THE NATIONAL INSTITUTE OF ENGINEERING

MYSURU-570008

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

MINI PROJECT [EC0201] –VI Semester

Synopsis On

ARDUINO BASED RADAR SYSTEM

Under the guidance of:

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Contents

1. AIM:

To build an Arduino based 360-degree RADAR system using HC-SR04 Ultrasonic sensor and a Stepper Motor**.**

2. INTRODUCTION:

Radar is an object-detection system that uses radio waves to determine the range, angle, or velocity of objects. It can be used to detect aircraft, ships, spacecraft, guided missiles, motor vehicles, weather formations, and terrain. A radar system consists of a transmitter producing electromagnetic waves in the radio or microwaves domain, a transmitting antenna, a receiving antenna (often the same antenna is used for transmitting and receiving) and a receiver and processor to determine properties of the object(s). Radio waves (pulsed or continuous) from the transmitter reflect off the object and return to the receiver, giving information about the object's location and speed.

3. COMPONENTS REQUIRED:

1) Arduino Uno board
2) HC-SR04 Ultrasonic Distance Sensor
3) Stepper motor
4) SN754410 H-Bridge motor driver
5) LM7805 5V voltage regulator
6) 100µF electrolytic capacitor (1)
7) 100nF capacitor (1)
8) Perforated board (1)
9) 9V batteries and connectors (2)
10) alligator clips (2)
11) connection wire
12) soldering iron and solder
13) solderless breadboard

3.1. Arduino Uno board:

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

3.2. HC-SR04 Ultrasonic Distance Sensor:

This is the HC-SR04 ultrasonic ranging sensor. This economical sensor provides 2cm to 400cm of non-contact measurement functionality with a ranging accuracy that can reach up to 3mm. Each HC-SR04 module includes an ultrasonic transmitter, a receiver and a control circuit.

There are only four pins that you need to worry about on the HC-SR04: VCC (Power), Trig (Trigger), Echo (Receive), and GND (Ground).

3.3. Stepper motor:

A stepper motor or step motor or stepping motor is a brushless DC electric motor that divides a full rotation into a number of equal steps. The motor's position can then be commanded to move and hold at one of these steps without any position sensor for feedback (an open-loop controller), as long as the motor is carefully sized to the application in respect to torque and speed.

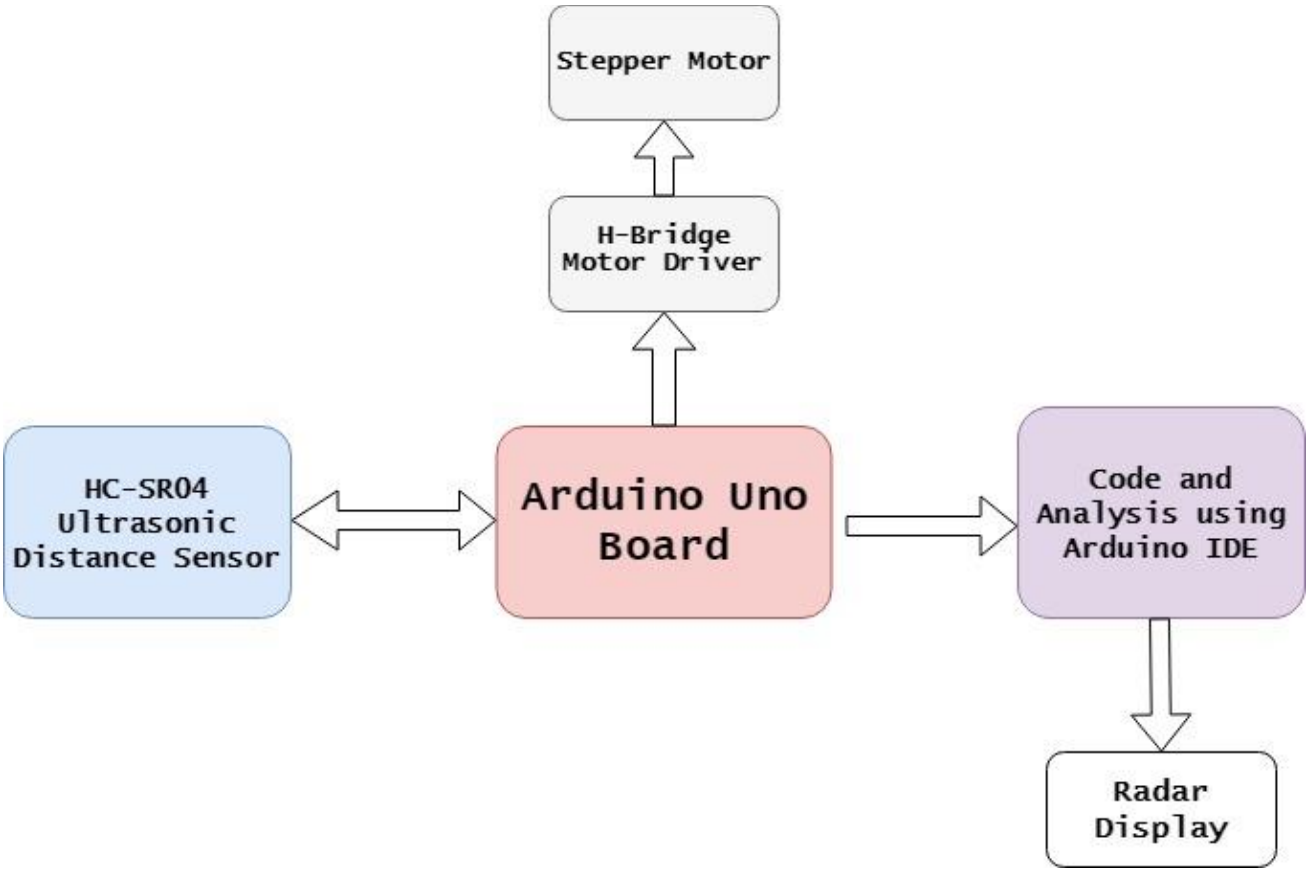
3.4. LM7805 5V voltage regulator:

Voltage sources in a circuit may have fluctuations resulting in not providing fixed voltage outputs. A voltage regulator IC maintains the output voltage at a constant value. 7805 IC, a member of 78xx series of fixed linear voltage regulators used to maintain such fluctuations, is a popular voltage regulator integrated circuit (IC). The xx in 78xx indicates the output voltage it provides. 7805 IC provides +5 volts regulated power supply with provisions to add a heat sink.

3.5. Arduino Software IDE:

The open-source Arduino Software (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.

4. BLOCK DIAGRAM:



4.1. BLOCK DIAGRAM DESCRIPTION:

4.1.1. Radar Display: It is used to display the value of range of the target, angle at which it is present and the space around the Radar System. Here we use Laptop for displaying this.

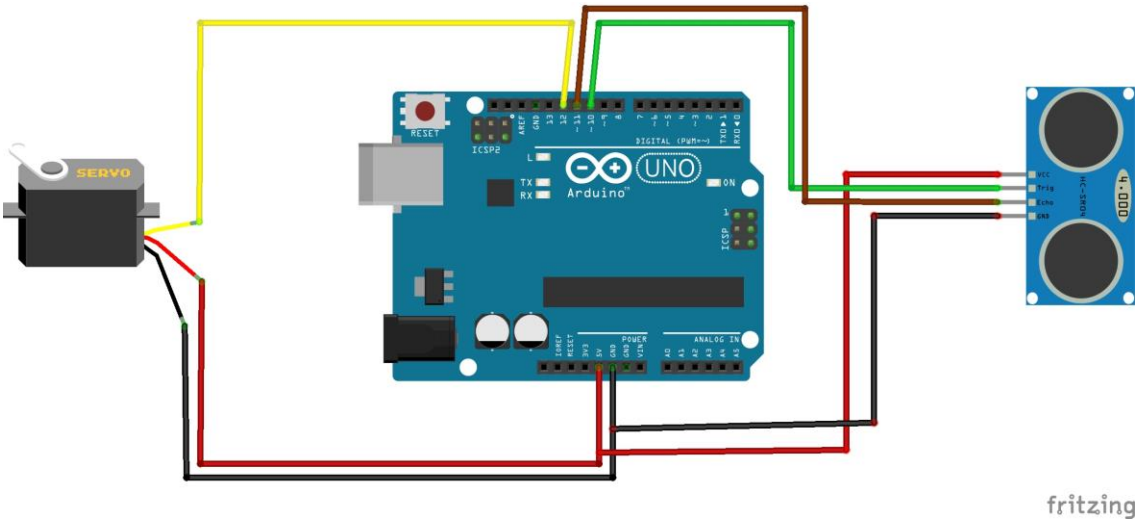
4.1.2. Arduino: It is the main component of the Radar System which controls the Stepper Motor through a Motor Driver IC so that 360 degrees is covered and also reads the data from the Ultrasonic Sensor and interprets it accordingly.

4.1.3. Utrasonic sensor: It is the one which gives the exact location of the target and its distance, angle around the space covering the Radar.

4.1.4. Stepper Motor: It is used to rotate the entire Radar System so that the entire space gets scanned.

4.1.5. Motor Driver: A Motor Driver IC is used to interface a Stepper Motor according to our necessity.

5. INTERNAL CONNECTIONS:



6. WORKING:

The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver module. **Distance = Speed × Time.**

Now, to calculate the distance using the above formulae, we should know the Speed and time. Since we are using the Ultrasonic wave we know the universal speed of US wave at room conditions which is 330m/s. The circuitry inbuilt on the module will calculate the time taken for the US wave to come back and turns on the echo pin high for that same particular amount of time, this way we can also know the time taken. Now simply calculate the distance using a microcontroller or microprocessor.

Arduino Uno Board is the microprocessor used here; it reads the data from the Ultrasonic Sensor and with the help of Arduino IDE and Processing library, it displays the Radar Map.

7. APPLICATIONS:

Military Applications:

- In air defense it is used for target detection, target recognition and weapon control (directing the weapon to the tracked targets).
- In missile system to guide the weapon.
- Identifying enemy locations in map.

Air Traffic Control:

- To control air traffic near airports. The Air Surveillance RADAR is used to detect and display the aircraft's position in the airport terminals.
- To guide the aircraft to land in bad weather using Precision Approach RADAR.
- To scan the airport surface for aircraft and ground vehicle positions

Remote Sensing: RADAR can be used for observing weather or observing planetary positions and monitoring sea ice to ensure smooth route for ships.

Ground Traffic Control: RADAR can also be used by traffic police to determine speed of the vehicle, controlling the movement of vehicles by giving warnings about presence of other vehicles or any other obstacles behind them.

Space:

- To guide the space vehicle for safe landing on moon
- To observe the planetary systems
- To detect and track satellites
- To monitor the meteors

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