Short Range Radar System

A rangefinder is a device that measures the distance from the target to the observer, for the purposes of surveying, determining focus in photography, or accurately aiming a weapon. In this technical project, we make a simple radar using the ultrasonic sensor, this radar works by measuring a range from 3cm to 40 cm as non-contact distance, with angle range between 15˚ and 165˚.The movement of the sensor is controlled by using a small servo motor. Information received from the sensor will be used by “Processing Development Environment” software to illustrate the result on a PC screen.

➢ Introduction:

Radar is an object detection system that uses electromagnetic waves to identify range, altitude, direction, or speed of both moving and fixed objects such as aircraft, ships, vehicles, weather formations, and terrain. When we use ultrasonic waves instead of electromagnetic waves, we call it ultrasonic radar.

The main components in any ultrasonic radar are the ultrasonic Sensors. Ultrasonic sensors work on a principle similar to radar or sonar which evaluates attributes of a target by interpreting the echoes from radio or sound waves respectively.

Radar’s information will appear in different ways. Basic and old radar station used sound alarm or LED, modern radar uses LCD display to show detailed information of the targeted object. We use Computer screen to show the information (distance and angle).

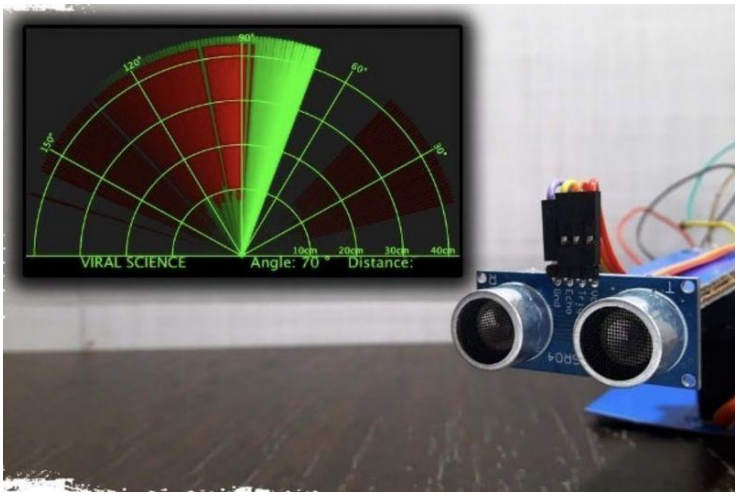

Figure 1 - Mini Rader System Using Arduino Uno

➢ Arduino Board UNO Model:

Arduino is a hardware and software company, project, and user community that designs and manufactures computer open-source hardware, open-source software, and microcontroller-based kits for building digital devices and interactive objects that can sense and control physical devices.

The project is based on microcontroller board designs. The board provides sets of digital and analog Input/output (I/O) pins that can interface to various expansion boards (termed shields) and other circuits Fig -2. The boards feature serial communication interfaces, including Universal Serial Bus (USB) on UNO model, for loading programs from personal computers.

For programming the microcontrollers, the Arduino project provides an integrated development environment (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open-source software. This software can be used with any Arduino board Fig-3.

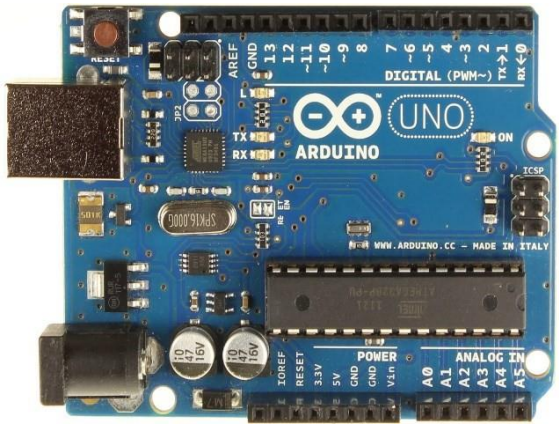

Figure 2 – Arduino Uno

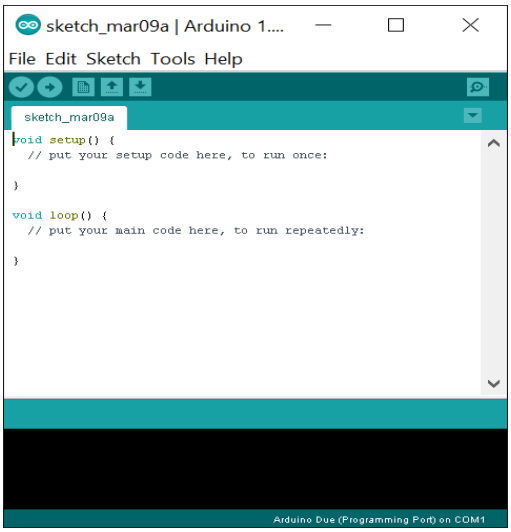

Figure 3 – IDE Software

➢ Processing:

Processing is an open source computer programming language and integrated development environment (IDE) built for the electronic arts, new media art, and visual design communities with the purpose of teaching the fundamentals of computer programming in a visual context.

❖ Specifications

- Free to download and open source
- Interactive programs with 2D, 3D or PDF output
- OpenGL integration for accelerated 2D and 3D
- For GNU/Linux, Mac OS X, and Windows
- Over 100 libraries extend the core software
- Well documented, with many books available

➢ Ultrasonic sensors HC- SR04:

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, within measuring angle 15 degrees Fig 4.

❖ The basic principle of work. (Fig 5)

(1) Using IO trigger for at least 10us high-level signal,

(2) The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.

(3) 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.

❖ **Wire connecting directly as following:**

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

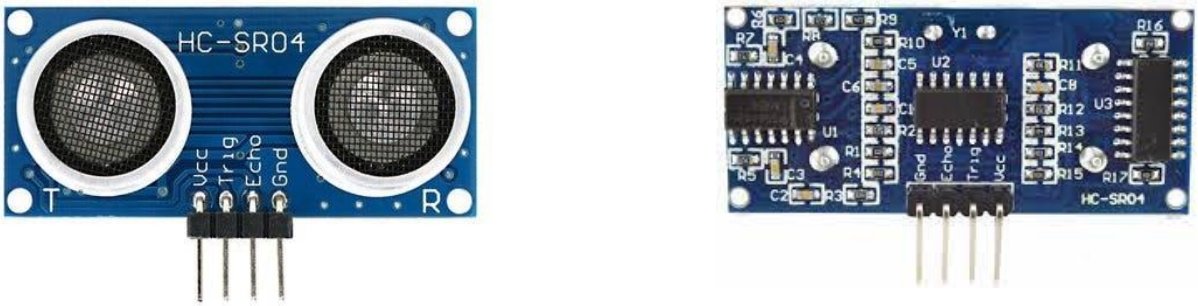

Figure 4 – Ultrasonic HC SR04

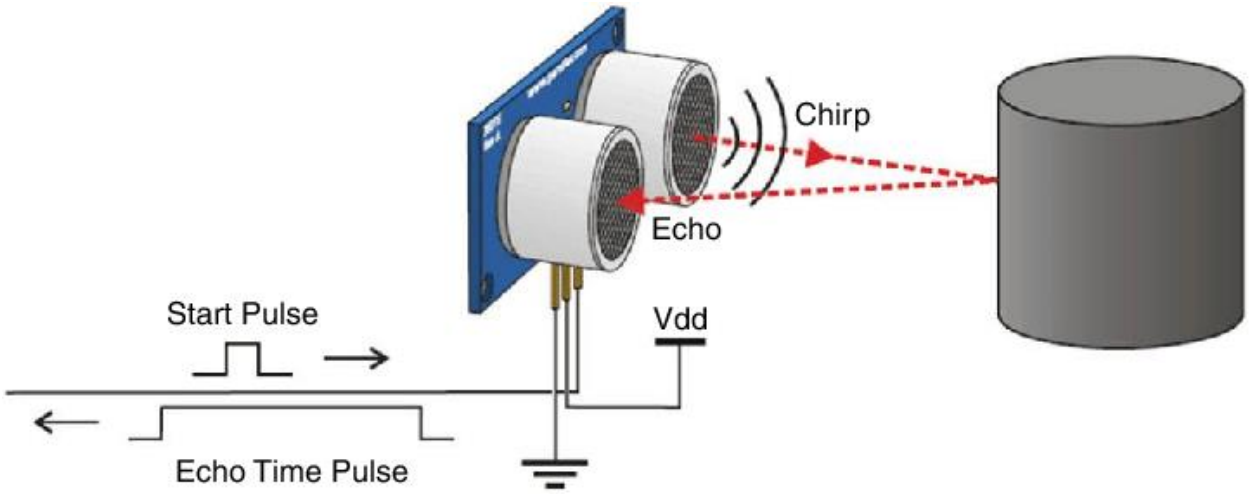

Figure 5 – Ultrasonic Sensor Working Principle

➢ Servo Motor tower pro micro servo 9g:

Tiny and lightweight with high output power. The servo can rotate approximately 180 degrees (90 in each direction), and works just like the standard kinds but smaller Fig-6. You can use any servo code, hardware or library to control these servos.

❖ Specifications

- Weight: 9 g
- Dimension: 22.2 x 11.8 x 31 mm approx.
- Stall torque: 1.8 kg f cm
- Operating speed: 0.1 s/60 degree
- Operating voltage: 4.8 V (~5V)
- Temperature range: 0 ºC – 55 ºC

Figure 6 – Servo Motor Tower Pro Micro Servo 9g

➢ Output:

After uploading the code, the servo motors start running from 0 to 180 degrees and again back to 0 degrees. An ultrasonic sensor also rotates along with the servo as it is mounted on the motor.

Now, open the processing application and paste the above code. In this code, update the COM port number where your Arduino board is connected.

Now, run this processing code. If your code is right then, you will get a new window. This is the graphical representation of data from the Ultrasonic Sensor is represented in a radar type display.

If an ultrasonic sensor detects any object within its range, you can see the same on the graphical representation. The below gif shows the output of the Arduino radar project.

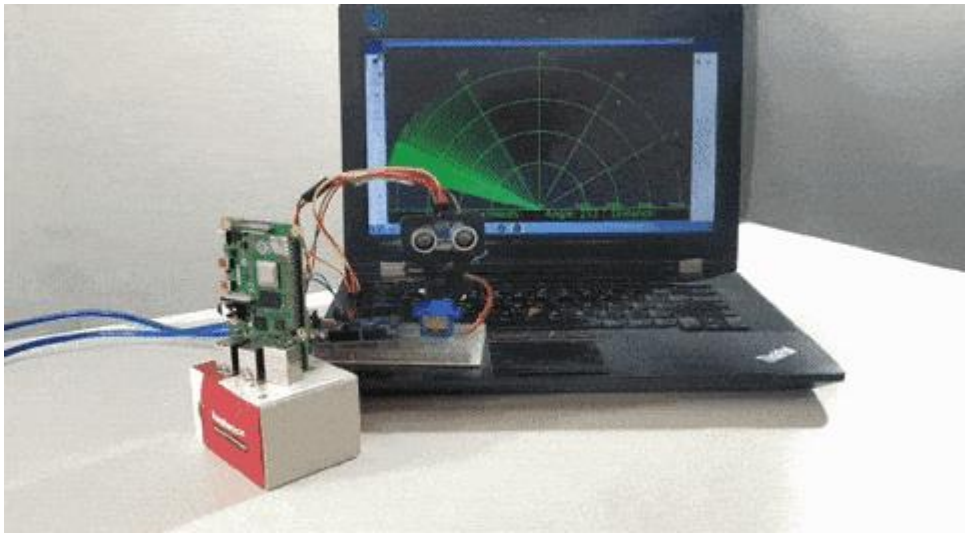

Figure 7 – Final State of Mini Rader System

➢ Conclusion

Radar is normally used to determine velocity, range, and position of an object. In this technical project, we read the distance and angles of detected objects in order to convert these data into visual information. The performance of our project is so good. It works smoothly to detect objects within the designed range. The screen shows the information clearly with enough delay for the user to read it. This project could be helpful for object avoidance/ detection applications. This project could easily be extended and could be used in any systems may need it.