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TITLE:

OBJECT RANGE DETECTION SENSOR USING ULTRASONIC SENSOR AND ARDUINO UNO

TEAM MEMBERS DETAILS:

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COURSE CODE AND NAME: BECE320E – Embedded C Programming

Abstract:

The objective of this project is to design and implement an Object Range Detection Sensor system using an ultrasonic sensor and Arduino Uno, as the core controller. In today's world, object detection plays a critical role in numerous fields, including robotics, automotive safety, industrial automation and assistive devices for the visually impaired. This system aims to measure the distance of any object in front of it and alert users based on the proximity using a set of LED indicators and a buzzer.

The core sensing element, the HC-SR04 ultrasonic sensor, emits ultrasonic waves and calculates the time it takes for the echo to return, thus computing the distance. Depending on the measured distance, the Arduino triggers three LEDs (green for safe, yellow for caution & red for danger) and a buzzer to warn of very close obstacles. The design is cost-effective, simple and highly efficient for small-scale range detection applications.

By integrating visual and auditory feedback mechanisms, the system ensures enhanced user awareness in real time. It can be implemented in parking assistance systems, robotic obstacle detection and smart surveillance systems. The project demonstrates the power of embedded systems in building intelligent sensing devices using minimal components.

Components:

Hardware:

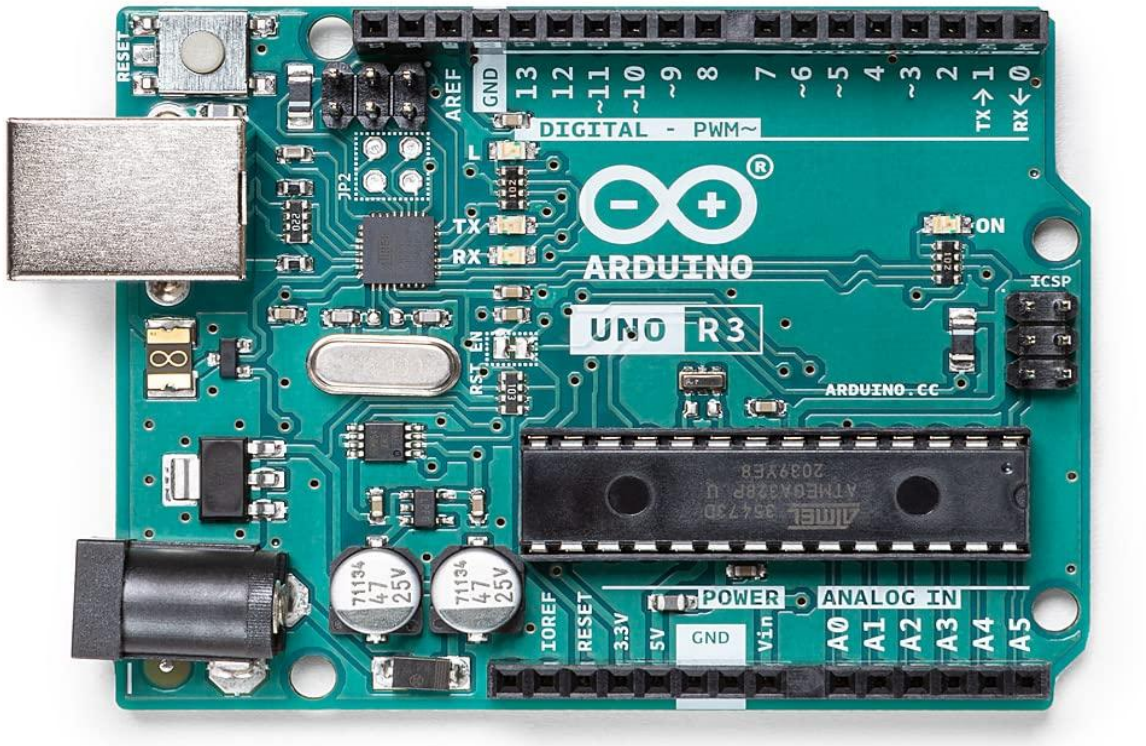
1. Arduino UNO
2. Ultrasonic Sensor
3. LEDs
4. Buzzer
5. Resistors

Software:

1. Arduino IDE

Hardware:

1. **Arduino UNO:**



A microcontroller board that acts as the brain of the system. It reads signals from the ultrasonic sensor, processes the distance data and controls LEDs.

2. **Ultrasonic Sensor:**

It is an (HC-SR04). Measures distance by emitting ultrasonic waves and calculating time taken for the echo to return.

3. **LEDs**

Provide visual indication of object proximity:

Red → Danger (Object is too Close)

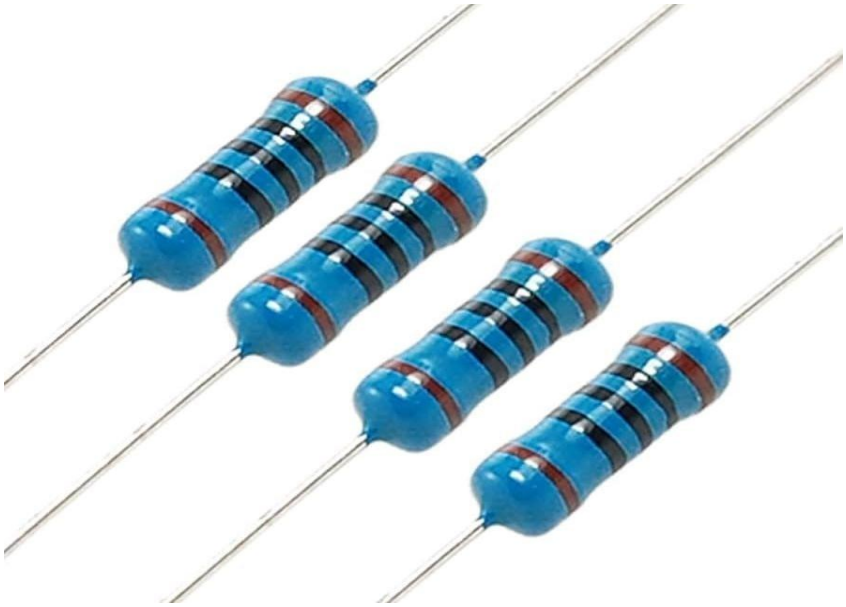
Yellow → Caution (Object is at a moderate distance)

Green → Safe Distance (Object is at a distance > 30 cm)

4. **Buzzer:**

Provides audible alerts when an object is too close. It turns ON only when RED LED is triggered.

5. **Resistors:**



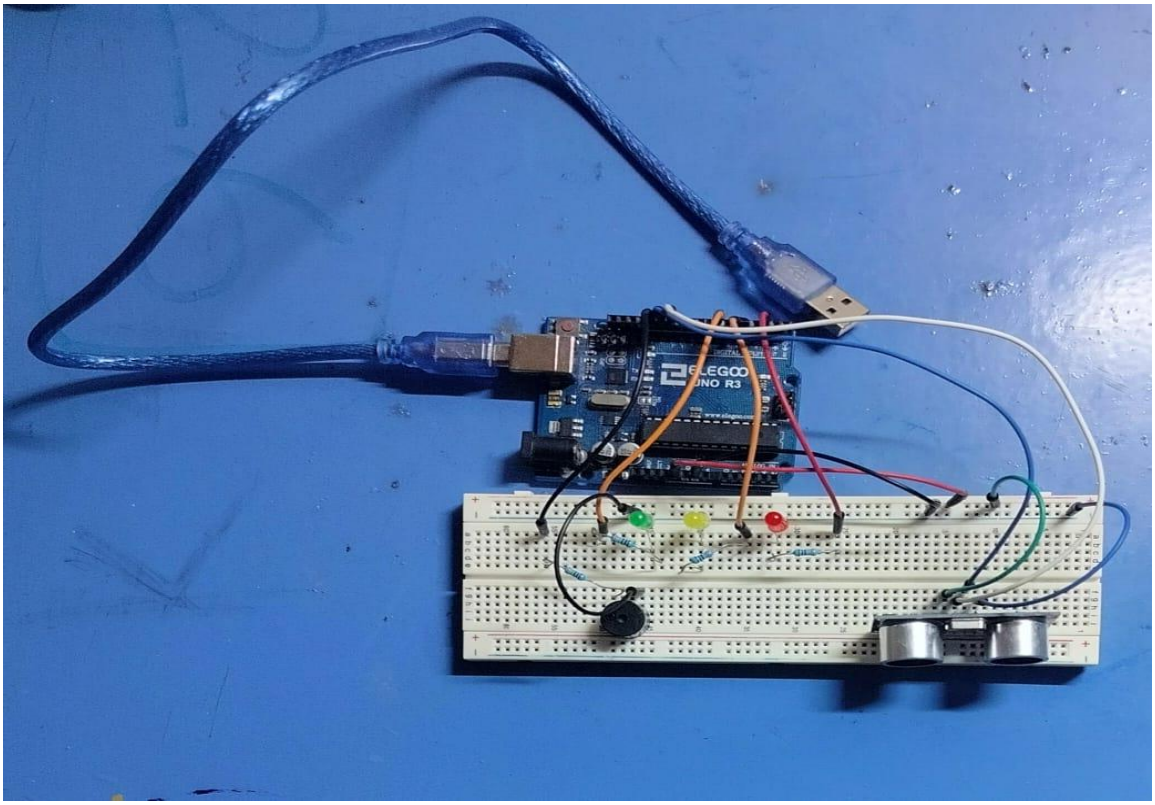
Protect the LEDs from drawing too much current and burning out.

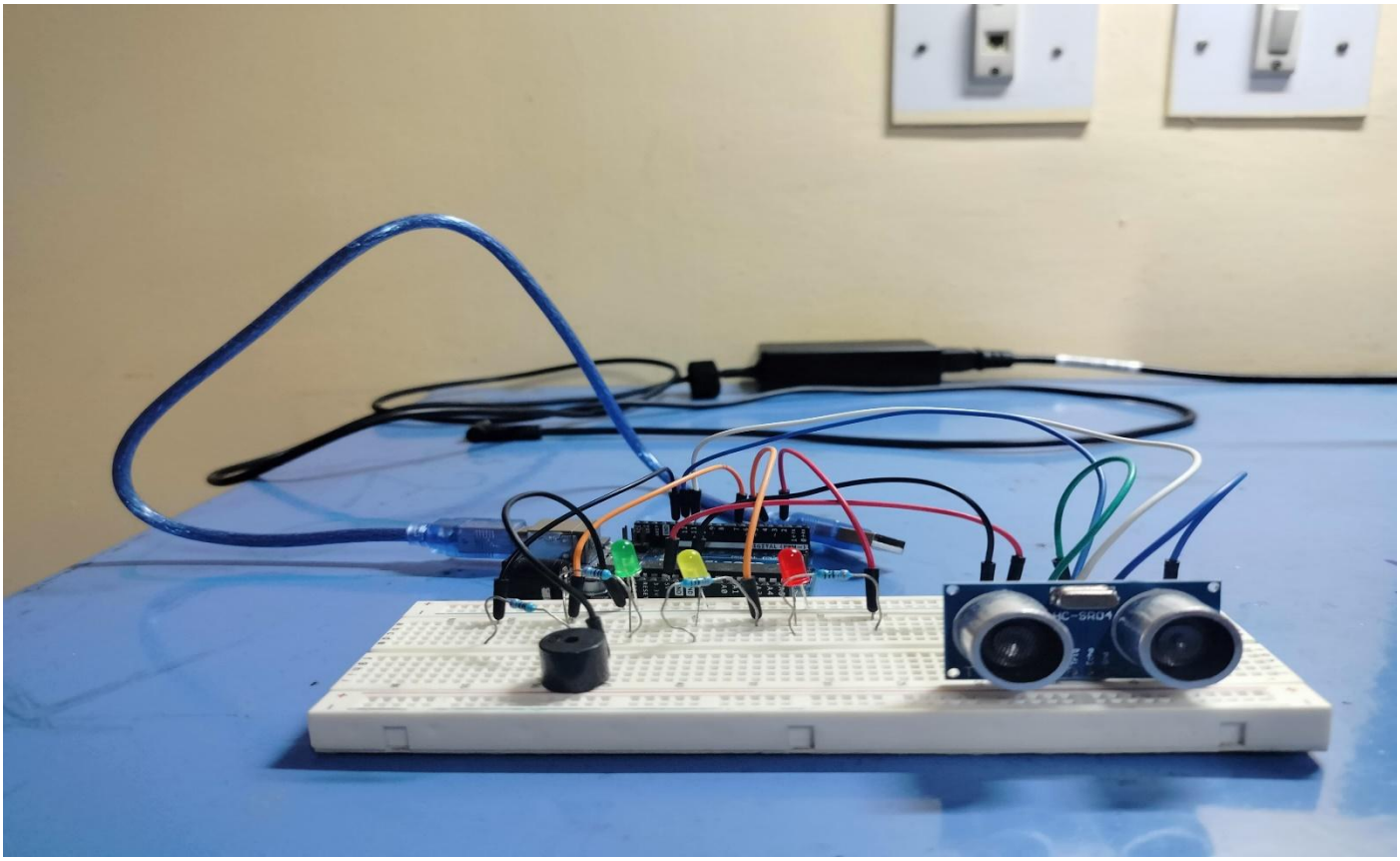
Software:

1. **Arduino IDE:**

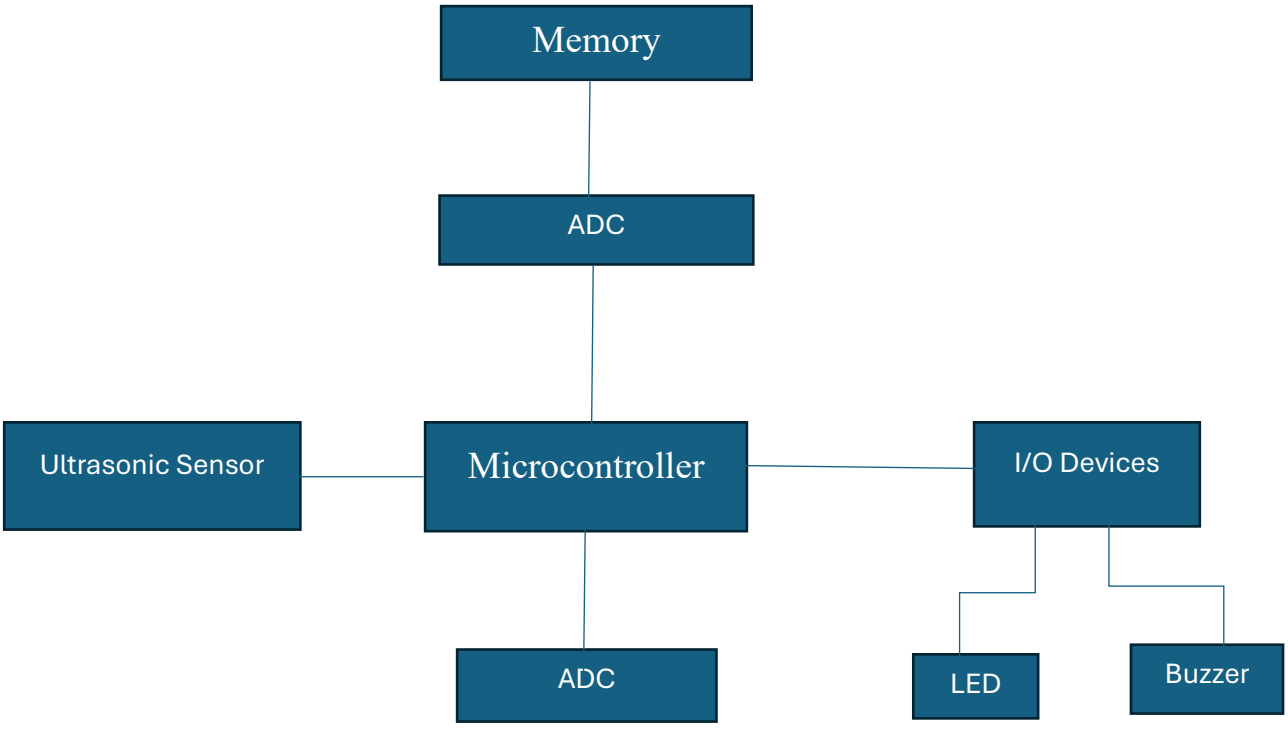
Used to write, compile, and upload code to Arduino Uno board

Circuit Diagram:

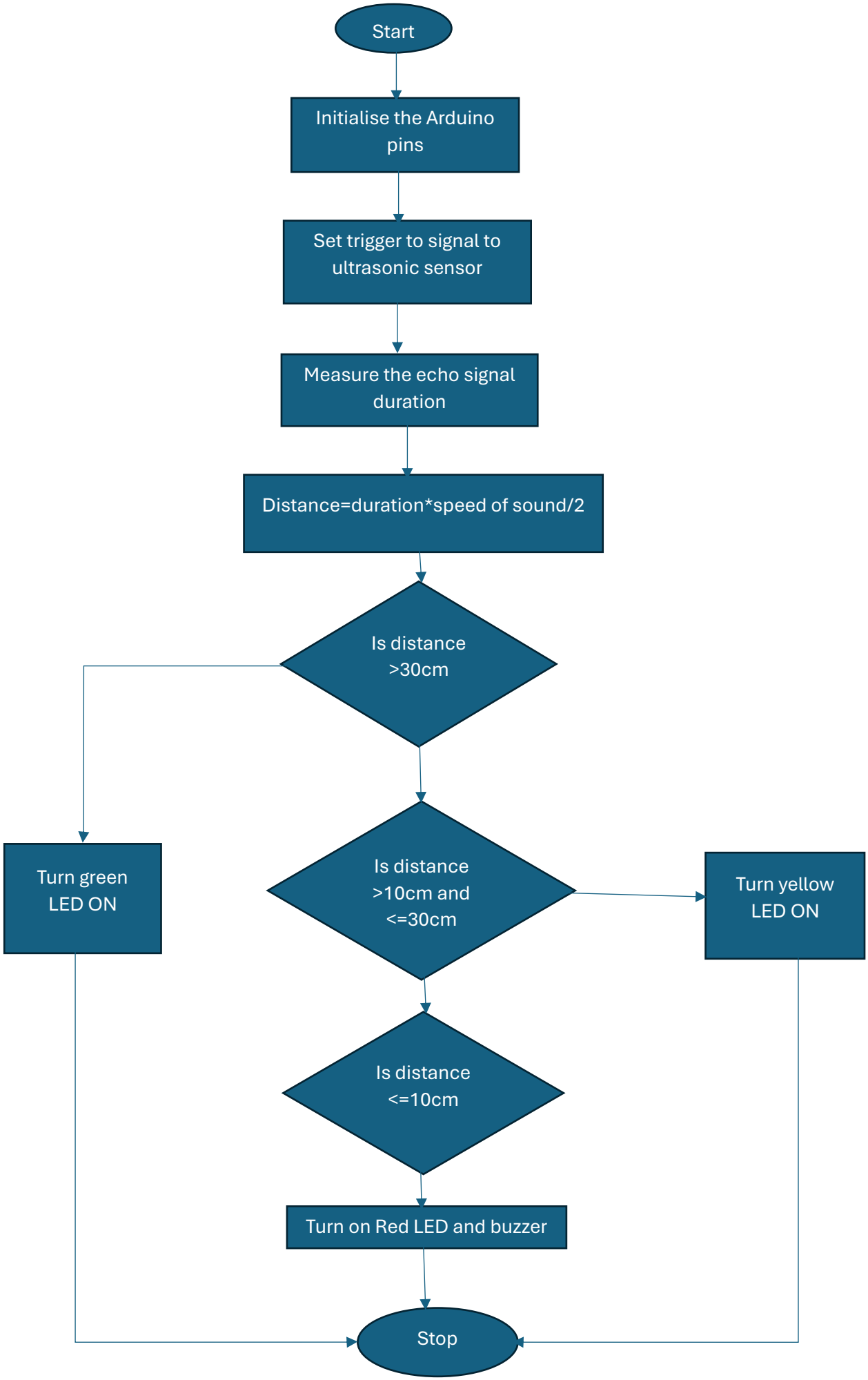




Block Diagram:



Flowchart:


Start
Initialise the Arduino pins
Set trigger to signal to ultrasonic sensor
Measure the echo signal duration
Distance=duration*speed of sound/2
Is distance >30cm
Turn green LED ON
Is distance >10cm and <=30cm
Turn yellow LED ON
Is distance <=10cm
Turn on Red LED and buzzer
Stop

Methodology:

Pin Configuration

- TRIG_PIN (11) – Trigger pin of ultrasonic sensor.
- ECHO_PIN (12) – Echo pin of ultrasonic sensor.
- RED_LED (2) – Indicates danger (object too close).
- YELLOW_LED (4) – Indicates caution (object nearby).
- GREEN_LED (7) – Indicates safe distance.
- BUZZER (13) – Beeps when object is too close.

The **ultrasonic sensor** emits a sound wave using the trigger pin.

The sound wave reflects off a nearby object and returns to the echo pin.

The Arduino calculates the **time taken** for the echo to return and converts it to **distance** using the speed of sound.

Based on the measured distance, the system:

- **Above 30 cm**: Lights **green LED** (Safe).
- **Between 10 cm and 30 cm**: Lights **yellow LED** (Caution).
- **Below 10 cm**: Lights **red LED** and activates **buzzer** (Danger).

Software Flow

- Setup:

  Configure pins for input/output.

  Initialize Serial Monitor for debugging.

- Loop:

  Measure the distance using the ultrasonic sensor.

  Display the distance on the Serial Monitor.

  Control LEDs and buzzer based on the measured distance.

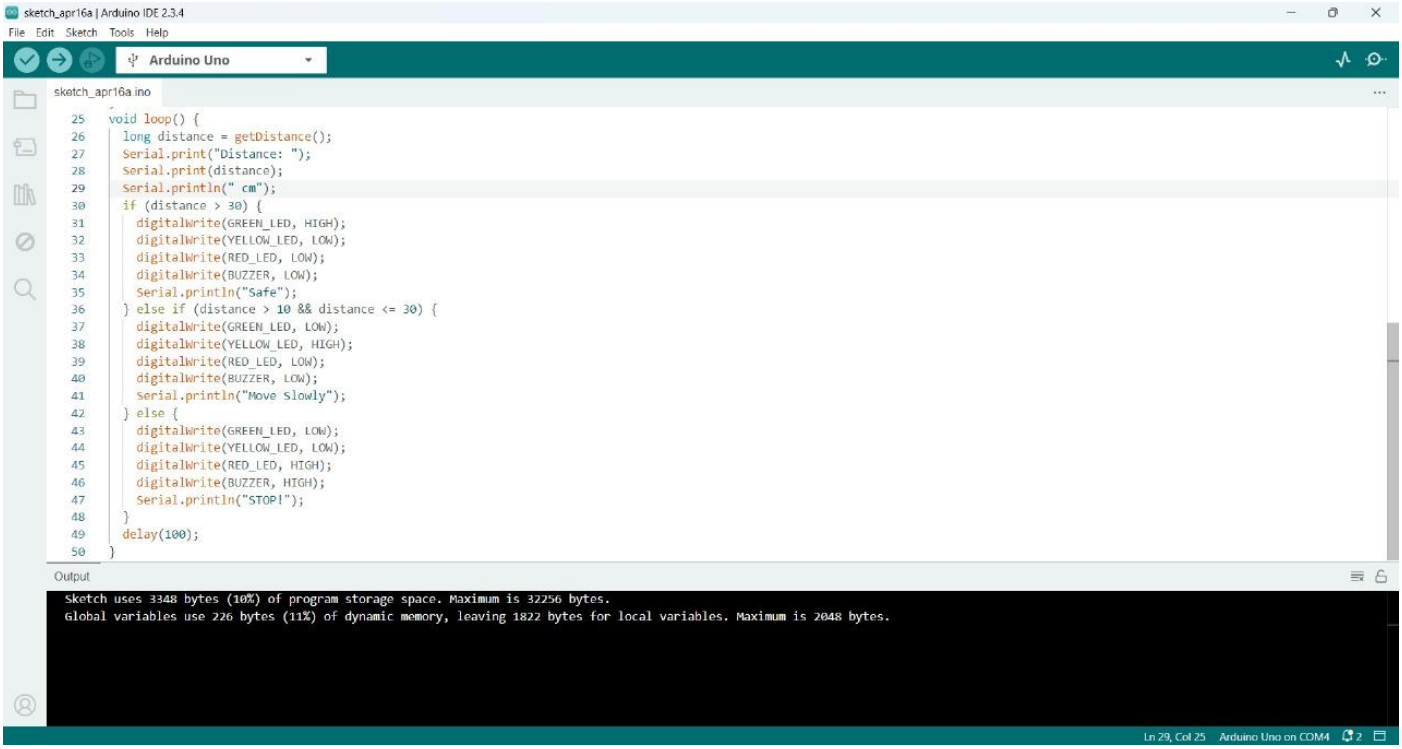
  Add a short delay for sensor stability.

CODE:

```
#define TRIG_PIN 11
#define ECHO_PIN 12
#define RED_LED 2
#define YELLOW_LED 4
#define GREEN_LED 7
#define BUZZER 13

void setup() {
  pinMode(TRIG_PIN, OUTPUT);
  pinMode(ECHO_PIN, INPUT);
  pinMode(RED_LED, OUTPUT);
  pinMode(YELLOW_LED, OUTPUT);
  pinMode(GREEN_LED, OUTPUT);
  pinMode(BUZZER, OUTPUT);
  Serial.begin(9600);
}

long getDistance() {
  digitalWrite(TRIG_PIN, LOW);
  delayMicroseconds(2);
  digitalWrite(TRIG_PIN, HIGH);
  delayMicroseconds(10);
  digitalWrite(TRIG_PIN, LOW);
  long duration = pulseIn(ECHO_PIN, HIGH);
  return duration * 0.034 / 2;
}
```

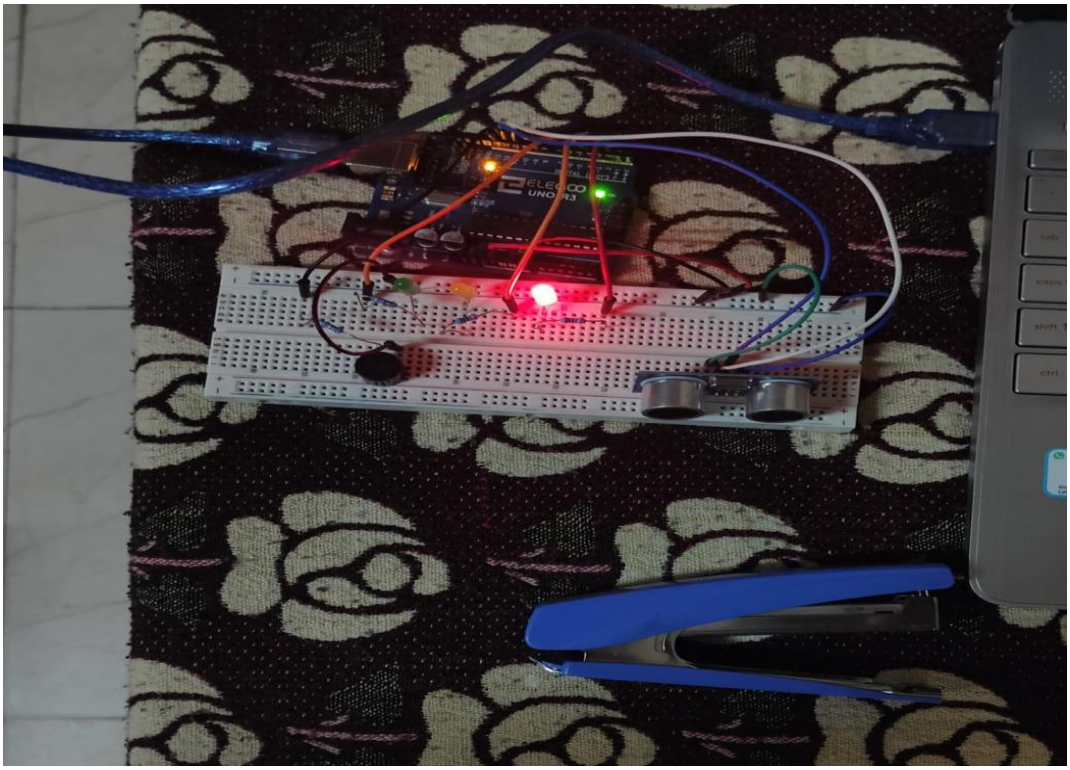
```
void loop() {
  long distance = getDistance();
  Serial.print("Distance: ");
  Serial.print(distance);
  Serial.println(" cm");

  if (distance > 30) {
    digitalWrite(GREEN_LED, HIGH);
    digitalWrite(YELLOW_LED, LOW);
    digitalWrite(RED_LED, LOW);
    digitalWrite(BUZZER, LOW);
    Serial.println("Safe");
  } else if (distance > 10 && distance <= 30) {
    digitalWrite(GREEN_LED, LOW);
    digitalWrite(YELLOW_LED, HIGH);
    digitalWrite(RED_LED, LOW);
    digitalWrite(BUZZER, LOW);
    Serial.println("Move Slowly");
  } else {
    digitalWrite(GREEN_LED, LOW);
    digitalWrite(YELLOW_LED, LOW);
    digitalWrite(RED_LED, HIGH);
    digitalWrite(BUZZER, HIGH);
    Serial.println("STOP!");
  }
  delay(100);
}
```

Simulation Results:

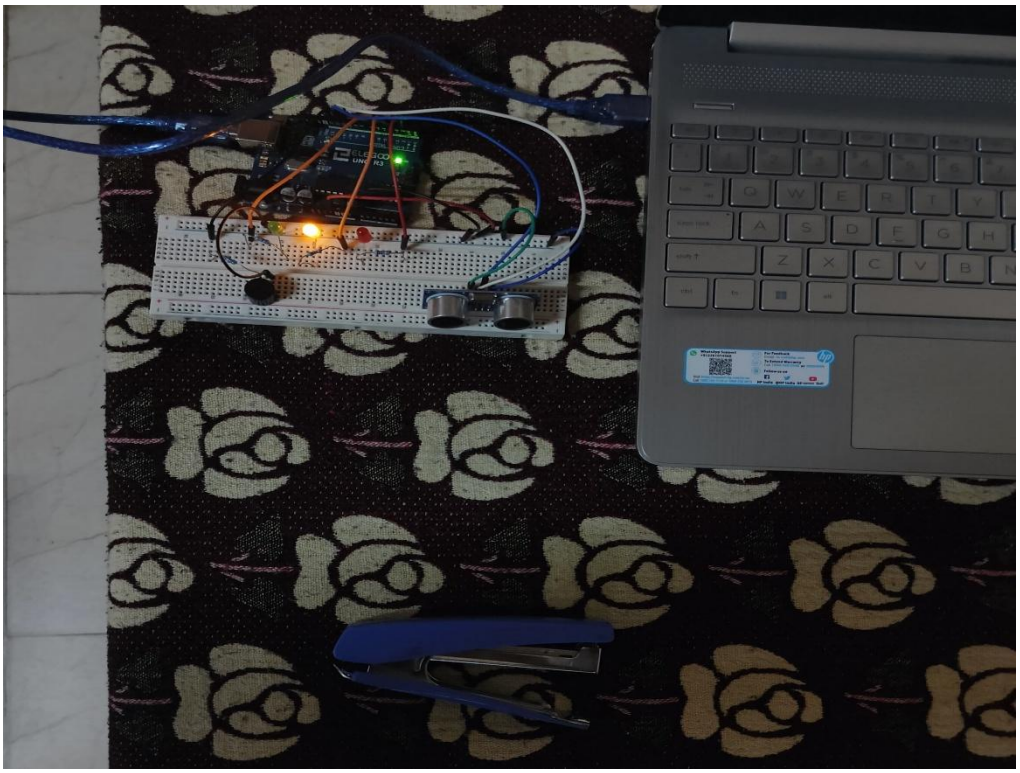


Hardware results:

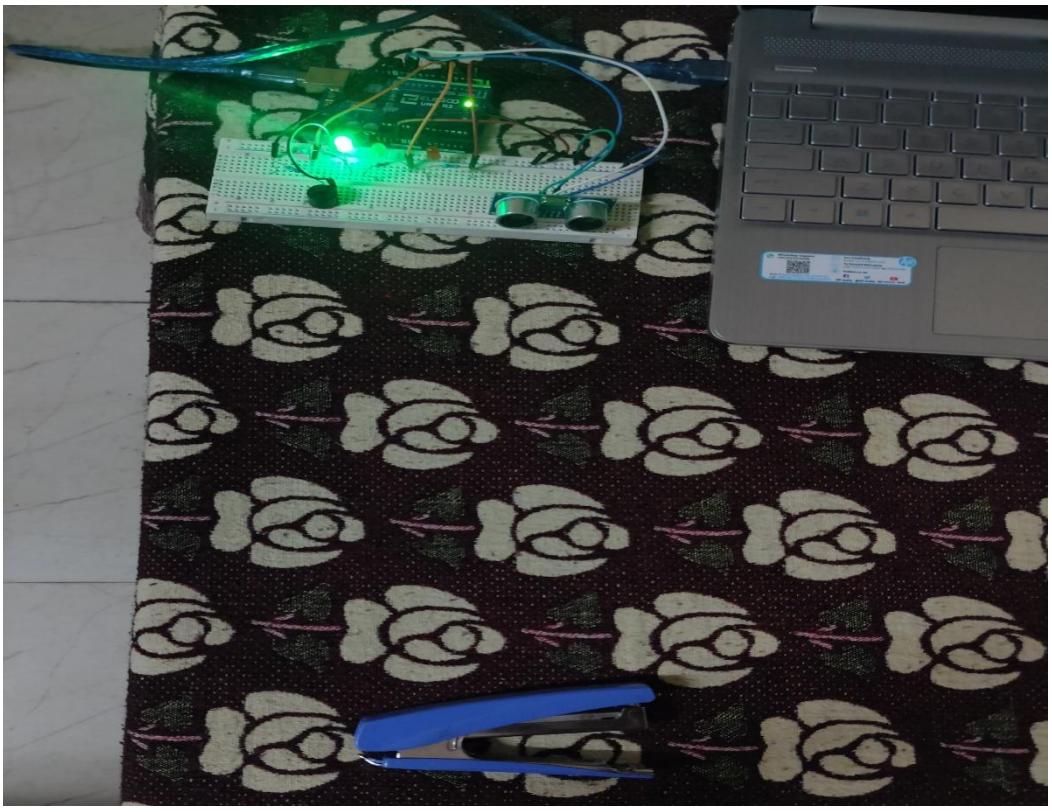
If distance b/w the object(stapler) and ultrasonic sensor is less than or equal to 10cm



If distance b/w the object(stapler) and ultrasonic sensor is 10 cm to 30 cm:



If distance b/w the object(stapler) and ultrasonic sensor is greater than 30 cm:



Conclusion:

The object range detection system using an ultrasonic sensor and Arduino Uno successfully detects the distance of an object and provides visual (LEDs) and audio (buzzer) alerts based on proximity. It's a simple yet effective embedded system application that showcases real-world use of sensors, microcontroller and actuator.

This project can be a stepping stone for more advanced systems like automated braking, smart surveillance, and industrial automation.

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