Khulna University of Engineering and Technology

CSE 3104: Peripherals and Interfacing Laboratory

Project Name: Ultrasonic Based Arduino Radar System

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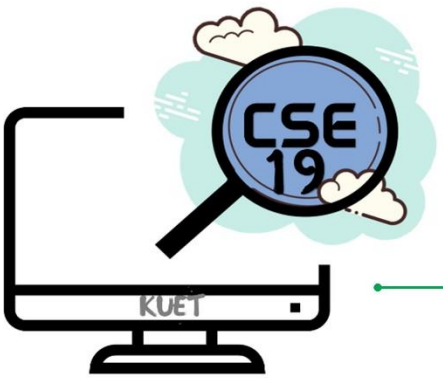

Objectives:

- ✓ To provide an overview of the Arduino radar project, including its purpose and system architecture.
- ✓ To explain the functionality of the Arduino radar system, including object detection and measurement capabilities.
- ✓ To evaluate the performance of the Arduino radar system through experimental measurements.
- ✓ To identify potential areas of improvement for the Arduino radar project.

Introduction:

The Arduino radar system project combines electronics, programming, and sensor technology to create a radar-like system using an Arduino board. Radars are commonly used for detecting and tracking objects in various fields, such as aviation, meteorology, and traffic control. With this project, we built a simplified radar system that can detect objects within a certain range and display their presence on a visual interface.

Required Hardware Equipment:

1. Arduino Uno
2. Servo Motor
3. Ultrasonic Sonar Sensor HC- SR04
4. LCD Display (16x2)
5. Active Buzzer
6. 50K Ohm Potentiometer
7. Mount
8. Bread Board
9. Connecting Wires

Required Software Equipment:

1. Arduino IDE
2. Processing IDE

Working Principle:

- ✓ The project typically involves utilizing an ultrasonic distance sensor and a servo motor to scan the surroundings.
- ✓ The ultrasonic sensor emits high-frequency sound waves and measures the time it takes for the waves to bounce back after hitting an object. By calculating the time delay, the distance between the sensor and the object can be determined.
- ✓ The servo motor is used to rotate the sensor, allowing it to scan the area in different directions.
- ✓ Using the data obtained from the sensor, the Arduino board processes the information and provides a visual representation of the detected objects.
- ✓ An additional 'Processing' IDE along with Arduino is used to display the output which involves visualization of the detected object and its position and angle as well.
- ✓ An LCD display is connected with the bread board along with Arduino in order to count the total detected objects.

Arduino Pseudocode:

```
Include <libraries>
Define variables, constants and objects

Void Setup () {
    Define pins and modes
    Initiate serial output and LCD display
}

Void Loop () {
    Loop (15 to 165 degrees) {
        Calculate distance
        Serial outputs
        Buzzer Condition
        Display count Condition
    }
    Print on LCD display
```

```
    Loop (165 to 15 degrees) {
        Calculate distance
        Serial outputs
        Buzzer Condition
        Display count Condition
    }
    Print on LCD display
}

Calculate Distance () {
    Trigger pin manipulation
    Calculate duration
    Measure distance using data
    Return distance
}
```

Processing IDE Pseudocode:

```
Import <libraries>
Define variables, constants and objects

Void Setup () {
    Initialize screen
    Receive serial port inputs
    Define buffers and fonts
}

Void Draw () {
    Initialize screens and fonts
    Call other drawing related functions
}
```

```
Void Serial Event () {
        Read serial data
        Divide serial data into required parts
}

Void Draw Radar () {
        Initialize and create radar background and co-ordinates
}

Void Draw Object () {
        Initialize and create object detection lines
        Initialize object detection conditions
}

Void Draw Line () {
        Initialize and create lines for radar mapping
}

Void Draw Text () {
        Initialize and create textual outputs
        Initialize text conditions
}
```

Project Snapshots:

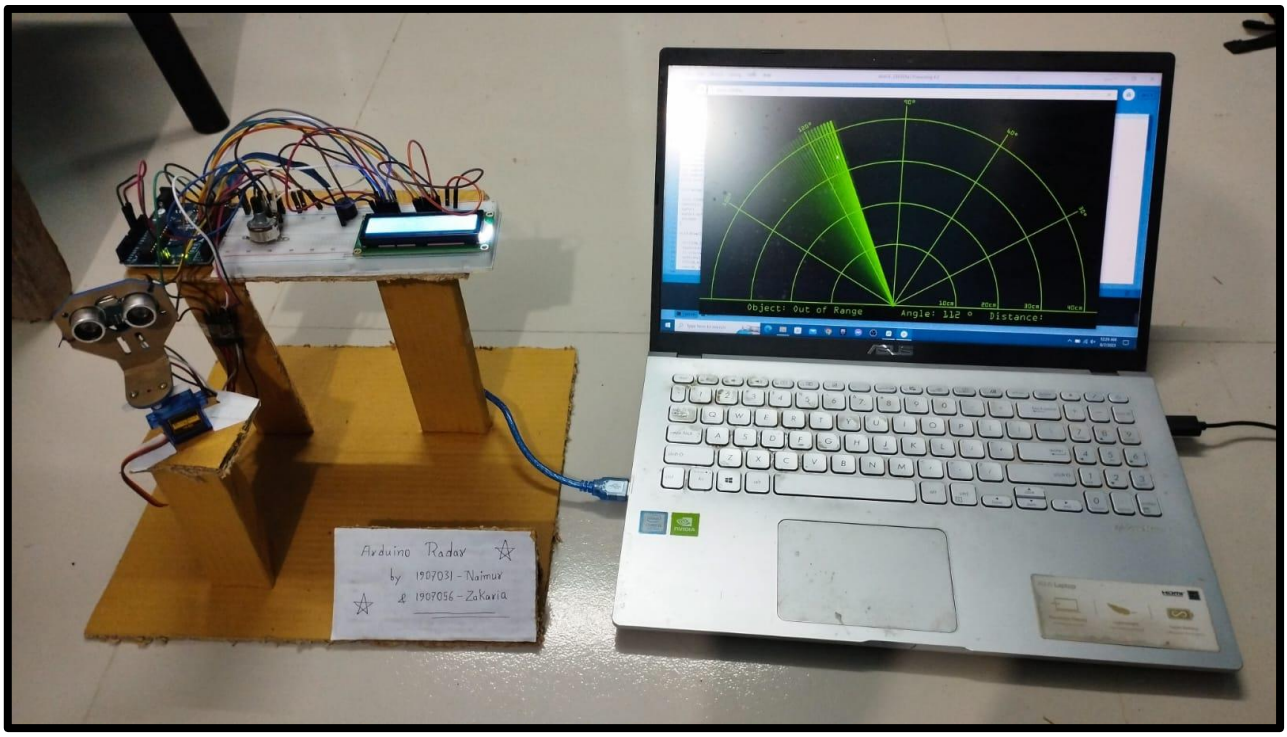

Figure-1.1: Full Front View

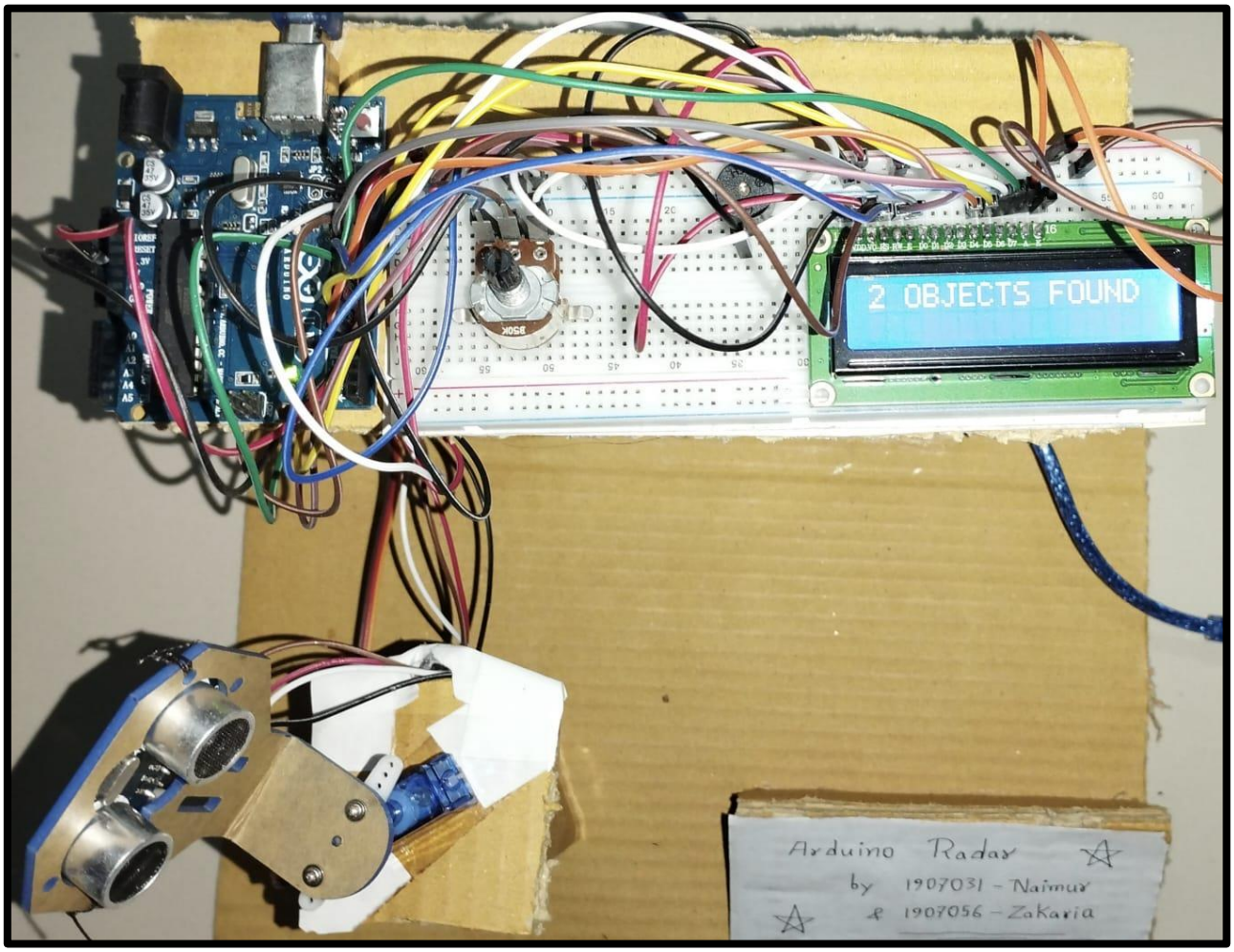

Figure-1.2: Top View

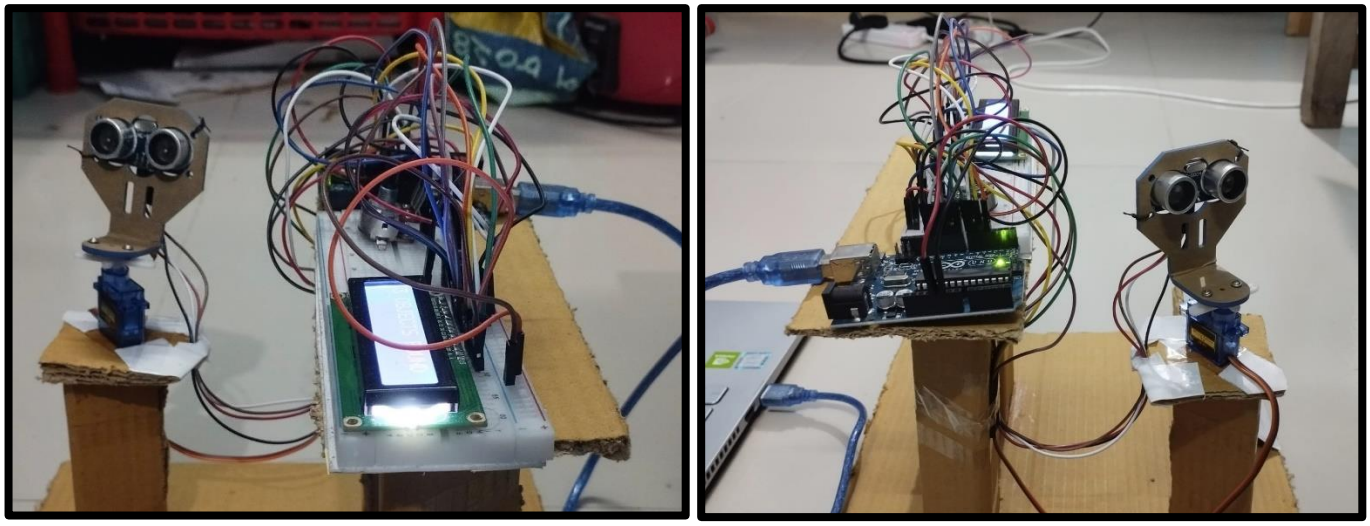

Figure-1.3: Side Views

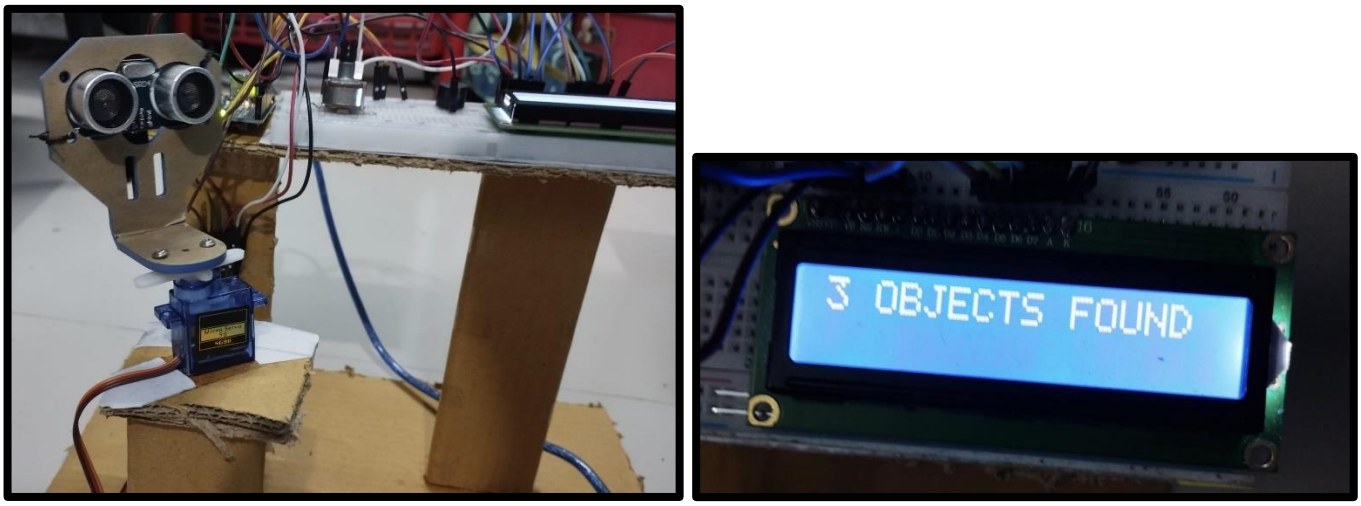

Figure-1.4: Ultrasonic Sonar Sensor & LCD Total Object Count Display

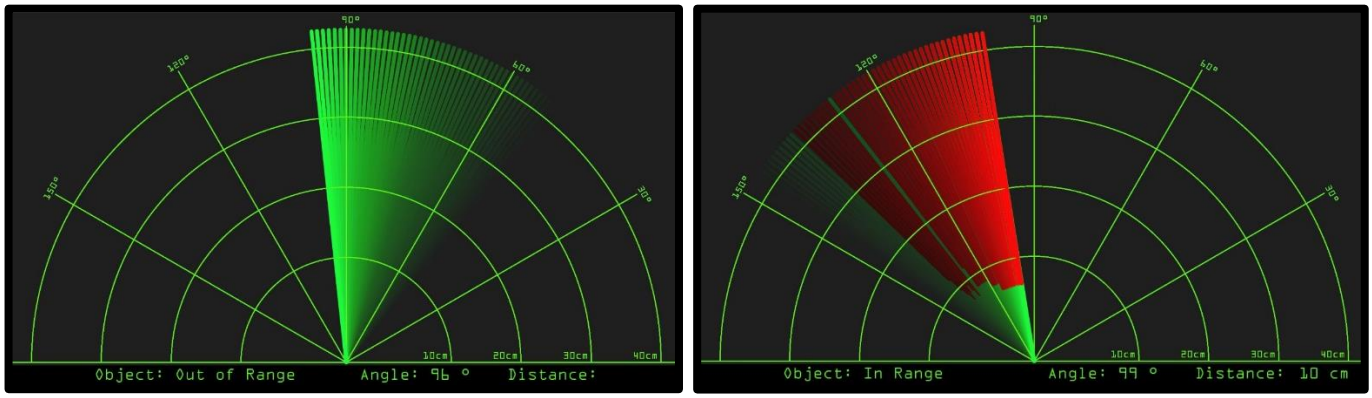

Figure-1.5: No Objects Detected vs Object Detected

Real Life Applications:

1. Collision avoidance in vehicles.
2. Home security intrusion detection.
3. Industrial automation object detection and tracking.
4. Environmental monitoring for water level measurement.
5. Robotics obstacle avoidance.
6. Traffic monitoring for speed measurement.
7. Medical imaging for non-invasive diagnostics.
8. Search and rescue operations for locating missing persons.
9. Weather monitoring for precipitation detection.
10. Smart agriculture for crop monitoring.

Limitations:

- ✓ Range limitation: Arduino radar systems may have a limited detection range, which can impact their effectiveness in detecting objects at longer distances.
- ✓ Resolution limitation: The radar system's resolution may affect the accuracy and level of detail in object detection, potentially leading to false positives or missed detections.
- ✓ Environmental interference: Factors such as weather conditions, reflective surfaces, or electromagnetic interference can interfere with radar signals and impact the system's performance.
- ✓ Power consumption: Arduino radar systems may consume a significant amount of power, which can be a limitation in battery-powered or energy-efficient applications.
- ✓ Signal processing complexity: The processing capabilities of Arduino boards may limit the complexity of signal processing algorithms used in radar systems, potentially affecting their performance in advanced applications.

Discussion:

Arduino radar systems have some limitations that should be considered. They may have a limited detection range and resolution, which can impact their effectiveness in detecting objects accurately and at longer distances. Environmental factors like weather conditions, reflective surfaces, and electromagnetic interference can interfere with radar signals, affecting the system's performance. Additionally, power consumption can be significant, making them less suitable for battery-powered applications. Finally, the processing

capabilities of Arduino boards may limit the complexity of signal processing algorithms, which can impact their performance in more advanced applications.

Conclusion:

For a beginner or an experienced Arduino enthusiast, the radar system project provides a hands-on experience in building a functional and engaging electronic project. The Arduino radar system project is a great way to learn and explore various aspects of electronics, programming, and sensor integration. It offers an opportunity to understand concepts such as sensor interfacing, data processing, motor control, and visual display. Additionally, one can customize the project by adding features like audible or visual alerts for detected objects, or by integrating it with other devices or systems.

References:

- ✓ https://howtomechatronics.com/projects/arduino-radar-project/
- ✓ https://robu.in/arduino-radar-project-ultrasonic-based-radar-connection-and-code/
- ✓ https://www.hackster.io/noneedforit/arduino-radar-49127a
- ✓ https://www.instructables.com/Arduino-Radar-1/
- ✓ https://chat.openai.com/