# Ultrasonic RADAR for Motor Vehicles Using Microcontroller

**Rishabh Sinha[1], Deepak Kumar[2], Ms. Rasveen[3]**
[1, 2, 3] Department of ECE
[1, 2, 3] Dronacharya Group of Institutions, Greater NOIDA

***Abstract-****As we all know Road safety is one of the biggest concerns in our country and most of the road accidents occur due to Harsh or Bad driving weather where visibility becomes very low, so we come up with this idea to make an ultrasonic RADAR system for motor vehicles that will become the extra vision for the drivers. This project is truly based on the use of microcontroller, and the motive of this project is to make a device which can be attach with the LMVs (Light Motor Vehicles) and Transport vehicles to increase the vision of the Driver in harsh conditions for driving like in foggy weather, in smog or in dusty weather. By this project we can assist the drivers in harsh conditions so the number of road accidents in our country that happens due to bad weather can reduce. This device will attach in front of the vehicle and give the real time feedback of the front road on display or LED.*

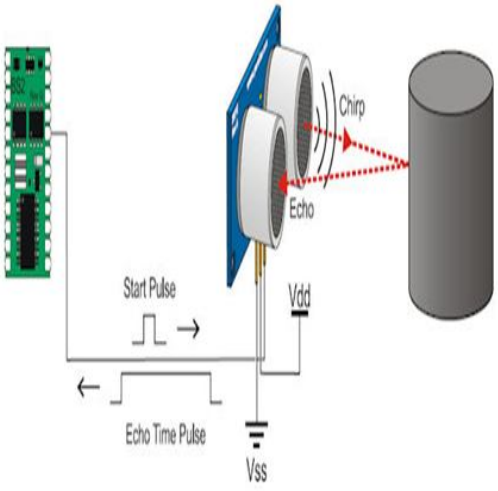
***Keywords***-ATMEGA 128, Ultrasonic, LED panel, L293D, RADAR

## I. INTRODUCTION

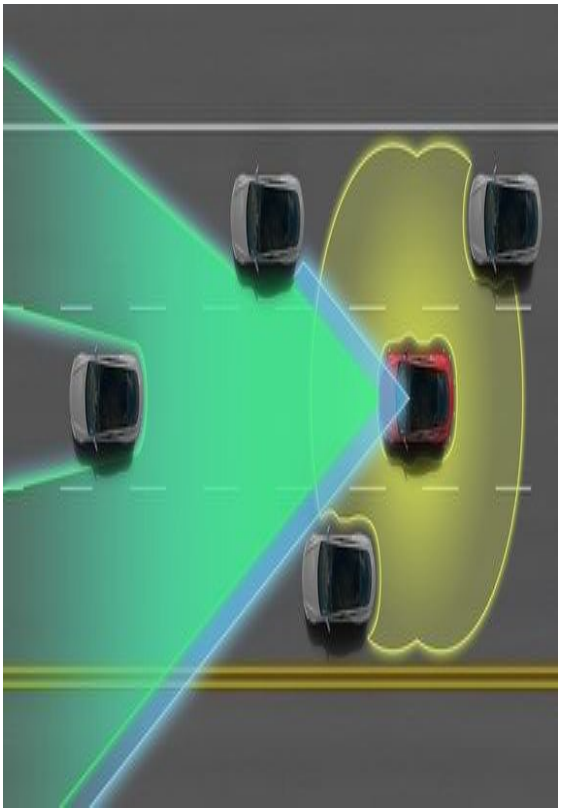
As we all know the main reason of the road accidents in bad weather is the lack of information of the objects in front of the vehicle due to low visibility, so the basic solution of this problem is to increase the information of the objects on the road to the driver either by increasing the visibility or by providing some device which can sense the objects in the low visibility. For increasing the visibility we have fog lights which are useful for some extent but in extreme conditions fog lights are useless so this project will help in assisting the drivers in extreme conditions. This device uses the pair of transmitter and receiver which works on ultrasonic frequencies. The transmitter sends the signal in front road if signal gets reflected by any of the object so the signal will returns to the receiver and by processing of the received signal we can display the position and distance of the object on LED. So why we chose ultrasonic RADAR system for this project, well because the ultrasonic systems are all weather systems and there are very less effects of environment on ultrasonic frequencies, That's why the other organisms like Bats also uses the ultrasonic frequencies to track the location of their pray. In the figure 1there is a comparison between uses of ultrasonic of bat with ultrasonic sensor. This figure shows that just like bats ultrasonic sensors contains pair of transmitter and receiver transmitter is for transmitting the signal and when the signal interact with the object its eco comes back to the receiver and receiver process the information from the eco. The figure 2 shows the actual representation of the transmission and receiving of the ultrasonic frequency with the help of the ultrasonic sensor and processing circuit. In figure 2 there is a difference in time duration of start pulse and eco pulse because the eco pulse get spread over the wide range so it is difficult to get information through it so for this purpose we use the processing system as shown in figure 2.

The figure 3 shows the implementation of the ultrasonic technique in traffic with the vehicles. The figure 4 shows that we can understand the ultrasonic technique with the help of car parking assist system both works in a same way.

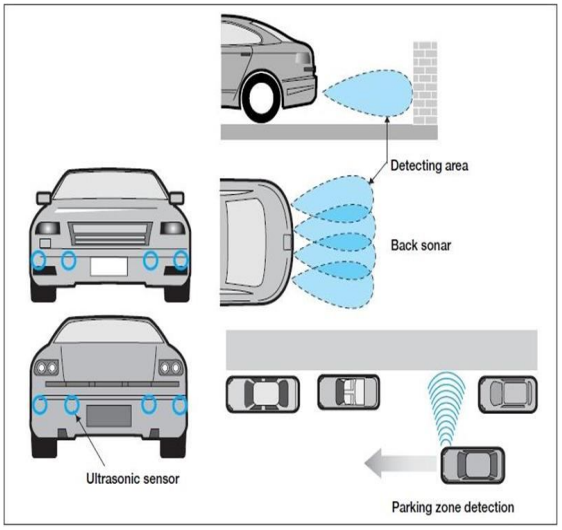
[1] Figure 1. Bat VS Ultrasoic



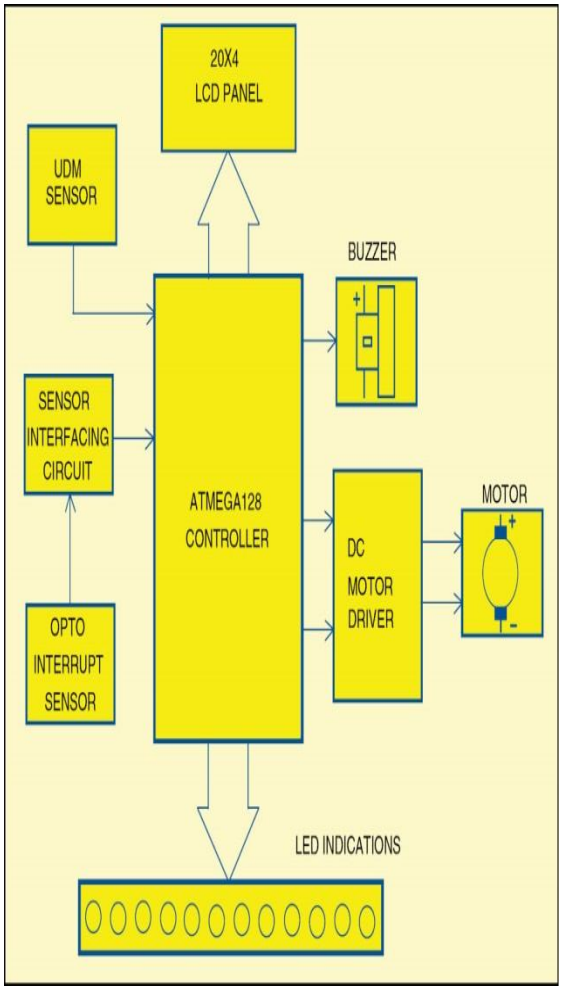

[2] Figure 2. Ultrasonic system



[3] Figure 3. Ultrasonic on road




[4] Figure 4. Parking assist as an example




[5] Figure 5. Block diagram of the device

## II. BLOCK DIAGRAM

The block diagram contains several components like buzzer, dc motor, motor driver, OPTO interrupt sensor, UDM sensor etc.

ATMEGA 128- [6] AVR microcontroller ATmega128 (IC3) is a high-performance, low-power Atmel 8-bit AVR RISC based microcontroller that combines 128kB of programmable flash memory, 4kB SRAM, 4kB EEPROM, 8-channel 10-bit A/D converter and JTAG interface for on-chip debugging. The device operates between 4.5V and 5.5V [6].This IC performs the processing of the signal as well as controls the reception of the signal on LEDs.

ULTRASONIC SENSOR OR UDM SENSOR- [6] The UDM sensor module has four pins but this module has only three pins for connection to external circuit. The transmitter unit sends an ultrasonic wave of 40 kHz directed towards the target. The reflected signal is received by the receiver unit, which calculates distance based on the speed of ultrasonic waves and the time required by the waves to travel

to-and-fro. The sensor works on 5V DC power supply. Its minimum and maximum ranges are 10cm and 400cm, respectively. The rate of transmission of the serial data is 9600bps with TTL level output.

We can also use the UDM1 which is a modified or advance version of UDM it comes with screen so no need of external LED and the special feature of UDM1 is it has wireless connectivity which means we can connect it through Bluetooth, WI-FI, or Infrared.

L293D OR MOTOR DRIVER IC- [6] L293D contains two in-built H-bridge driver circuits. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse directions. The operation of the two motors can be controlled by input logic at pins 2 and 7, and 10 and 15. Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anti-clockwise directions, respectively. In the circuit, it is programmed to run 5rpm DC motor in a clockwise as well as anti-clockwise direction. In this circuit, the input logics are fed to pins 2 and 7 to control the motor connected across pins 3 and 6 of IC2 [6].

LCD- [6] the 20×4 LCD displays the scanning angle, measured distance, messages like Object Detected and scanning, etc. It accepts ASCII value of any letter or digit and displays it on the selected line [6].

LED Dial- Twelve red-colour LEDs are arranged like a dial of clock. Each LED indicates an angle between 0o and 330o that is separated from the next or previous by 30 degrees. When an object is detected, its angle is indicated by the corresponding angle of LED. This gives an approximate idea of position, direction and angle of an object with respect to reference position.

BUZZER- [6] it is a piezoelectric DC buzzer that generates audible beep-like sounds when given DC supply of 5V. It is used to give short beep sounds on detection of an object [6].

OPTO Interrupt sensor circuit- [6] This circuit generates a negative pulse when the strip passes the gap in the sensor.

This pulse is used to generate an interrupt signal for the microcontroller; the device circuit comprises a slotted OPTO isolator module, BC547 NPN transistor T1 and a few resistors.

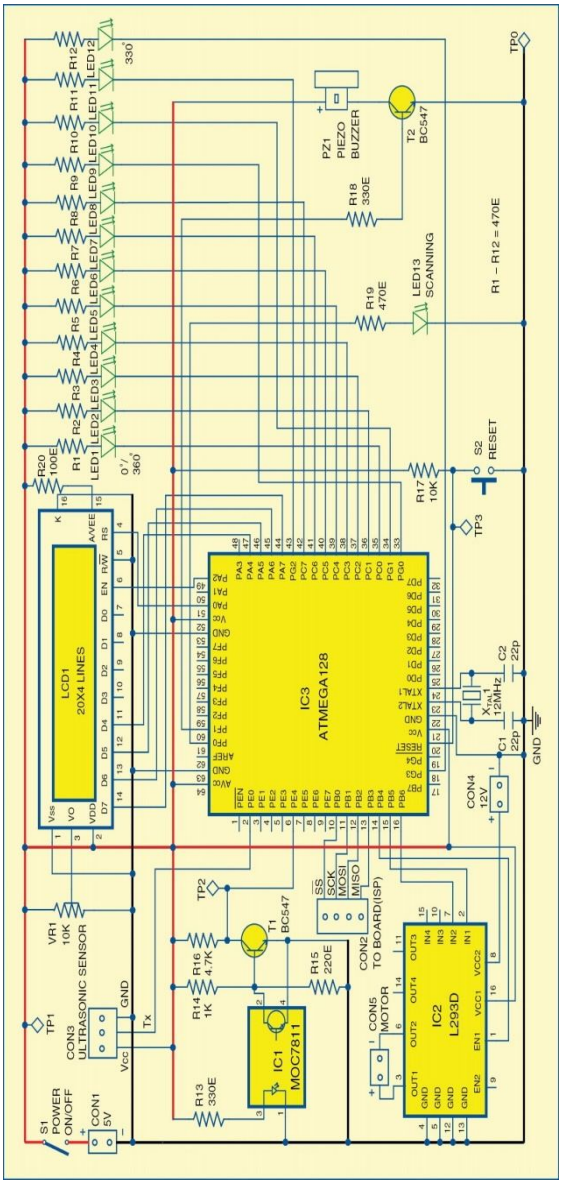
The internal LED is forward-biased through the current-limiting resistor of 330Ω. This turns it on continuously. The falling LED light drives the photo transistor to saturation. Its output at the collector is low, which drives T1 into cut-off. This means that output of the circuit is high, which is the normal state when the falling light is not interrupted.

When a strip passes through the gap, it blocks the light and the photo transistor goes into cut-off.

Its output at the collector is high, which drives transistor T1 into saturation and gives low output at its collector.

As the strip passes through the gap, we get high to low, which is taken as interrupt[7].

## III. CIRCUIT DIAGRAM




[6] Figure 6. Circuit diagram of ultrasonic Radar system using ATMEGA 128.

Description Of components of circuit diagram

Resistors- R1, R12, and R19 are of 470 ohm. R13 and R18 are of 330 ohm. R14, R15, R16, R17, and R20 are of 1Kohm, 220 ohm, 4.7Kohm, 10Kohm, and 100 ohm respectively. VR1 has 10Kohm pre-set value.

Capacitors- C1 and C2 are of 22pF ceramic disk.

IC's- IC1 is MOC7811 OPTO isolator, IC2 is L293D DC motor driver, and IC3 is ATMEGA 128 microcontroller. LCD1 is 20x4 LCD panel. T1 and T2 are BC547 NPN transistors. All the serial LEDs are the 5mm LEDs.

Miscellaneous Components- S1 is on/off switch, PZ1 is the piezo buzzer, and Xtl1 is the 12 MHz crystal oscillator, CON1 and CON4 are the two pin connector. CON2 is a 4 pin connector, CON3 is a 3 pin connector. CON 5 is a 2 pin connector. And circuit contains 12V-5rpm DC motor, 3 pin ultrasonic distance sensor-serial out.

## IV. INTERCONNECTIONS

[7] TX of the sensor is connected to the PE0 of the microcontroller.

OPTO interrupt sensor interfacing circuit is connected to the pin4 which is use for external interrupt at pin 6 of the microcontroller.

Pins PB5 and PB6 of port B is connected to the IN1 and IN2 of L293D. These pins are used to rotate the motor clockwise and anti-clockwise. Pin PB4 is connected to the enable input of L293D which is used to enables the output of the chip.

DC motor is connected to the 2 outputs of L293D OUT1 and OUT2.

Pin PF0 of PORTF is connected to operation (scanning) LED17 through current limiting resistor R19. Another pin, PF1, is connected to the buzzer through NPN transistor (T2) BC547.

PORTA pins PA4 through PA7 are connected to data pins D4 through D7 of the LCD. Pins PA0 and PA2 are connected to control pins RS and EN of the LCD, respectively. R/W pin of LCD is connected to ground.

LCD pins 2 and 15 are connected to Vcc, the latter through 100-ohm resistor R20, and pins 1 and 16 are connected to ground. Pin 3 of the LCD, which is used for contrast control, is connected with 10k pot, as shown in the figure.

PORTC pins PC0 through PC7 are connected to cathodes of eight LEDs. Anodes of all the LEDs are connected to Vcc through current-limiting resistors.

Similarly, four PORTG pins PG0 through PG3 are connected to four LEDs.

The 12MHz crystal with two 22pF capacitors is connected to pins XTAL1 and XTAL2.

The complete system works on 5V DC supply, with additional 12V DC supply given to pin 8 of L293D (IC2) for the DC motor [7].

## V. WORKING OPERATIONS OF THE CIRCUIT

[7] Initially, the motor is stationary and the strip is in the gap of the slotted OPTO isolator module. This is the reference angle 0o (position) for ultrasonic sensor module.

Next, the motor starts rotating in a clockwise or anti-clockwise direction. The speed of the motor is 5rpm, so we can presume that in one minute (60 seconds) it completes five revolutions. So, to complete one revolution, it takes 60/5 = 12 seconds.

Now, one revolution = $360^o$, which means in 12 seconds the motor will rotate by $360^o$, and in one second, it will rotate by 30o. Thus, to rotate the motor by $30^o$, it has to run for one second only. Furthur, to reduce the speed of the motor to 2rpm only, after moving the motor by $30^o$ for one second, the motor rests for 1.5 seconds and then moves in a clockwise or anti-clockwise direction, depending on the direction of previous rotation.

As the motor rotates in clockwise or anti-clockwise direction, messages such as Scanning……, Angle:30, Angle:60, Angle:90, etc, are displayed on the LCD.

When the motor rotates completely by $360^o$ in 30 seconds, the strip again passes between the gap of the slotted opto isolator module. This generates an interrupt signal and the motor starts rotating in $30^o$ steps at a speed of 2rpm in reverse direction, and messages are displayed on the LCD as Scanning……, Angle:330, Angle:300, Angle:270, etc.

Same thing happens when the motor reaches back to $0^o$. Thus, the cycle continues and the motor rotates clockwise and anti-

clockwise continuously to scan a complete 360o at the rate of 2rpm [7].

## VI. PROGRAMING

[8] The program for the microcontroller is written in C language and compiled using AVR Studio 4. The compiler is used to convert C program into a hex file for burning into the flash memory of ATmega128 microcontroller using AVR Studio 4. A 4-pin connector (CON2) is provided in the circuit for programming the chip using a suitable ISP-compatible AVR programmer board.

The complete program is a combination of different functions. It starts with the main function, which is used to configure various ports of ATmega128 microcontroller as input/output (I/O) and initialise the LCD. It also calls UARTinit() function to initialise UART0 to 9600bps and enable reception. The main function also enables interrupts to be used in the project and continuously rotates the motor in either direction (clockwise or anti-clockwise) at 2rpm.

The function angle_disp() is used for displaying the corresponding angle of the rotation of ultrasonic sensor module from its point of origin. There are two interrupt handler sub-routine functions, ISR(UART0_RX_vect) and ISR(INT4_vect), which represent operation mode on receiving interrupts.

ISR(INT4_vect) is used to set reference for the angle and operation of the motor in the opposite direction to the current direction of the rotation of the motor. ISR(UART0_RX_vect) receives nine bytes from the sensor, calculates the distance of the object from the sensor, and displays it on the LCD screen. As soon as an object is detected, the buzzer sounds and indicates the angle of object detection on the LCD as well as on the LED dial with corresponding LED indication.

All LCD functions, such as lcd_init(), lcd_cmd(), lcd_str() and lcd_num(), are included in LCD header file lcd.h [8].

## VII. CONCLUSION

So by refer to this paper we can say that the ultrasonic RADAR is one of the best methods for navigation and scanning because of its high range and immunity from the environmental factors and it is easy to implement the small scale RADAR system for motor vehicles by ultrasonic sensor and microcontroller.

We can also conclude that this RADAR system can be easily install with any of the motor vehicles due to its compact size and less complexity also it is power efficient so we don't have to think much about the external power source because it needs only few volts of supply which can be fulfil easily.

As the future scope of this device we can say that "the biggest room in this world is room for improvement" so there will some room for further modifications like connection with GPS, wireless control etc.

So by looking all the concepts and references we can say that this device will fulfil its cause by assisting the drivers that will reduce the chances of road accidents and will increase the road safety, so there will be no threats for us on the roads in bad weather conditions. So it is one of the best applications of microcontroller.

## REFERENCES

[1] http://content.teachengineering.org/content/umo_/lessons/umo_sensorswork/umo_sensorswork_lesson06_image1web.jpg

[2] https://www.elprocus.com/wp-content/uploads/2013/08/Ultrasonic.png

[3] https://qph.ec.quoracdn.net/main-qimg-71af747a9f267f3b90a3b9dae6e2ecc2-c?convert_to_webp=true

[4] http://www.newelectronics.co.uk/article-images/24966/Fig1_popup.jpg

[5] http://electronicsforu.com/electronics-projects/hardware-diy/microcontroller-ultrasonic-radar-model-using-micro controller-atmega128

[6] http://electronicsforu.com/electronics-projects/hardware-diy/microcontroller-ultrasonic-radar-model-using-microcontroller-atmega128/2

[7] http://electronicsforu.com/electronics-projects/hardware-diy/microcontroller-ultrasonic-radar-model-using-microcontroller-atmega128/3

[8] http://electronicsforu.com/electronics-projects/hardware-diy/microcontroller-ultrasonic-radar-model-using-microcontroller-atmega128/4