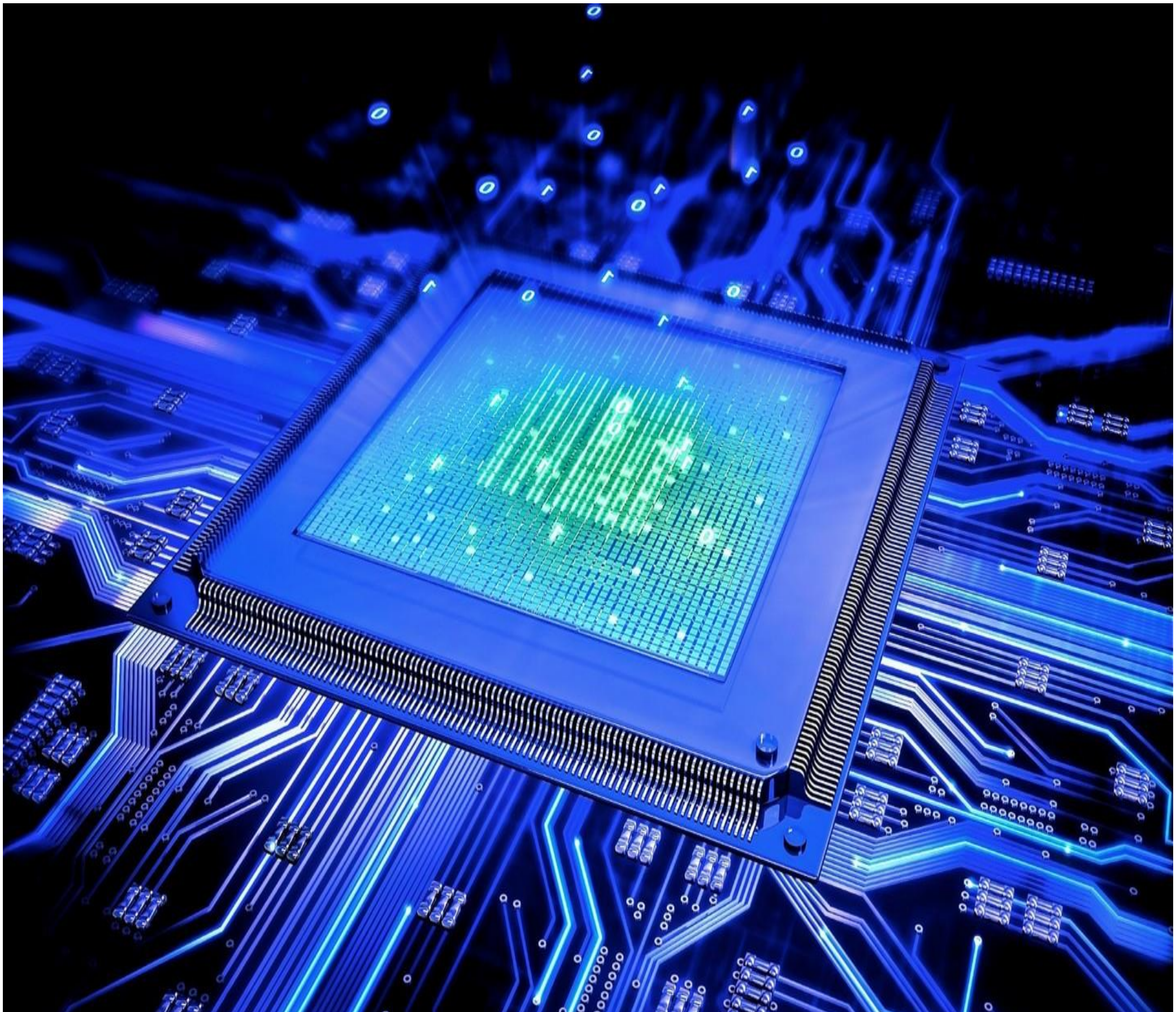

Collision Detection & Warning System

Project Report

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12/14/17
Microprocessor System & Interfacing

COMSATS Institute of Information Technology, Islamabad

Department of Electrical Engineering

Collision Detection & Warning System Based on AVR Platform

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Submitted in partial fulfillment of the 'Microprocessor Systems and Interfacing [EEE342]' course for Bachelor of Science in Electronics Engineering

December 14, 2017

Acknowledgments

We Would Like To Thank Our Instructor,

Dr. Rana Liaqat Ali,

For all his advice & support in the

Accomplishment of this project.

Our Advisor Mr. Syed Ali Akbar Jafri whose

Insight and guidance were invaluable.

Section **Page**

Summary / Abstract

- This project aims to implement a collision detection system using an Arduino that would detect on-coming traffic and take relevant precautionary measures.
- It was requested on November 28, 2017
- Submitted in partial fulfillment of the course, Microprocessor and System interfacing.
- Project was prepared by:

  Irfan Danish [CIIT/FA15-BEL-012/ISB]
  Hammad Munir [CIIT/FA15-BEL-034/ISB]
- Collision detection and warning system.
- Motor used to symbolize the speed of a moving car that the microcontroller would control.
- Arduino UNO ATMEGA 328 used to implement the project.
- Arduino IDE used for programming and implementing the code to Arduino UNO.
- Proteus ISIS 8.0 is used for simulation and making schematic of project.
- Microsoft Visio 2016 used to create Block Diagram.
- Major task was to determine the distance of the on-coming traffic. This information is than used to construct a code that would enable the controller to control the speed of the motor.
- HC-SR04 ultrasonic sensor determines the distance of the on-coming traffic.
- The repositories of project can be accessed by the following link: (https://github.com/irfandanishdani/Collision-Detection-and-Warning-System-Based-on-AVR-Platform)

List of Figures

Chapter 1

Introduction

i. Background:

Vehicles are an important way of transportation all over the world. There are many cases of road accidents every day in the world. Such accidents create traffic jams on road from hours to days, consequently resulting loss of valuable time. Frequency of road accidents is very high which causes a lot of damage to human life and valuable properties. Commonly many road accidents caused by collision between vehicles due to the inability of the drivers to sense the perimeter of their vehicles and other reason unawareness of nearby vehicles.

Timely detection of other vehicles on road is of extreme importance to help avoid accidents and potential loss of human life, traffic jams especially in Hilly areas and reduced visibility condition in dense foggy areas like motorway. The high incidence of on road accidents due to collision propels our concern on collision detection & warning system mainly for dense fog affected areas.

ii. Goal:

This system is an Arduino based collision detector. It is currently being use by automotive industries. This system enables vehicles to identify the chances of collision and gives visual or audio warning to the driver or it could also be used to burst open the air bags in a car to avoid serious injuries.

This project is about making cars more intelligent by issuing warnings and taking automatic action if necessary.

We will be using the ultrasonic sensor HR SC-04 that will receive and transmit ultrasonic waves and detect the distance of the distance of objects coming towards the vehicle. An Arduino (AVR Based microcontroller) board for processing of data and for warning generation.

iii. Scope & Need:

After the invention of airbags many casualties has stopped. Anyhow, the pressure created when the airbags burst open sometimes causes neck injuries. Moreover, the system of airbags opening is not up to the mark. Airbags might burst open in any minor accident.

Although airbags are very helpful, it still has its own drawbacks. Our collision detector will be much smarter and much efficient then the airbags. We will be using sensors that will detect any collision possibilities and give warning to driver so that he can be alert.

If the accident cannot stopped by just warnings, the car will automatically apply brakes and decrease the speed to a certain amount, if this is also not possible or the speed of the car is too high the last resort will be the airbags.

Well renowned automobile brand Volvo are using such sort of principles in their latest trucks. These trucks detects any car in front of it and the braking systems in these trucks is so advanced that it comes to a complete stop in just a span of mere inches and prevents the chance of any accident.

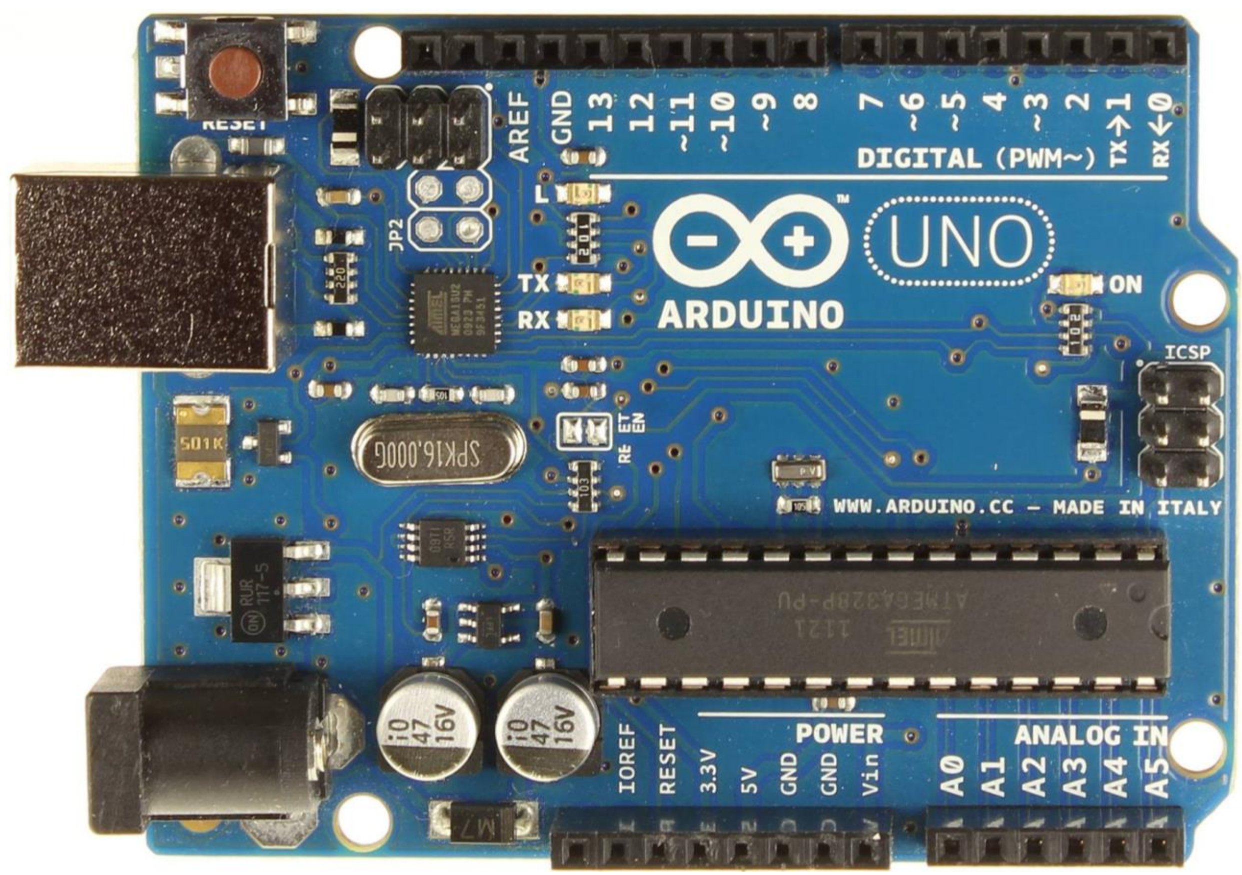
Chapter 2

Component Description

We used Arduino Uno, HC-04 ultrasonic sensor, 16x2 dot matrix LCD, motor, buzzer and LED for the development of the project.

i. Arduino:

The Arduino Uno is a microcontroller board based on the AVR ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator,10 bit ADC (Analog to Digital Converter) a USB connection, a power jack, an ICSP header, and a reset button.



1: *Arduino Uno*

Arduino Uno Microcontroller (AT mega 328) operating voltage 5V, input voltage 7-12V recommended. There are total 14 digital I/O Pins (of which 6 provide PWM output) 6 analog input pins. DC Current per I/O Pin is 40 mA DC Current for 3.3V Pin is 50 mA. Flash Memory 32 KB of which 0.5 KB used by bootloader SRAM is 2 KB, EEPROM 1 KB, Clock Speed of 16 MHz

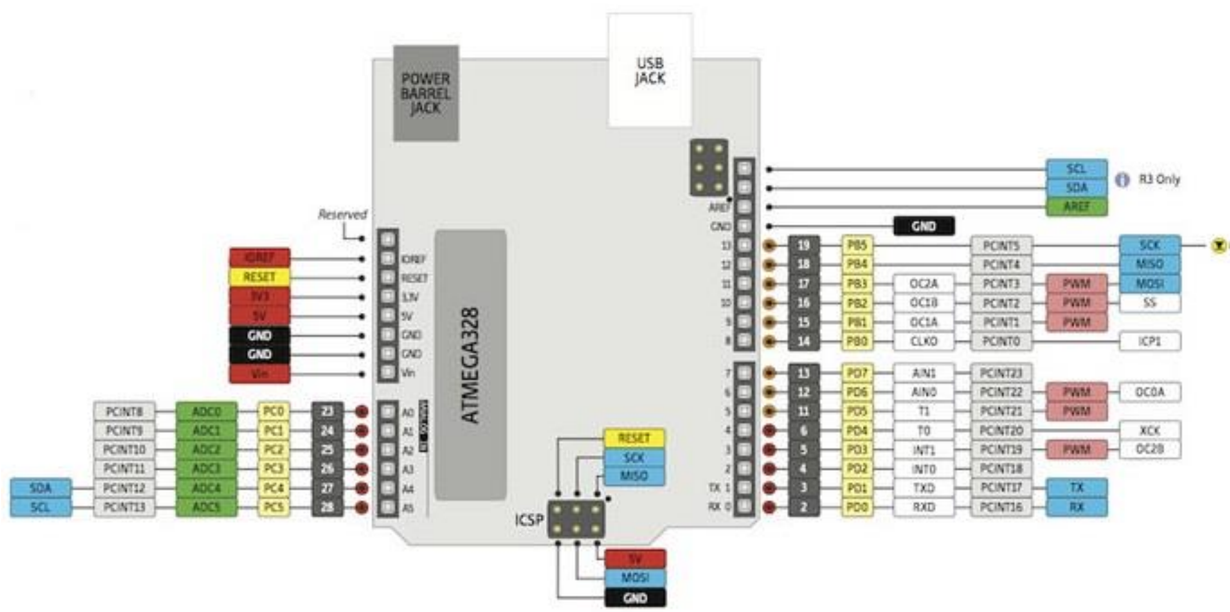
The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 5 to 12 volts.

Power:

- VIN: The input voltage to the Arduino board when it is using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- 5V: The regulated power supply used to power the microcontroller and other components on the board. This either can come from VIN via an on-board regulator, or supplied by USB or another regulated 5V supply.
- 3V3: A 3.3-volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
- GND: Ground pins.

Input & Output:

Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 K Ohms. In addition, some pins have specialized functions:



2: *Arduino Pin Configuration*

- Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data.
- External Interrupts: 2 and 3. These pins can configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.
- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.
- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.
- LED: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analogReference() function. Additionally, some pins have specialized functionality:

- TWI: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.
- AREF: Reference voltage for the analog inputs. Used with analogReference().

ii. **Ultrasonic Sensor:**

The Ultrasonic sound waves has an extremely high pitch that humans cannot hear and is also free from external noises from passive or active sources.

This ultrasonic distance sensor provides steady and accurate distance measurements within the range of 2cm to 450cm. It has a focus of less than 15 degrees and an accuracy of about 3mm.

This particular sensor transmits an ultrasonic sound that has a frequency of about 40 kHz. The sensor has two main parts- transducer that creates an ultrasonic sound wave while the other part listens to its echo and third is control circuit.

3: Sonar

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.

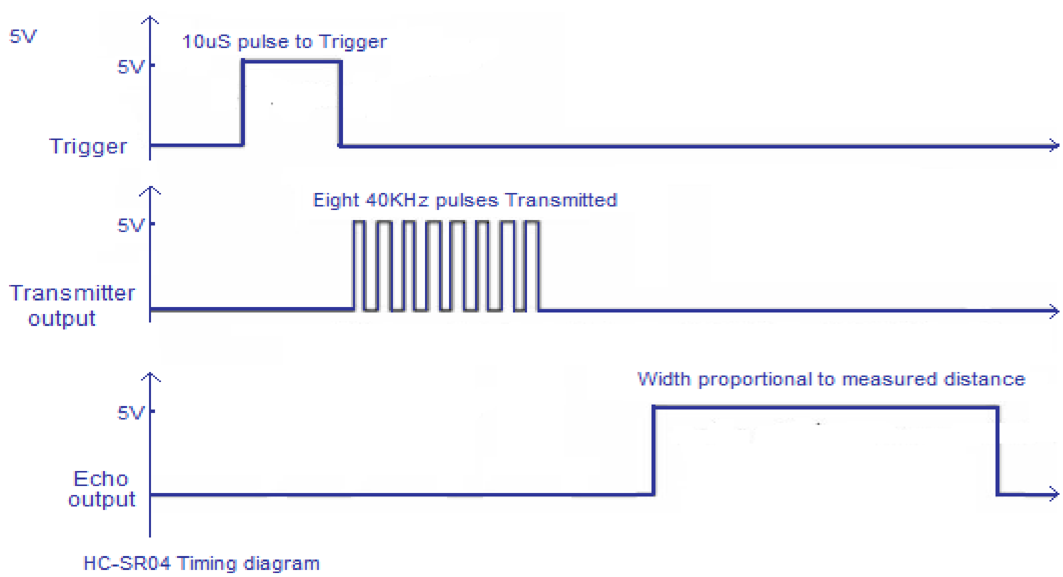
- IF the signal back, through high level , time of high output IO duration is the time from sending ultrasonic to returning.
- Test distance = (high-level time × velocity of sound (340M/S) / 2.

Electric Parameters:

Working Voltage	**DC 5 V**
Working Current	**15mA**
Working Frequency	**40Hz**
Max Range	**4m**
Min Range	**2cm**
Measuring Angle	**15 degree**
Trigger Input Signal	**10uS TTL pulse**
Echo Output Signal	**Input TTL lever signal and the range in proportion**

Timing Diagram:

The Timing diagram shown below. We only need to supply a short 10uS pulse to the trigger input to start the ranging, and then the module will send out an 8-cycle burst of ultrasound at 40 kHz frequency and raise its echo.



4: HC-SR04

The Echo is a distance object that is pulse width and the range in proportion .You can calculate the range through the time interval between sending trigger signal and receiving echo signal.

Formula:

uS / 58 = centimeters

uS / 148 =inch, *or the*

Range (meter) = high level time * velocity (340M/S) / 2

We have to use over 60ms measurement cycle, in order to prevent trigger signal to the echo signal.

iii. DC Motor:

A DC Motor used for the demo.

iv. 16x2 Dot Matrix LCD:

LCD used to display the distance from the object.

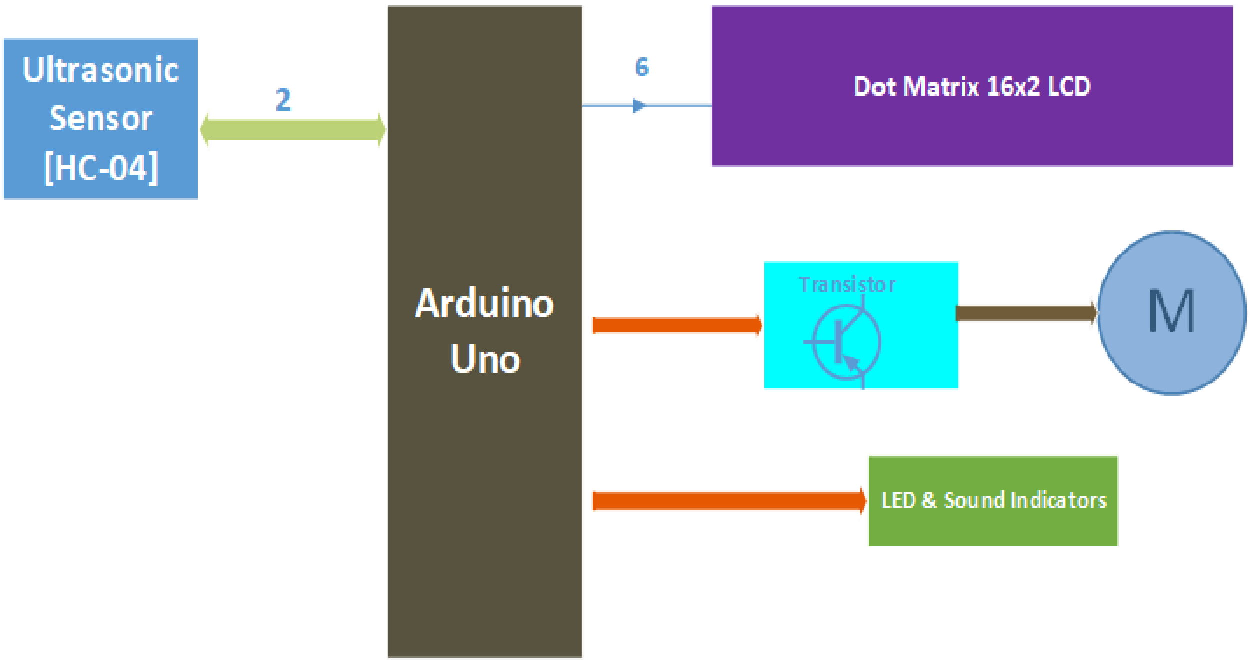
v. Buzzer & LED's:

LED's and buzzer used for warning.

Chapter 3

Working

i. Block Diagram:



5: Block Diagram

ii. Zone Definitions:

The major contribution in this project is of the ultrasonic sensor module. It emits ultrasonic waves of 40 KHz from its trigger. These waves hit any hindrance in its path and then echoes back to the receiver. The time taken for the echo to return determines the distance of the hindrance that created or occurred in the wave's path.

We have programmed our controller in such a way that it will create three zones.

ZONE 1:

First zone is the default state of our concept model. In this zone there will be no hindrance or object in the path of the ultrasonic waves. Thus, the motor will work normally without any speed changes or warning.

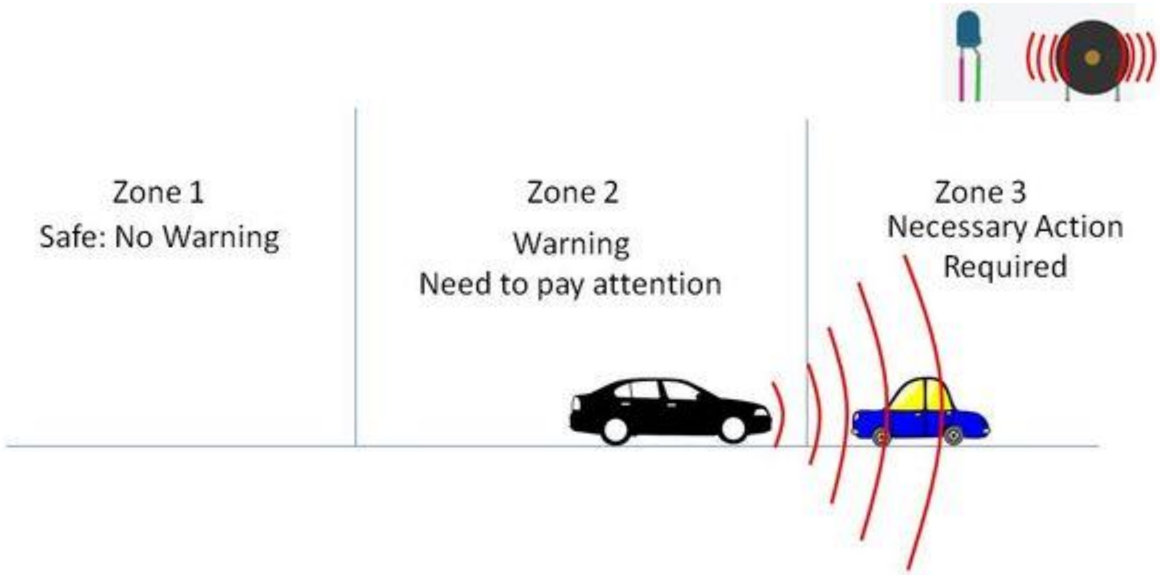
ZONE 2:

In the second zone, the warning light will turned on to alert the driver to take necessary action to prevent any disastrous situation. This zone in this concept model fixed to less than 50 cm and more than 20 cm from the sensor. If any object enters this range warning light will be turned on (yellow LED) until this object is removed from the range and the speed of the motor will be reduced. Speed controlled by reducing the duty cycles of motor. As motor is representing the speed of the car in this concept model, so when applied practically on a car, the brakes would applied and the speed of the car would reduce.

ZONE 3:
In the third zone of this conceptual model, the motor will be come to a complete stop and the red warning light will turned on. This zone in this concept model fixed to less than 20 cm from the sensor. If any object enters this range, red warning light will turned on and the motor will completely stop. Duty cycles of the motor are completely set to low when any object enters this zone.

6: Zone 1

7: Zone 2



8: Zone 3

PULSE WIDTH MODULATION (PWM):

Pulse width modulation, is modulation technique used to encode a message into a pulsing signal. It is achieved by changing the width of the signal and keeping the time or frequency same.

PWM uses digital signals to control power applications, as well as being easy to convert back to analog with minimum of hardware.

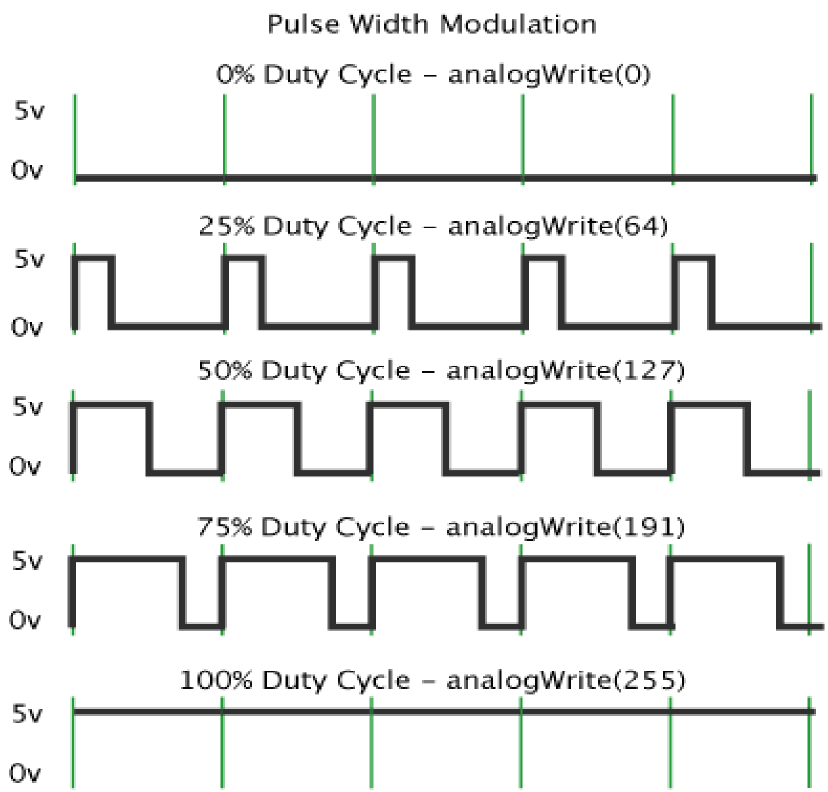
One of the parameters of any square wave is duty cycle. Most square waves are 50%, this is the norm when discussing them, but they usually do not have to be symmetrical.

DUTY CYCLE:

Duty cycle is the proportion of time during which a component, device or, system is operated. The duty cycle can expressed as a ratio or percentage.
Suppose a motor operates for 10 second and is off for 90 seconds, and then run for 10 seconds again, and so on.
This means that the motor runs for 10 seconds out of 100, or 1/10 of the time, and its duty cycle is therefore 10%.

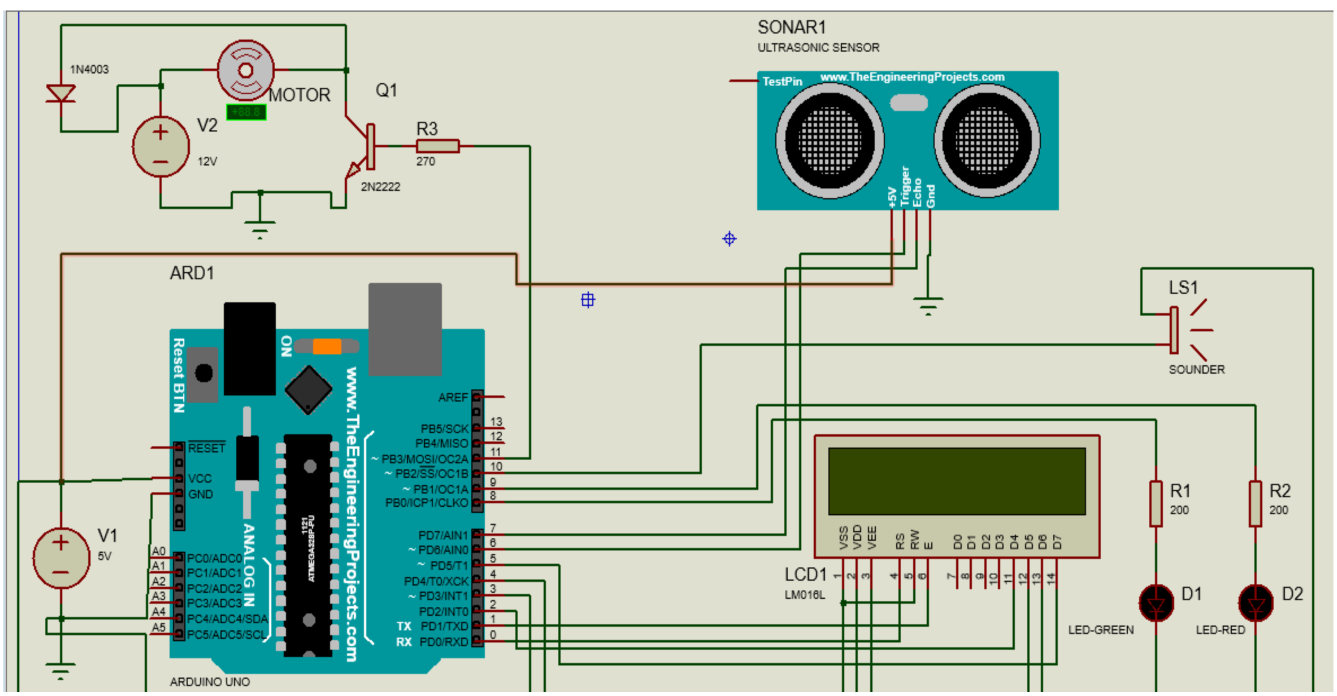
$$D = PW/T \times 100\%$$

Where, D is duty cycle. PW is the pulse width (pulse active time), and T is the total period of the signal.



9: *Duty Cycle*

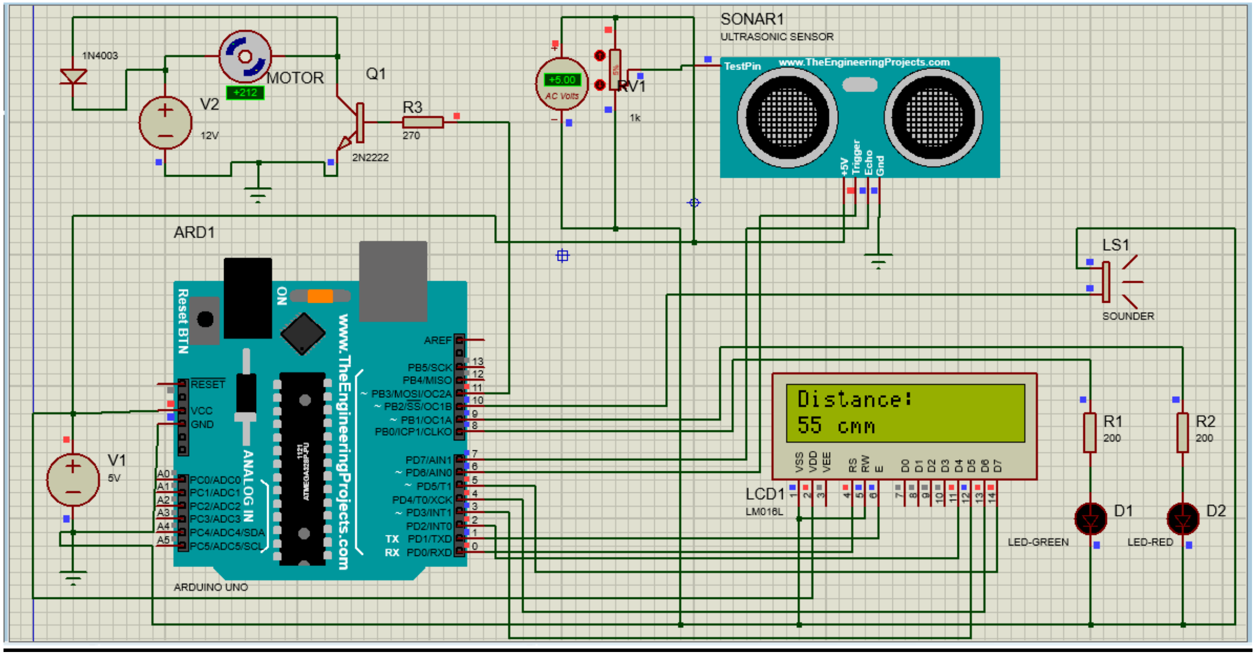
iii. <u>Schematic</u>



10: *Schematic*

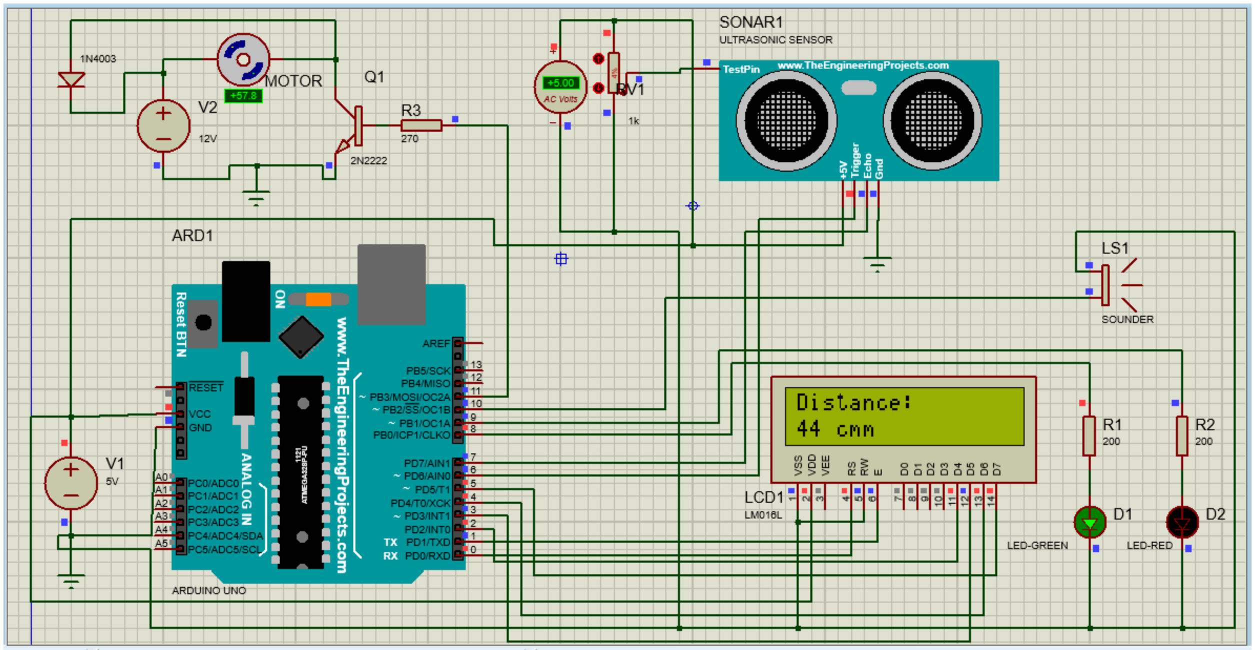
iv. Simulation Results:

Zone 1:



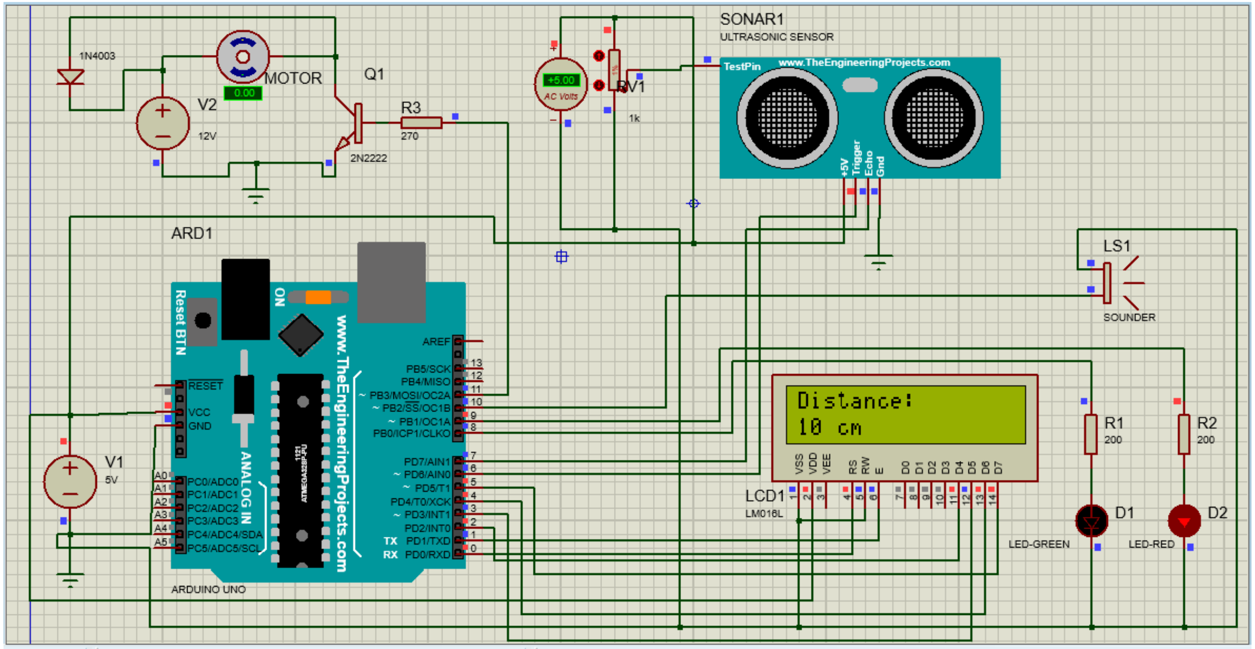
11: Zone 1 Results

Zone 2:



12: Zone 2 Results

Zone 3:

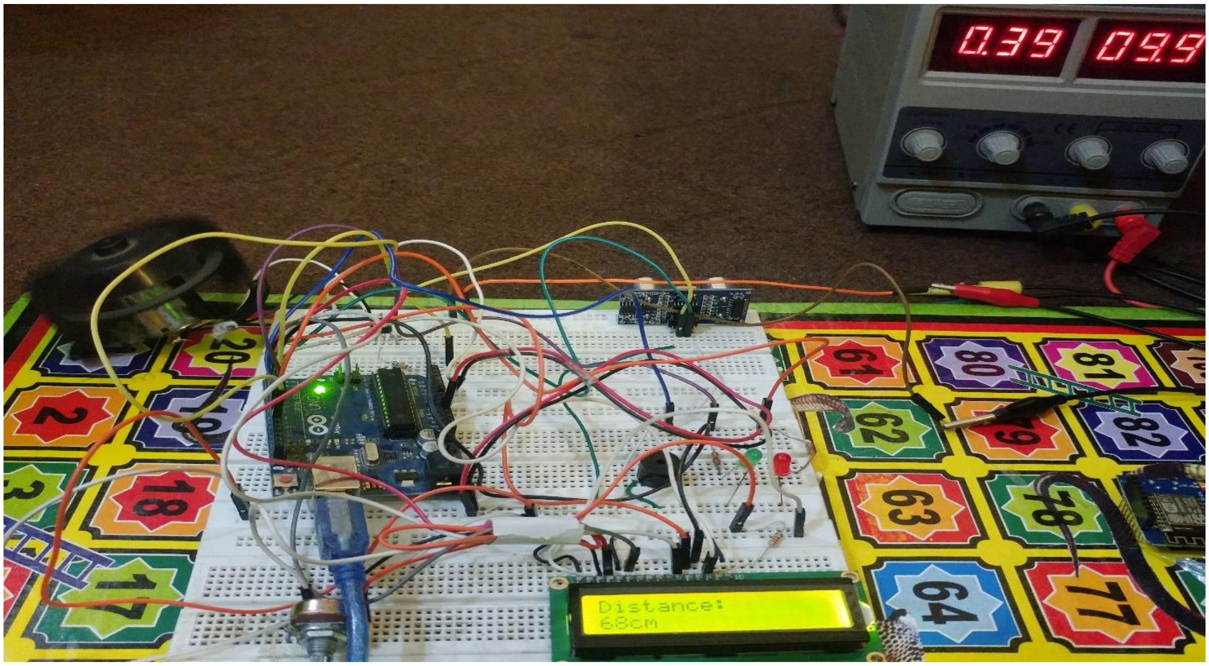


13 *Zone 3 Results*

Chapter 4

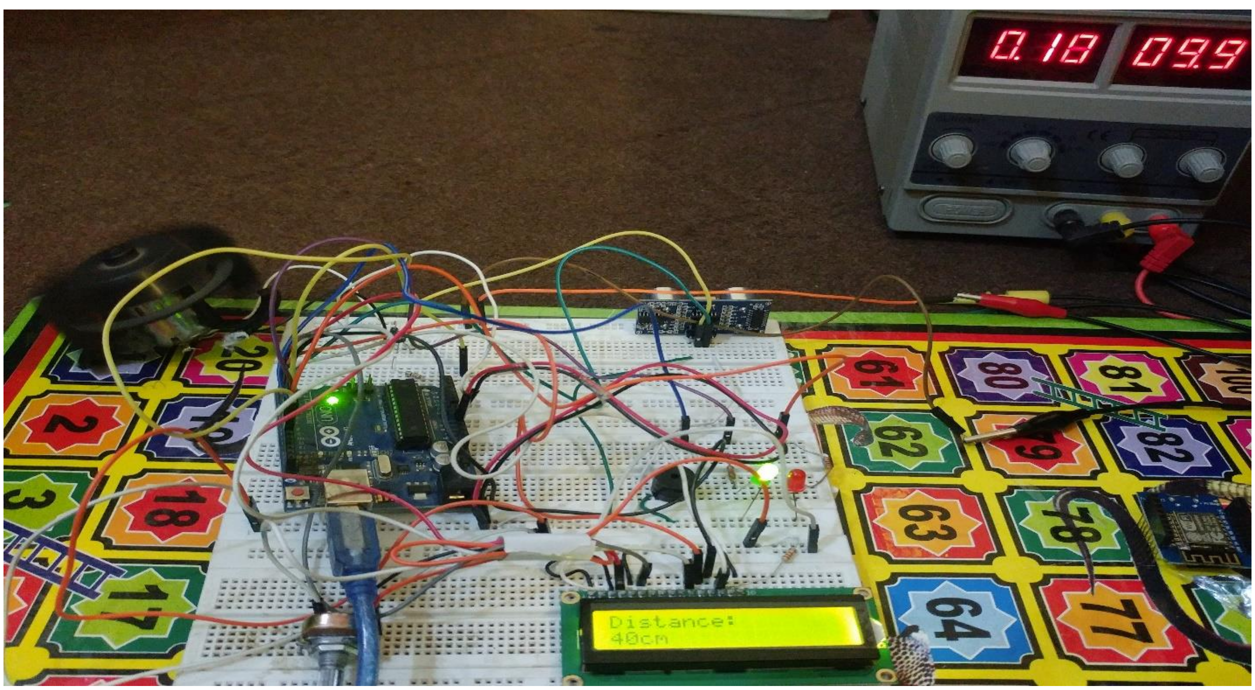
Output & Extensions

Zone 1:



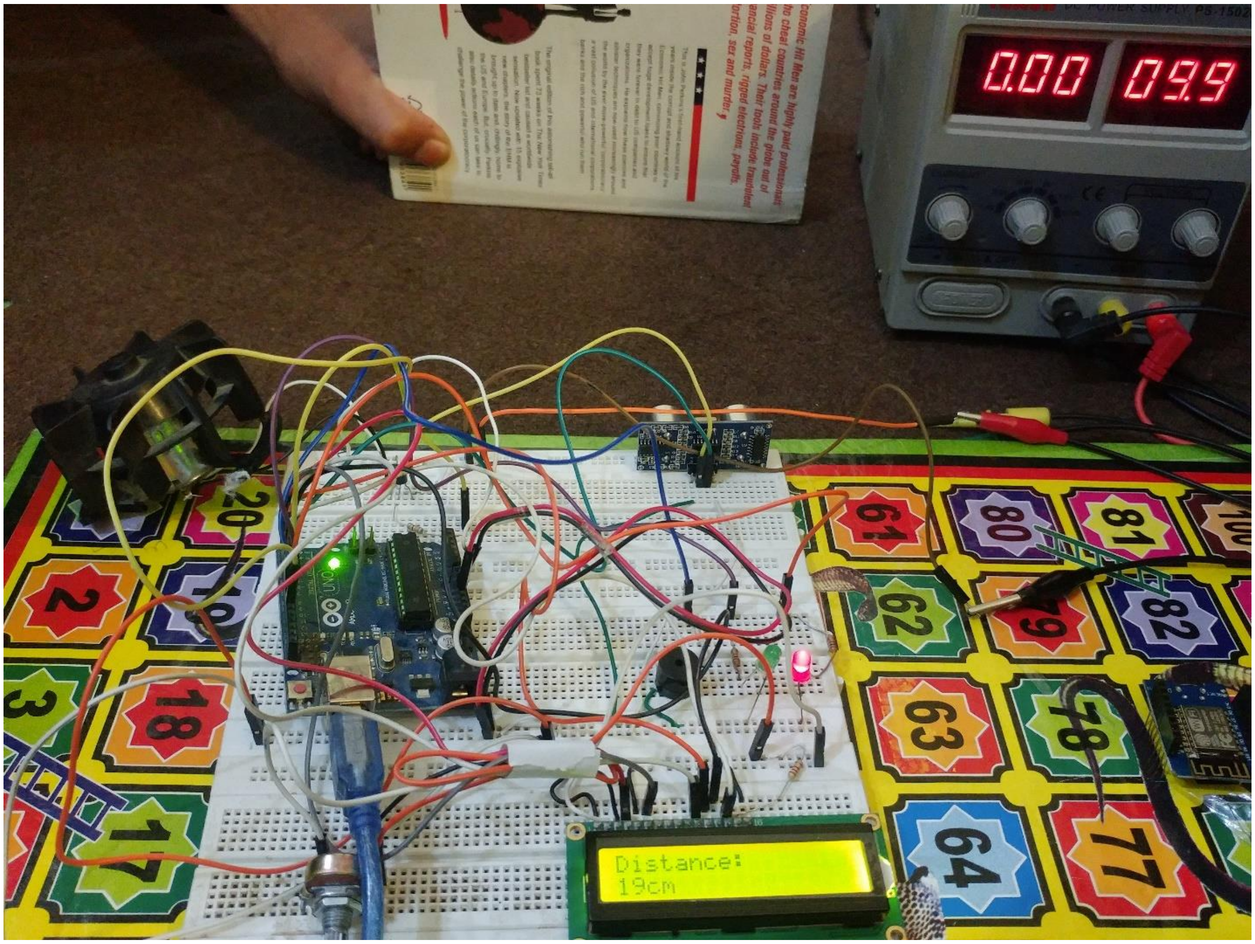
14: Zone 1; Output

Zone 2:



15: Zone 2; Output

Zone 3:



16: *Zone 3: Output*

i. <u>Extensions & Applications:</u>

a) By adding Wi-Fi (Controller Node MCU or Wi-Fi Module) and GPS Module, we can send the location of collision to nearby police stations and to family of the person.
b) We can create blind stick using Ultrasonic Sensor & Arduino.
c) An automatic water level controller can developed which can switch water pump by sensing water level in the tank.
d) It can also use for counting persons in a particular space.
e) Irregular parts detection for hoppers and feeder bowls.
f) Contouring or profiling using ultrasonic systems.
g) 45° Deflection; inkwell level detection.
h) Roll diameter, tension control, winding and unwind.
i) Thru beam detection for high-speed counting.

Appendix:

LCD: Liquid Crystal Display.

LED: Light Emitting Diode.

β : Current gain of Bipolar Junction Transistor

AC: Alternating Current.

DC: Direct Current.

NC: Normally Closed.

NO: Normally Open

PWM: Pulse Width Modulation

ADC: Analog to Digital Converter.

USB: Universal Serial Bus.

SRAM: Static Random Access Memory.

EEPROM: Electronically Erasable Programmable Random Access Memory.

KB: Kilo Byte.

I/O: Input /Output.

RX: Receiver.

TX: Transmitter.

TTL: Transistor-Transistor Logic.

SPI: Serial Peripheral Interface.

MOSI: Master In Slave Out.

SCK: Serial Clock.

SS: Slave Select.

AREF: Analog Reference Voltage.

SDA: Data Line.

SCL: Clock Line.

Wi-Fi: Wireless Fidelity.

MCU: Microcontroller

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