DISTANCE MEASUREMENT USING ULTRASONIC SENSOR

National Institute of Technology

Andhra Pradesh

Old aerodrome, Near kondrupolu , Tadepalligudem , Andhra Pradesh 534101

Electronics and Communication Engineering

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NATIONAL INSTITUTE OF TECHNOLOGY

ANDHRA PRADESH

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December 07 ,2023

CERTIFICATE

This is to certify that we have successfully completed the project report entitled "***DISTANCE MEASUREMENT USING ULTRASONIC SENSOR*** " in partial fulfilment of the requirements for the degree of BTech in ECE at NIT Andhra Pradesh.

The project report was submitted on 07-12-23 and was supervised by **Mr.B.Thulasya Naik**. The project was of high quality and demonstrated a deep understanding of the subject matter. The students were able to apply their knowledge and skills to solve a real-world problem.

Signature

Abstract

Distance measurement sensors are essential components in various fields, including robotics, automation, and navigation systems. One such sensor that has gained significant attention is the ultrasonic sensor. This abstract aims to provide an overview of the ultrasonic sensor and its application in distance measurement.

The ultrasonic sensor utilizes sound waves with frequencies higher than the human audible range to measure the distance between the sensor and an object. It consists of a transmitter that emits ultrasonic waves and a receiver that detects the reflected waves. By measuring the time taken for the waves to travel and return, the sensor can accurately determine the distance.

In conclusion, the ultrasonic sensor is a valuable tool for distance measurement applications. Its non-contact nature, wide range of measurement capabilities, and ease of integration make it a popular choice in various industries. While it has certain limitations, proper calibration and environmental considerations can help mitigate these challenges. As technology continues to advance, the ultrasonic sensor is expected to further evolve, offering even more precise and reliable distance measurement solutions.

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Introduction

Distance measurement sensors are essential components in many fields, enabling accurate and reliable measurements of distances between objects. One such sensor that has gained significant popularity is the ultrasonic sensor. This introduction aims to provide a brief overview of ultrasonic sensors and their application in distance measurement.

Ultrasonic sensors utilize sound waves with frequencies higher than the audible range of humans to measure distances. They consist of a transmitter and a receiver, which work together to emit and detect ultrasonic waves. By measuring the time it takes for the sound waves to travel and return, the sensor can calculate the distance between itself and an object.

The key advantage of using ultrasonic sensors for distance measurement is their non-contact nature. Unlike sensors that require physical contact with the object, ultrasonic sensors can measure distances without any direct interaction. This makes them suitable for applications where contact may not be feasible or desirable, such as in industrial automation, robotics, and security systems.

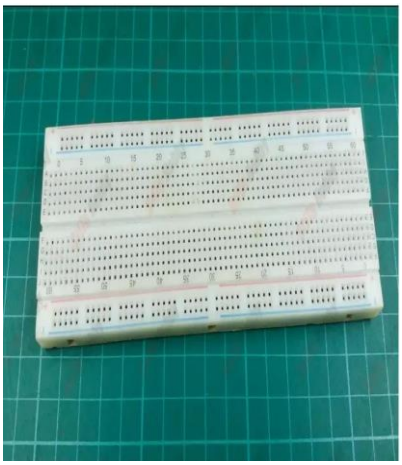
In conclusion, ultrasonic sensors provide a reliable and non-contact method for distance measurement. Their ability to accurately measure distances over a wide range, coupled with their ease of integration into existing systems, makes them a popular choice in many industries. As technology advances, ultrasonic sensors are expected to continue evolving, offering even more precise and efficient distance measurement solutions.

Component Set

1.ARDUINO NANO BOARD

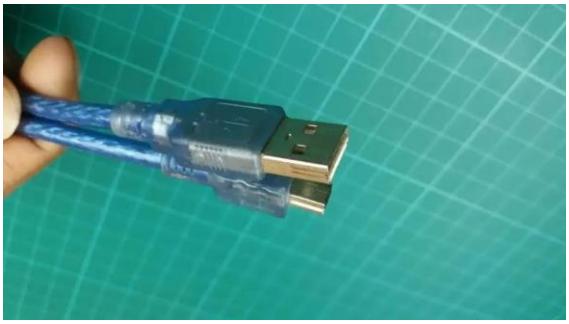
2. ULTRASONIC SENSOR

3.BREAD BOARD

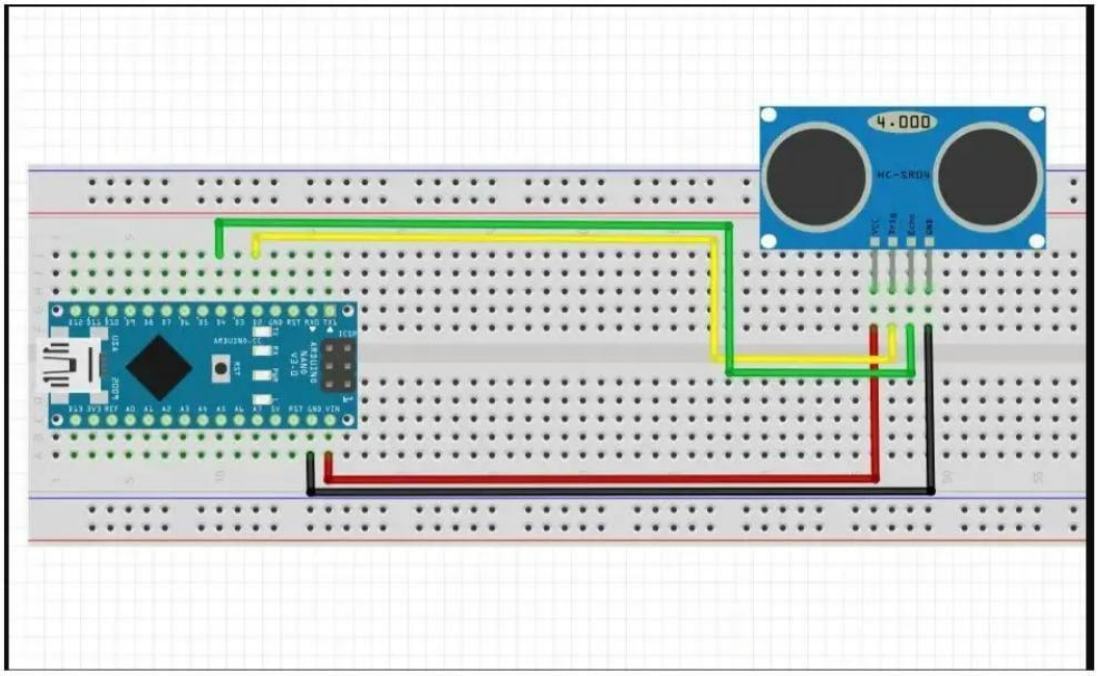


4. JUMPER WIRES

5.USB CABLE



Circuit Diagram



DESCRIPTION OF COMPONENTS:

1. ARDUINO NANO

The Arduino Nano is a compact and versatile microcontroller board based on the ATmega328P or ATmega168P chip. It features a USB interface for programming and power supply, making it suitable for a wide range of electronic projects. The Nano offers a variety of digital and analog I/O pins, enabling connections to sensors, and other electronic components. Its small form factor makes it ideal for projects with space constraints.

2.ULTRASONIC SENSOR

An ultrasonic sensor is a device that uses ultrasonic waves for distance measurement or object detection. It typically consists of a transmitter that emits ultrasonic waves and a receiver that detects the waves after they bounce off an object. By measuring the time it takes for the waves to travel to the object and back, the sensor can calculate the distance.

Ultrasonic sensors are commonly used in various applications, such as robotics, parking assistance systems, and industrial automation. They are known for their non-contact nature and reliability in providing distance information.

WORKING OF THE PROJECT

Distance measurement using an ultrasonic sensor involves sending ultrasonic waves towards an object and measuring the time it takes for the waves to return after bouncing off the object:

1.Trigger Signal: The microcontroller (often part of the system with the ultrasonic sensor) sends a short pulse, known as a trigger signal, to the ultrasonic sensor.

2. Ultrasonic Wave Emission: Upon receiving the trigger signal, the ultrasonic sensor emits a burst of ultrasonic waves. These waves travel through the air at the speed of sound.

3. Object Interaction: The ultrasonic waves encounter an object in their path. Upon hitting the object's surface, the waves are reflected back towards the sensor.

4. Echo Reception: The ultrasonic sensor's receiver detects the reflected waves, known as echoes. The sensor converts the received signal into an electrical impulse.

5. Time Measurement: The microcontroller measures the time it takes for the ultrasonic waves to travel to the object and back. This time is typically measured in microseconds.

6. Distance Calculation: Using the speed of sound in air (approximately 343 meters per second at room temperature), the microcontroller calculates the distance to the object. The formula is usually distance = (time * speed of sound) / 2.

7. Output: The calculated distance is then used for various applications, such as displaying the distance on a screen, triggering an action when an object is too close, or providing input for control systems.

This process is repeated continuously, allowing real-time monitoring of the distance between the sensor and the object. Keep in mind that factors like temperature and air pressure can affect the speed of sound, so calibration may be necessary for precise measurements.

SPECIFICATIONS:

HC-SR04 CHARACTERISTICS

Supply voltage: 5V (DC).

• Supply current: 15mA.

Modulation frequency: 40Hz.

Output: 0-5V (Output high when obstacle detected in range).

Beam Angle: Max 15 degree.

Theoretical measuring Distance: 2cm-400cm.

Accuracy: 0.3cm.

APPLICATIONS:

- Proximity Detection.
- Liquid Level Sensing.
- Obstacle Detection.
- Ranging/Distance Measurement.
- Anti Collision system.
- Contouring or Profiling.
- Presence Detection.
- Product Counting and Sorting.
- Anti Intrusion System.

ADVANTAGES

- Its small size makes it easy to integrate into projects.
- Ultrasonics can easily integrate with any type of controller.
- Its high frequency, sensitivity, and power make it easy to detect objects.
- It have greater accuracy than many other methods at measuring thickness and depth of a parallel surface.
- Ultrasonics are easy to use and not dangerous during operation.
- An inexpensive option.

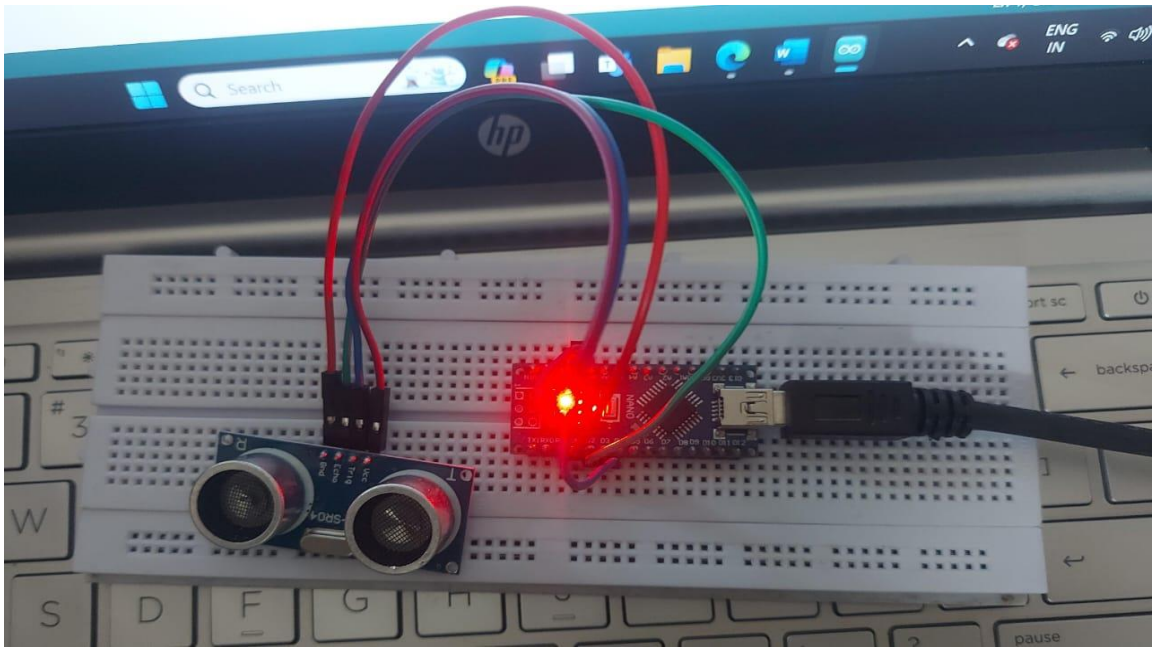
Code

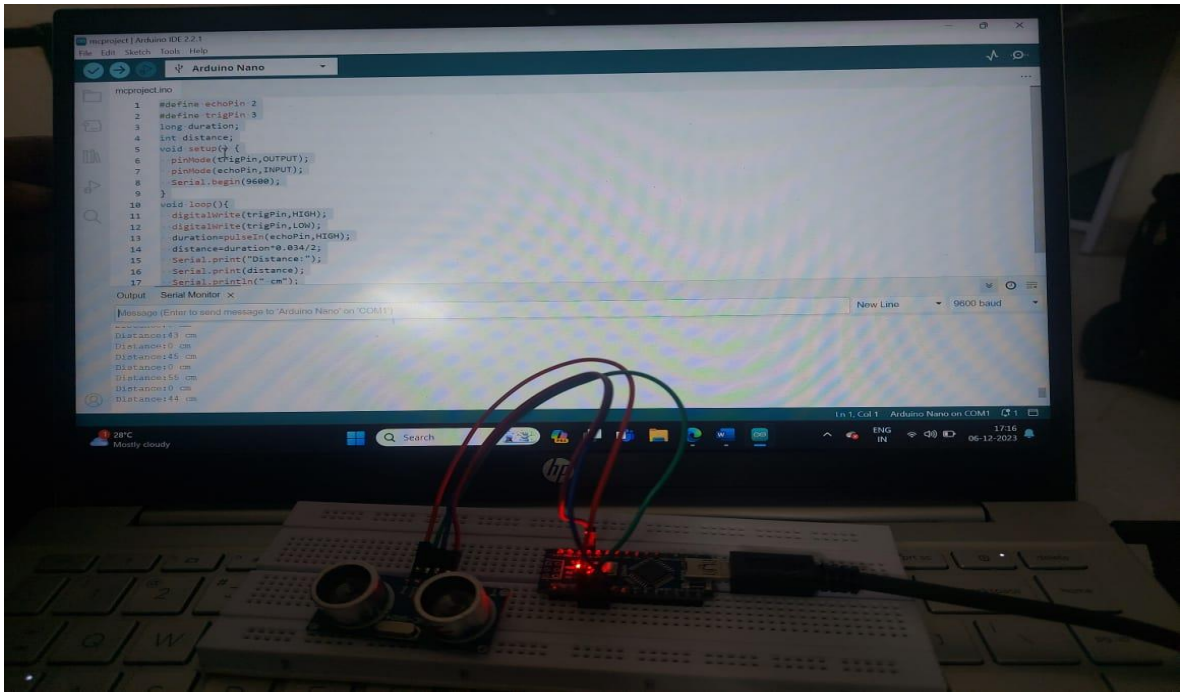
```
#define echoPin 2
#define trigPin 3
long duration;
int distance;
void setup() {
  pinMode(trigPin,OUTPUT);
  pinMode(echoPin,INPUT);
  Serial.begin(9600);
}
void loop(){
  digitalWrite(trigPin,HIGH);
  digitalWrite(trigPin,LOW);
  duration=pulseIn(echoPin,HIGH);
  distance=duration*0.034/2;
  Serial.print("Distance:");
  Serial.print(distance);
  Serial.println(" cm");

}
```

Result

The result of distance measurement using an ultrasonic sensor is typically a numerical value representing the distance between the sensor and the object or surface being measured. This distance is often provided in units such as centimeters or inches, depending on the specific sensor and its configuration.

For example, after sending ultrasonic waves and receiving echoes, the sensor measures the time it takes for the waves to travel to the object and back. Using the speed of sound in air, the sensor then calculates the distance and outputs this value. The result can be obtained through the sensor's analog or digital output, depending on the sensor's design.

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File Edit Sketch Tools Help
Arduino Nano
mcproject.ino
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duration=pulseIn(echoPin,HIGH);
distance=duration*0.034/2;
Serial.print("Distance:");
Serial.print(distance);
Serial.println(" cm");
Output Serial Monitor
Message (Enter to send message to 'Arduino Nano' on 'COM1')
New Line
9600 baud
Distance:43 cm
Distance:0 cm
Distance:45 cm
Distance:0 cm
Distance:55 cm
Distance:0 cm
Distance:44 cm
Ln 1, Col 1 Arduino Nano on COM1
28°C
Mostly cloudy
Search
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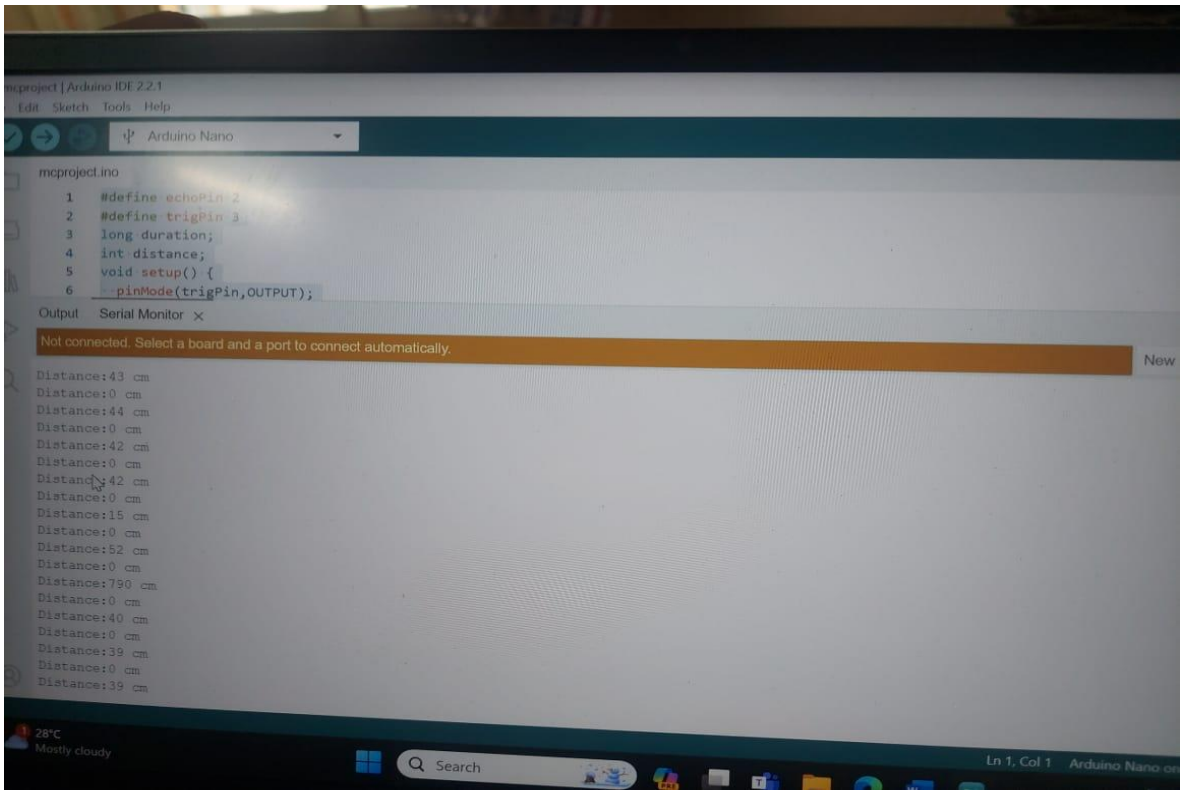
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Edit Sketch Tools Help
Arduino Nano
mcproject.ino
#define echoPin 2
#define trigPin 3
long duration;
int distance;
void setup() {
pinMode(trigPin,OUTPUT);
Output Serial Monitor
Not connected. Select a board and a port to connect automatically.
New
Distance:43 cm
Distance:0 cm
Distance:44 cm
Distance:0 cm
Distance:42 cm
Distance:0 cm
Distance:42 cm
Distance:0 cm
Distance:15 cm
Distance:0 cm
Distance:52 cm
Distance:0 cm
Distance:790 cm
Distance:0 cm
Distance:40 cm
Distance:0 cm
Distance:39 cm
Distance:0 cm
Distance:39 cm
28°C
Mostly cloudy
Search
Ln 1, Col 1 Arduino Nano