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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING (II – 'A')

SENSORS AND ACTUATORS (U24EC203)

MINI PROJECT REPORT

PROXIMITY BASED EYE STRAIN REDUCTION SYSTEM

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PROXIMITY-BASED EYE STRAIN REDUCTION SYSTEM

Introduction

In today's digital world, mobile phones have become an essential part of our daily life. Students and adults spend long hours using smartphones for online classes, entertainment, and social media. One of the major health concerns associated with prolonged mobile usage is eye strain. Eye strain occurs when the eyes are forced to focus closely on a screen for long periods, especially when the user holds the device too close to the face. Medical guidelines recommend a minimum 30 cm safe viewing distance to protect the eyes from long-term damage.

Many people, especially school and college students, unknowingly bring their mobile very close to their eyes, which increases the risk of Computer Vision Syndrome (CVS), blurred vision, headaches, dry eyes, and fatigue. To help users maintain a safe viewing distance, a simple electronic alert system can be used.

This mini-project aims to create a Proximity-Based Eye Strain Reduction System using an Ultrasonic Sensor, Arduino UNO, and Buzzer. The system continuously measures the distance between the user's face and the mobile device. If the distance becomes less than 30 cm, the buzzer automatically turns ON, warning the user to move the device away. This ensures healthy viewing habits and reduces the risk of eye strain.

This project uses basic sensors and actuators, making it ideal for beginners in embedded systems, IoT, and electronics. It also demonstrates practical real-world applications of distance measurement and automation.

Objectives:

- To measure the distance between the mobile device and the user's face using an ultrasonic sensor.
- To alert the user with a buzzer whenever the distance falls below 30 cm.
- To promote healthy screen-viewing habits and reduce eye strain.
- To build a simple, low-cost health-based warning system using sensors and actuators

Hardware requirements:

- Arduino UNO
- Ultrasonic sensor (HC-SR04)
- Buzzer
- Power supply /USB Cable

Software requirements:

- Arduino IDE
- Tinker Cad

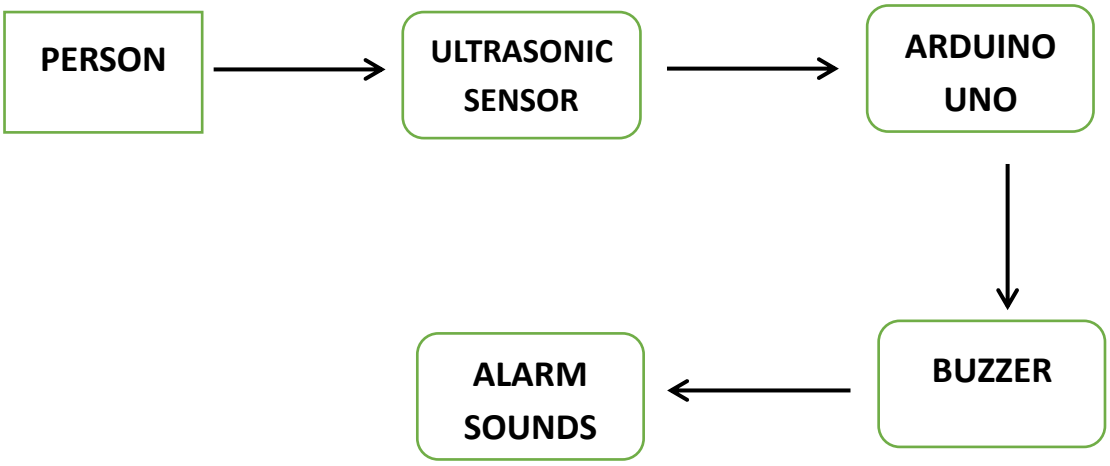
Working principle:

- The working principle of the Proximity-Based Eye Strain Reduction System is based on continuous distance measurement using an ultrasonic sensor and generating an alert through a buzzer. The ultrasonic sensor (HC-SR04) is positioned facing the user so it can measure how close the user's face is to the mobile phone.
- In operation, the Arduino sends a trigger pulse to the sensor, which emits ultrasonic waves. These waves travel forward, strike the user's face, and return to the sensor. The Arduino measures the echo time and calculates the distance using:

  Distance = Duration * (0.034 / 2)

- This gives the real-time user-to-screen distance.
- The Arduino continuously checks whether this distance is less than the preset safe limit of 30 cm. If the user holds the mobile too close (≤ 30 cm), the buzzer immediately turns ON to warn the user. Once the distance becomes safe again, the buzzer automatically turns OFF. This helps maintain healthy viewing habits and reduces eye strain.
- However, the ultrasonic sensor detects any object in front of it, not specifically the user's eyes or face. This can lead to false alerts during real-time usage. To achieve more accurate detection, an advanced sensor such as an iris eye-detection sensor can be used. Iris-based eye detection can precisely identify the user's eye position and measure the actual eye-to-screen distance, making the system more reliable and user-specific.

Block diagram:



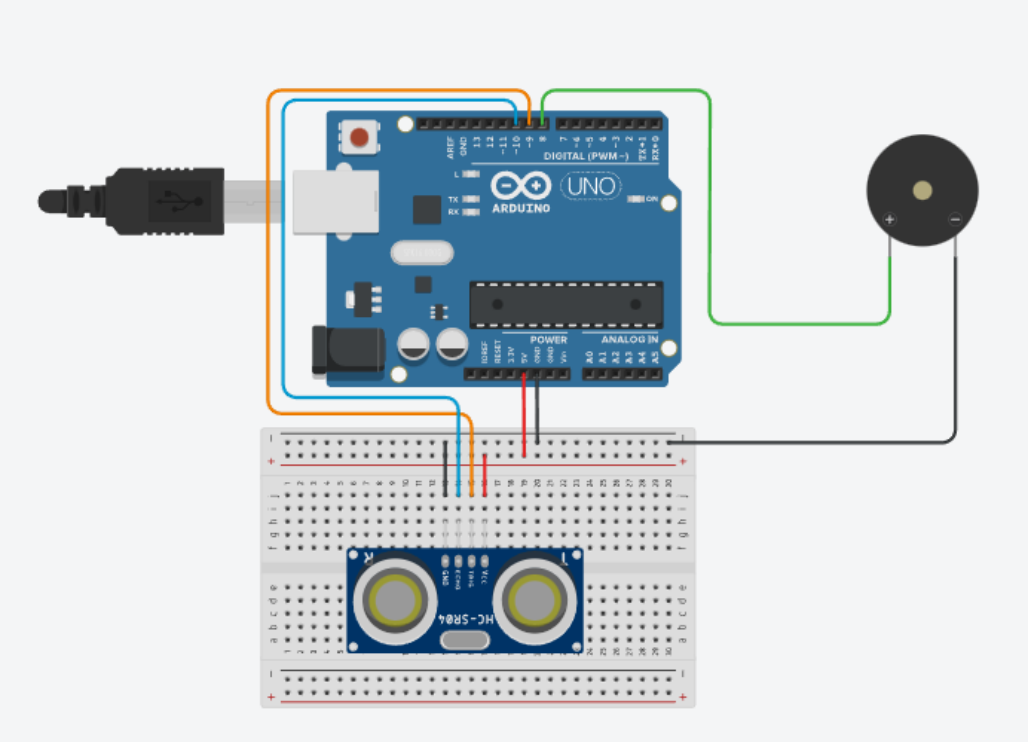
Arduino code:

```
#define trigPin 9
#define echoPin 10
#define buzzer 8
long duration;
int distance;
void setup() {
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
  pinMode(buzzer, OUTPUT);
  Serial.begin(9600);
}
void loop() {
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
```

```
  digitalWrite(trigPin, LOW);
  duration = pulseIn(echoPin, HIGH);
  distance = duration * 0.034 / 2;

  Serial.print("Distance: ");
  Serial.print(distance);
  Serial.println(" cm");
  int limit = 30;
  if (distance > 0 && distance <= limit) {
    digitalWrite(buzzer, HIGH);
  } else {
    digitalWrite(buzzer, LOW);
  }
  delay(100);
}
```

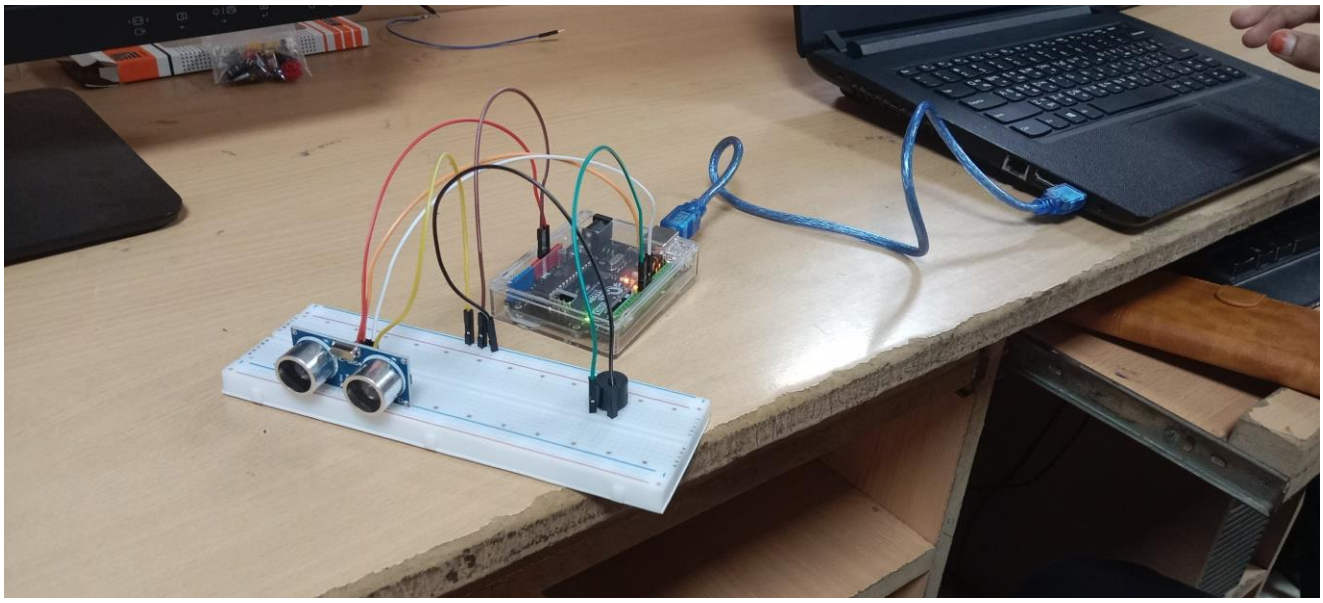
Circuit diagam:



Output:

Distance: 25 cm

Distance: 50 cm



Applications:

Personal Device Safety

- Prevents others from touching your phone or laptop.
- Alerts you if someone comes too close.

Workplace/Office Use

- Prevents disturbance to office systems.
- Alerts if someone enters restricted zones.

Laboratory & Equipment Protection

- Used to protect costly devices.
- Alerts when handling distance is violated.

Home Automation

- Alerts if someone comes near a door or cupboard.

Advantages

- Highly Accurate

  Ultrasonic sensors provide precise distance measurement.

- Low Cost

  The entire system is very economical.

- Easy to Implement

  Requires minimal wiring and simple Arduino code.

- Real-Time Alert

  Instant response when someone comes close.

- Customizable

  Distance limit can be set to any value**.**

Conclusion

The project ‘Proximity Alert System Using Ultrasonic Sensor and Buzzer’ is a simple yet highly effective prototype for security and distance monitoring. It successfully detects human presence near laptops, systems, or mobile phones and provides an audible alert using a buzzer.This system can be expanded or adapted for several applications in homes, offices, labs, and security-sensitive areas.

The Proximity-Based Eye Strain Reduction System demonstrates a simple and effective method to promote healthy mobile-viewing habits. By using an ultrasonic sensor to continuously measure the distance between the user and the screen, the system provides an immediate buzzer alert whenever the mobile phone is held too close. This encourages users to maintain a minimum safe distance of 30 cm, thereby helping to reduce eye strain, discomfort, and long-term vision problems. Overall, the project achieves its objective of creating an efficient alert system for protecting eye health and demonstrates a strong foundation in embedded systems, sensor interfacing, and automation.