Road traffic Safety more broadly includes roadway safety. The aim is to design and develop a control system based on pneumatic braking system for an intelligent electronically controlled automotive braking system. Based on this model, control strategies such as an 'antilock braking system' (ABS) and improved maneuverability via individual wheel braking are to be developed and evaluated.

Cushion (energy absorption) –

The cushion function of the bumper in a pedestrian impact is directly related to the Acceleration impact criterion. It is intended to reduce the severity of bone fractures in a Pedestrian impact. This function is not entirely dissimilar from the traditional function of a Bumper system (absorbing energy of a vehicle impact). However, there are two key differences: the Impact energy and the acceptance criteria. Impact Energy in a vehicle-to-vehicle impact requires a local energy absorption 'density' approximately double that of the pedestrian impact, as can be seen through this brief analysis.

Support (load distribution) –

The support function of the bumper system is directly related to the knee bend angle Criterion illustrated. It is intended to reduce the risk of severe knee joint injuries such as Ligament ruptures and intra-articular fractures. The goal is to provide enough support below And/or above the main bumper to limit the bending moment at the knee joint during an impact. This situation is complicated by two vehicle design requirements:

- The vehicle damageability standard for bumpers requires the front bumper to be located At approximately the same height as the pedestrian 'leg-form' knee. So without other Support, the greatest bending moment would occur at the knee. This standard also Mandates no damage to other vehicle components, limiting their location.

- The ground clearance and approach angle requirements limit how low to the ground any Components can be located. The goal in the design of bumper components to support the Lower limb during a pedestrian impact & to limit the ‘leg-form’ bending without either,

- (i) Sacrificing vehicle damageability,
- (ii) Violating vehicle approach angles.

The literature and patent review identified

Different approaches to meet this goal. As above, these are summarized in order of Decreasing popularity, as measured by the number of patents describing each solution.

Beam design –

The design of the bumper beam in a beam-absorber system (traditional passenger car) has also received some attention. In particular, there are several proposals to change the shape Of the face of the beam to eliminate foam ‘bottoming-out’ and reduce leg form knee bending. In Addition, molded plastic absorbers often require additional attachment points on the face of the Beam. This represents a common though minor design trend that is really just part of good Design practice.

III. SYSTEM OVERVIEW

Block diagram of the system:

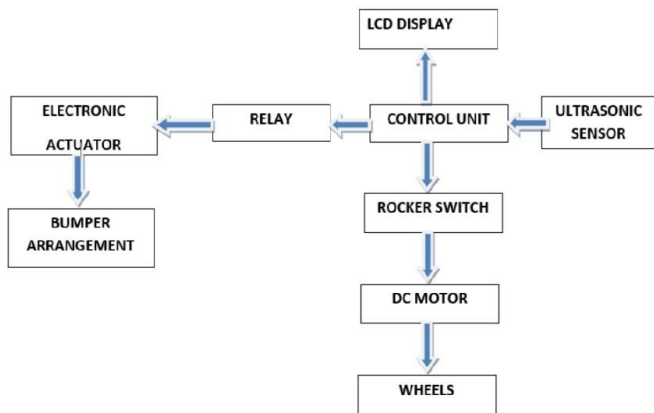


Fig.1 Block diagram of the system

Operation:

The Ultrasonic TRANSMITTER circuit is to transmit the Ultrasonic rays. If there is any obstacle in the path, the Ultrasonic rays will get reflected. These reflected rays are received by the receiver circuit called “ultrasonic RECEIVER”. The ultrasonic sensor module receives the reflected ultrasonic rays and gives the control signal to the control circuit. LPC2148 controller is used in the control circuit, to control the operation. If the measured distance is greater than the reference value which was put in the program then the controller gives signal to relay coil, Once relay get energized it passes the signal to electronic actuator. Then the Electronic Actuator will extend the Bumper Arrangement connected to it. when the measured distance is less than the reference value which was put in the program then the controller gives signal to relay coil, Once relay get energized it passes the signal to electronic actuator. Then the Electronic Actuator will retract the Bumper Arrangement connected to it.

The Rocker switch is used to move the vehicle forward & reverse. It operates by taking input from controller. It is connected to the Dc Motor & DC motor is connected to wheels. In this way, the extendable and retractable bumper will work for protecting our vehicle from damage.

We are applying two modes as follows:

- City Mode
- Highway mode

City mode: In this mode we are not using this Automatic bumper activation system because in city mode mostly rush is there therefore bumper system activate frequently. Therefore, we are disabling this system in City mode.

Highway Mode: In the highway mode, normally speed is greater than 50 Kmph. If there is possibility of accident then maximum damage will take place. Therefore, for safety and avoid vehicle level damage we are activating the system in the highway mode.

Flowchart of operation:

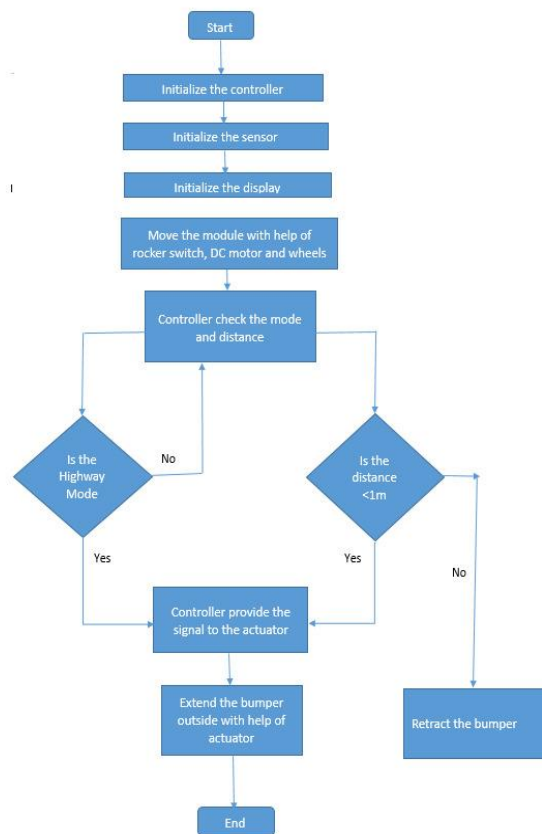


Fig. 2 Flowchart of operation

IV. HARDWARE AND SOFTWARE

Hardware used:

1. Power supply
2. LPC2148 (arm7)
3. Ultrasonic sensor
4. Actuator

5. Lcd display
6. Dc motor
7. Rocker switch
8. Dummy whhel
9. Frame
10. Acrylic plate

1 Power supply:

LPC2148 works on 3.3 V power supply. LM 117 can be used for generating 3.3 V supply. However, basic peripherals like LCD, ULN 2003 (Motor Driver IC) etc. works on 5V.

So AC mains supply is converted into 5V using below mentioned circuit and after that LM 117 is used to convert 5V into 3.3V.

Transformer:-It is used to step down 230V AC to 9V AC supply and provides isolation between power grids and circuit.

Rectifier:- It is used to convert AC supply into DC.

Filter: It is used to reduce ripple factor of DC output available from rectifier end.

Regulator:- It is used to regulate DC supply output.

Circuit for this is as shown below.

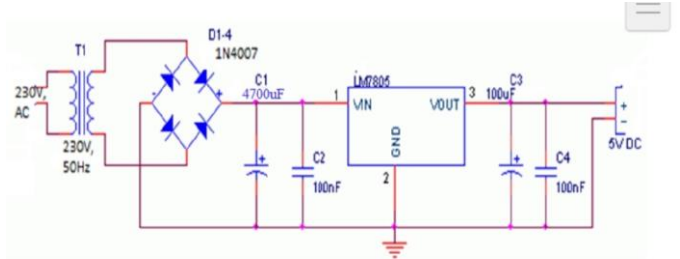


Fig. 3 Power supply circuit

2 ARM LPC2148:

Project includes LPC 2148 of ARM7 as the core controller, which is used as a control system to control the entire vehicle.

2.1 Features of LPC2148:

- 16-bit/32-bit ARM7TDMI-S microcontroller in a tiny LQFP64 package.
- 8 KB to 40 KB of on-chip static RAM and 32 KB to 512 KB of on-chip flash memory.
- 128-bit wide interface/accelerator enables high-speed 60 MHz operation.
- In-System Programming/In-Application Programming (ISP/IAP) via on-chip boot loadersoftware. Single flash sector or full chip erase in 400 ms and programming of 256 B in 1 ms.
- Embedded ICE RT and Embedded Trace interfaces offer real-time debugging with the on-chip Real Monitor software and high-speed tracing of instruction execution.
- USB 2.0 Full-speed compliant device controller with 2 kB of endpoint RAM. In addition, the LPC2146/48 provides 8 KB of on-chip RAM accessible to USB by DMA.
- One or two (LPC2141/42 vs. LPC2144/46/48) 10-bit ADCs provide a total of 6/14 Analog inputs, with conversion times as low as 2.44 as per channel.
- Single 10-bit DAC provides variable analog output (LPC2142/44/46/48 only).

- Two 32-bit timers/external event counters (with four capture and four compare channels each), PWM unit (six outputs) and watchdog.
- Low power Real-Time Clock (RTC) with independent power and 32 kHz clock input.

2.2 Pin diagram of LPC2148:

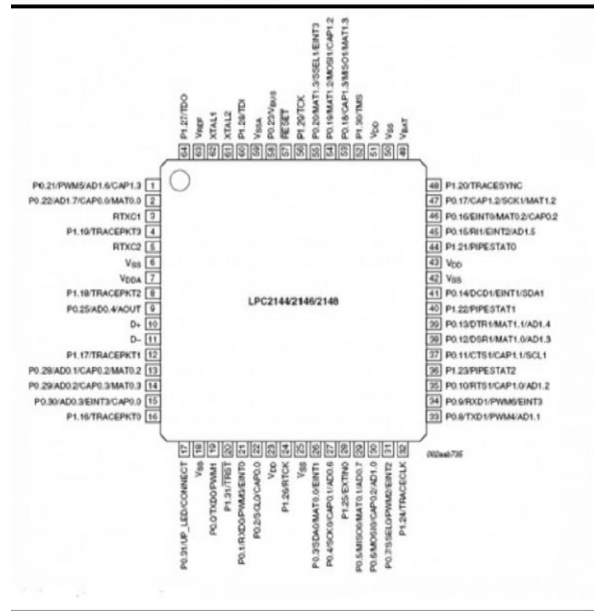


Fig.4: Pin diagram of LPC2148

2.3 Reset Circuit:

Reset button is essential in a system to avoid programming pitfalls and sometimes to manually bring back the system to the initialization mode. MCP 130T is a special IC used for providing stable RESET signal to LPC 2148.

2.4 Oscillator Circuit:

Oscillations, the heartbeat, are provided using a crystal and are necessary for the system to work. The value of capacitors C20 & C21 depends upon the frequency of crystal Y3. We can also use external oscillator for providing system clock.

2.5 UART:

LPC 2148 has inbuilt ISP which means we can program it within the system using serial communication on COM0. It has also COM1 for serial communication. MAX 232/233 IC must be used for voltage logic conversion.

2.6 Serial Port:

The microcontroller LPC2148 has an inbuilt UART for carrying out serial communication. The serial communication is done in the asynchronous mode. A serial port, like other PC ports, is a physical interface to establish data transfer between computer and an external hardware

3 ULTRASONIC SENSOR :

Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can

reach to 3mm. The modules include ultrasonic transmitters, receiver and control circuit. The basic principle of work:

- Using IO trigger for at least 10us high level signal,
 - The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.
 - IF the signal back, through high level, time of high output IO duration is the time from sending ultrasonic to returning.
- Test distance = (high-level time velocity of sound (340M/S) / two.

• **Wire connecting direct as following:**

- 5V Supply
- Trigger Pulse Input
- Echo Pulse Output
- 0V Ground

• **Electric Parameter**

Working Voltage	DC 5 V
Working Current	15mA
Working Frequency	40Hz
Max Range	4m
Min Range	2cm
MeasuringAngle	15 degree
Trigger Input Signal	10us TTL pulse
Echo Output Signal	Input TTL lever signal and the ra proportion
Dimension	45*20*15mm

4 ACTUATOR:

A linear actuator is an actuator that creates motion in a straight line, in contrast to the circular motion of a conventional electric motor. Linear actuators are used in machine tools and industrial machinery, in computer peripherals such as disk drives and printers, in valves and dampers, and in many other places where linear motion is required. Hydraulic or pneumatic cylinders inherently produce linear motion. Many other mechanisms are used to generate linear motion from a rotating motor.

• **Electric Actuator:**

A motor that converts electrical energy into mechanical torque powers an electric actuator. The electrical energy is used to actuate equipment such as multi-turn valves. It is one of the cleanest and most readily available forms of actuator because it does not directly involve oil or other fossil fuels.



Fig.6 Electronic Actuator

5. LIQUID CRYSTAL DISPLAY(LCD):

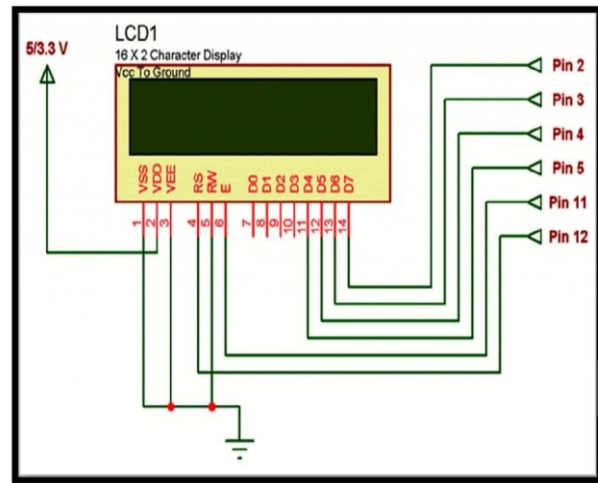


Fig 7: LCD Display

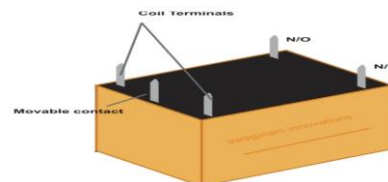
Pin Symbol Function

- 1 Vss Ground
- 2 Vdd Supply Voltage
- 3 Vo Contrast Setting
- 4 RS Register Select
- 5 R/W Read/Write Select
- 6 En Chip Enable Signal
- 7-14 D0-D7 Data Lines
- 15 A/Vee Gnd for the backlight
- 16 K Vcc for backlight

Functions of pins of LCD Display

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6 RELAY:



A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

7 ROCKER SWITCH:

A rocker switch is an on/off switch that rocks (rather than trips) when pressed, which means one side of the switch is raised while the other side is depressed much like a rocking horse rocks back and forth. A rocker switch may have a circle (for "on") on one end and a horizontal dash or line (for "off") on the other to let the user know if the device is on or off. Rocker switches are used in surge protectors, display monitors, computer power supplies, and many other devices and applications. A rocker switch with independent circuitry can have a light activated on the face of the switch in both the on and off positions, which allows the switch to be found easily in the dark. With dependent circuitry, the light is activated only when the switch is on.

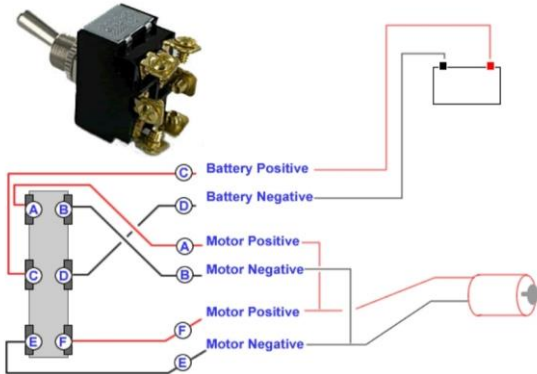


Fig.9 Rocker Switch

8 DC MOTOR:

DC motors are part of the electric motors using DC power as energy source. These devices transform electrical energy into mechanical energy. The basic principle of DC motors is same as electric motors in general, the magnetic interaction between the rotor and the stator that will generate spin. DC motors are widely used in speed and direction control because control of these motors are easier than other motors. The motion of a DC motor is controlled using a DC drive. DC drive changes the speed and direction of motion of the motor. Some of the DC drives are just a rectifier with a series resistor that converts standard AC supply into DC and gives it to the motor through a switch and a series resistor to change the speed and direction of rotation of the motor. But many of the DC drives have an inbuilt microcontroller that provides programmable facilities, message display on LCD, precise control and also protection for motors.

- Controlling of DC motor using Rocker Switch

- Rocker Switch provides us only digital logic (1 or 0)
- The polarity can't be provided from Rocker switch
- The motors can't be connected to Controller as mostly motors runs on voltage higher than +5V, and motors demands high current (depends), this can be removed by use of a "H Bridge here four transistors are used to change polarity

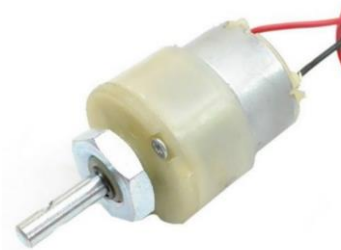


Fig. 10 DC Motor.

9 DUMMY WHEEL



Fig.11 Dummy Wheel

SOFTWARE USED:

1. Dip Trace
2. Proteus 8.0

1.DIP Trace:

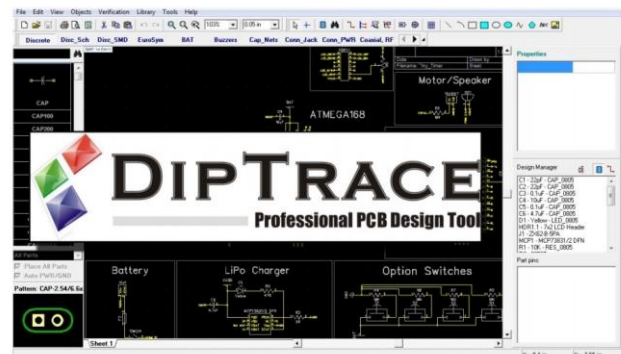


Fig. 12 Dip Trace screenshot

Pattern Editor:

The pattern editor is used to create the pattern (physical dimension) of the component to be used in PCB Layout. To create a pattern the physical dimensions of the part is needed.

2. Proteus 8.0:

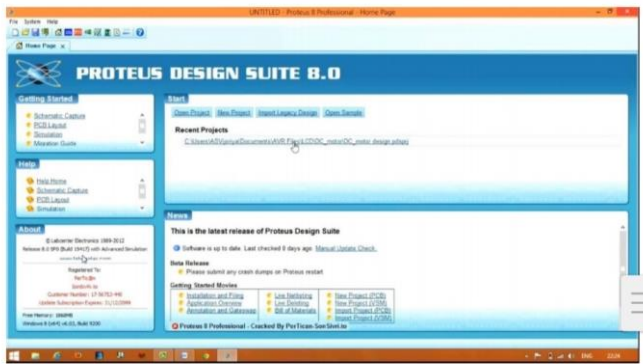


Fig. 14 Proteus 8.0 Screenshot

Circuit Design:

The Proteus Design Suite is an **Electronic Design Automation (EDA)** tool including schematic capture, simulation and PCB Layout modules. It is developed in **Yorkshire**, England by Lab center Electronics Ltd with offices in North America and several overseas sales channels. The software runs on the **Windows** operating system and is available in English, French, Spanish and Chinese languages.

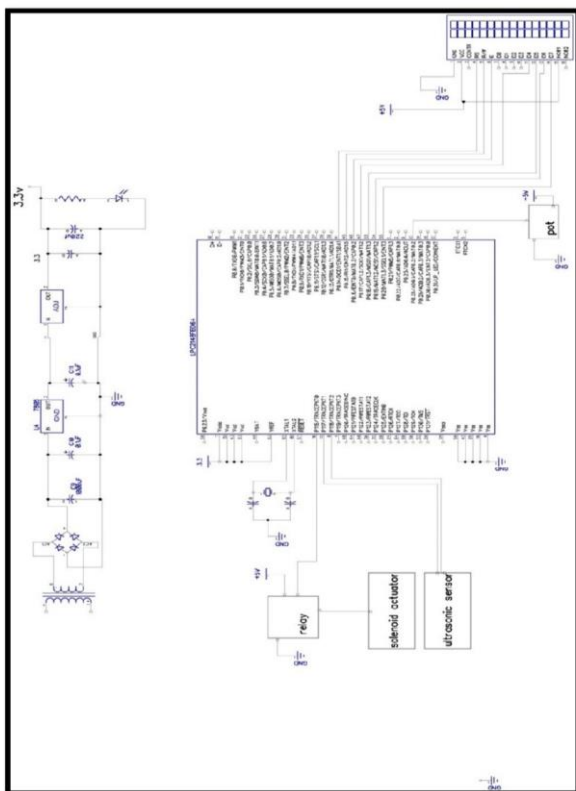
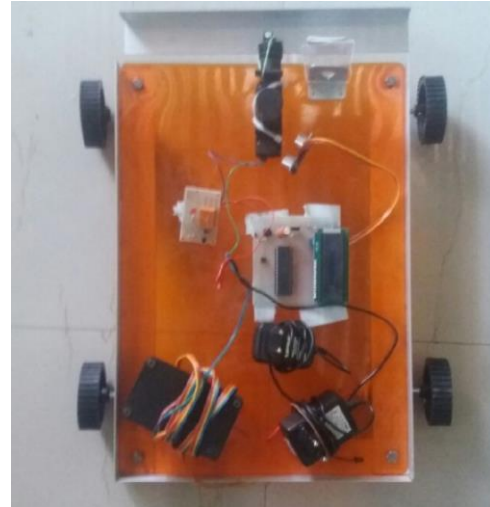


Fig. 15 Circuit design of proposed system

V. RESULT AND CONCLUSION



The following conclusions are drawn from the present work. Ultrasonic sensor is well affected by the light incident on it; however, model works better in night conditions. Response time was very low, thus it provides better result when compared to that of IR sensors. This mechanism can be used in all type of vehicles; an additional installation cost would provide a safer environment. Our main aim behind the designing of this system is to improve the prevention technique of accidents and reducing the hazard from accidents like damage of vehicle, injury of Human etc.

VI. ACKNOWLEDGMENT

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