AMERICAN INTERNATIONAL UNIVERSITY-BANGLADESH

Faculty of Engineering

OEL Report

Title: Building a Distance-Measuring Device with Visual and Auditory Feedback using Arduino and RGB Color Model.

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Course Title	MICROPROCESSOR AND EMBEDDED SYSTEMS		
Course Code	COE3104	**Section**	C
Semester	Spring 2022-23	**Degree Program**	BSc in CSE
Course Teacher	**RICHARD VICTOR BISWAS**		

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Group # 01

Sl No	Name	ID
1	Zaid Amin **Rawfin**	20-42459-1
2	Abzana Sultan **Ira**	20-41973-1
3	MD. Sanjid Bin Karim **Sezan**	19-41702-3
4	Abdur Rahman **Swapnil**	18-38950-3

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	Total Marks	

Table of Contents

Experiment Title

Building a Distance-Measuring Device with Visual and Auditory Feedback using Arduino and RGB Color Model.

Objective

The objective of this experiment was to build a device using an Arduino board and various components, including an ultrasonic sensor, LEDs, a buzzer, and an LCD screen. The device was designed to measure distance and provide visual and auditory feedback based on that measurement.

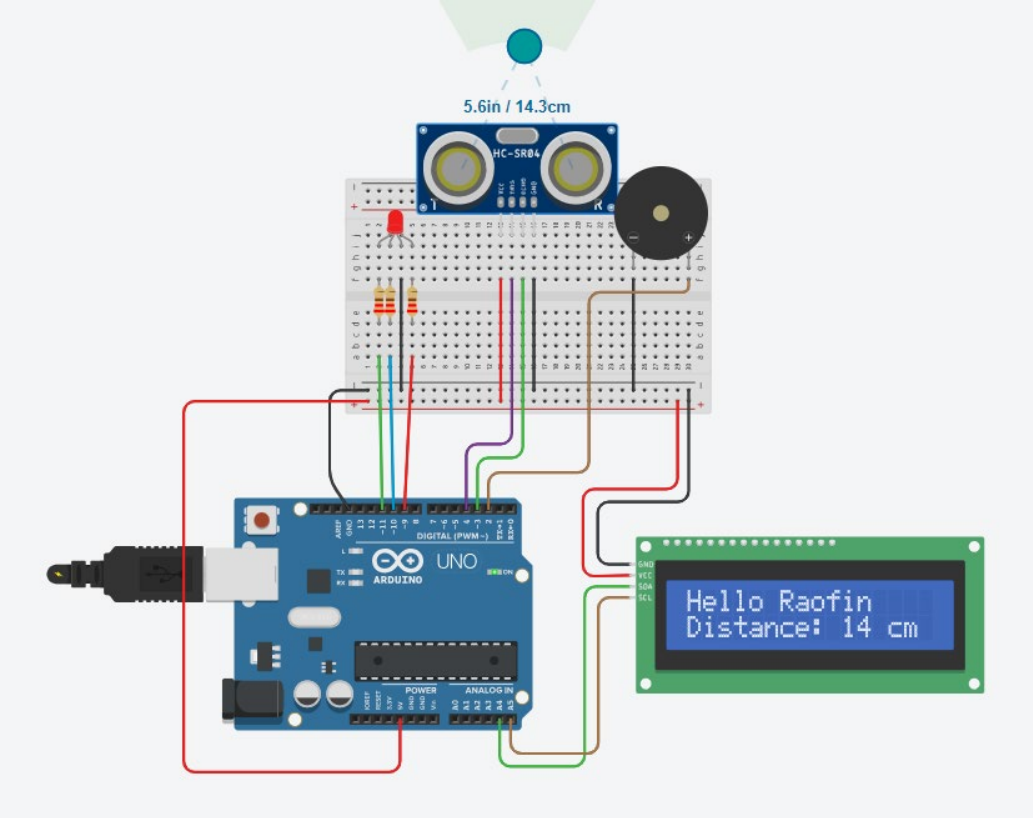
Theory and Methodology

The RGB color model was used in this experiment to control the color of the LEDs. This color model is based on the additive mixing of red, green, and blue light to create a wide range of colors. Each color is represented by a value between 0 and 255. By combining different levels of red, green, and blue, any color in the visible spectrum can be created on digital devices.

To build the device, we first connected an ultrasonic sensor to the Arduino board along with LEDs, a buzzer, and an LCD screen. The ultrasonic sensor was used to measure the distance between the device and an object in front of it. This measurement was then converted to centimeters and displayed on the LCD screen. Depending on the distance measured, the color of the LED would change, and a message was displayed on the LCD screen. If the distance measured was less than 5 cm, the buzzer would sound every 200 milliseconds to draw attention to the proximity of the object.

The RGB values for each LED were set using the setColor() function, which allowed us to control the intensity of each color in the model. We used conditional statements, loops, and functions to ensure that the device responded appropriately based on the distance measured. Through this experiment, we gained hands-on experience in building and programming a device using an Arduino board and learned about the importance of careful planning and testing to ensure that all components work together seamlessly.

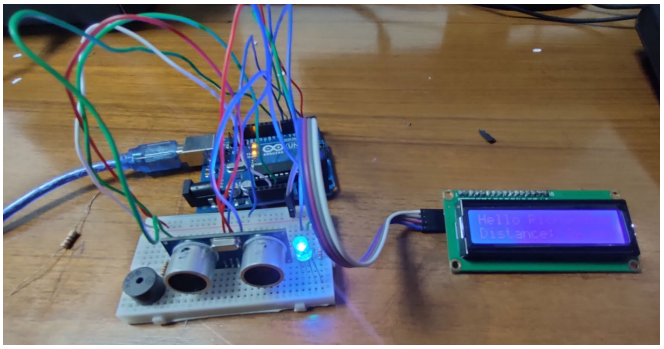
Circuit Diagram



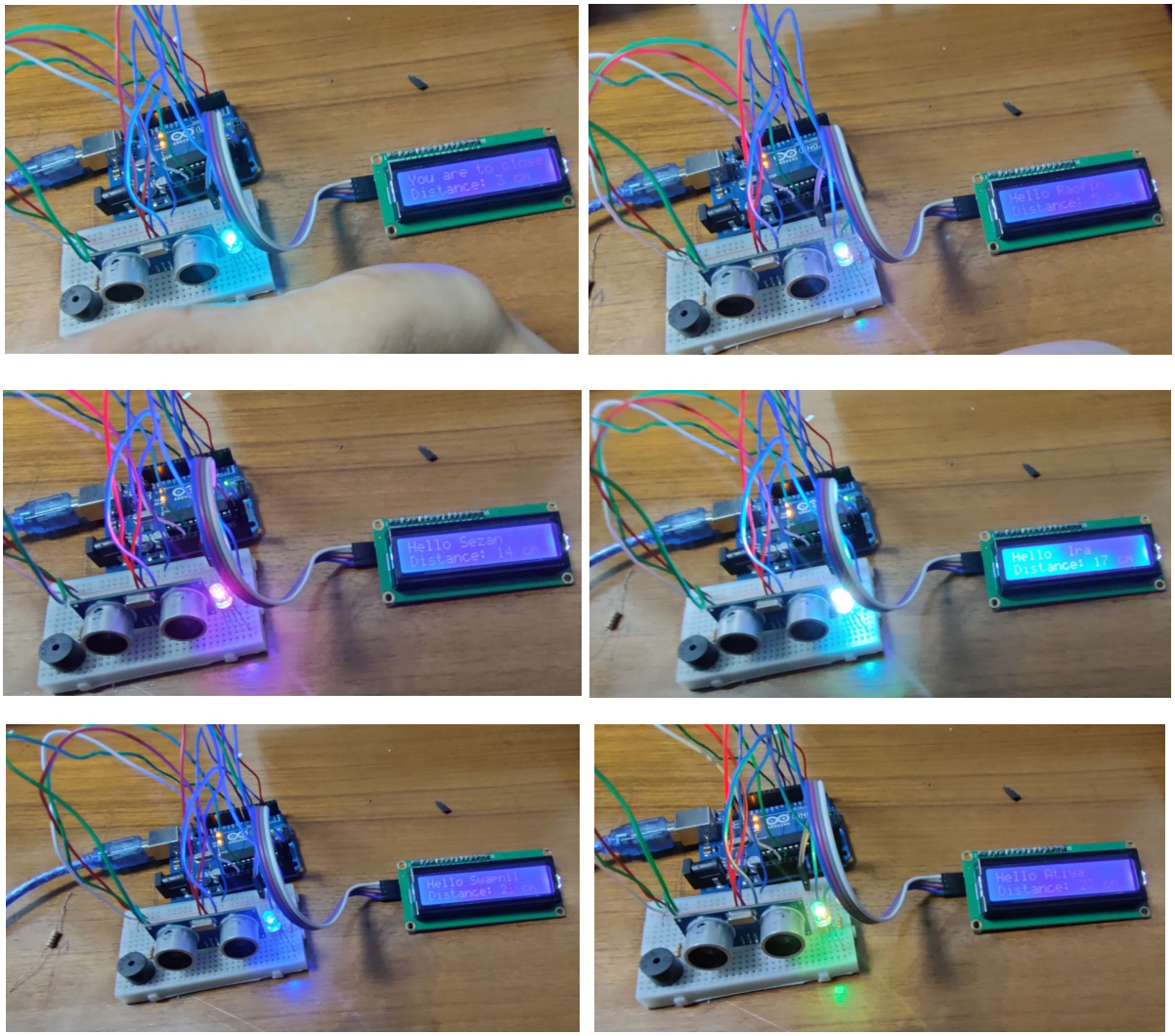
Apparatus

- Arduino board
- Ultrasonic sensor
- LEDs (red, green, blue)
- Buzzer
- LCD screen
- Jumper wires
- Breadboard
- 220 ohm resistors
- USB cable (for programming and power)

Experimental Setup



Hardware Setup



RGB LED Color and LCD Display Message Changing based on the distance measured.

Code/Program

```
// library for the I2C communication
#include <Wire.h>
// library for the the LCD library
#include <LiquidCrystal_I2C.h>

// Define pins
const int buzzerPin = 2;
const int echoPin = 3;
const int trigPin = 4;
const int redPin = 9;
const int greenPin = 11;
const int bluePin = 10;

// variable to store the distance
   measured by the ultrasonic sensor
int distance;

// variables for the buzzer and
   millis()
bool buzzerState = false;
unsigned long previousMillis = 0;

// create an instance of the
   LiquidCrystal_I2C library for 16x2
   display at address 0x27
LiquidCrystal_I2C lcd(0x27, 16, 2);

void setup() {
  Serial.begin(9600);
  pinMode(buzzerPin, OUTPUT);
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
  pinMode(redPin, OUTPUT);
  pinMode(greenPin, OUTPUT);
  pinMode(bluePin, OUTPUT);

  lcd.begin(); // initialize the lcd
  lcd.backlight(); // turn on backlight
}

void loop() {
  // Read the distance from the
     ultrasonic sensor
  long duration, distance;
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  duration = pulseIn(echoPin, HIGH);
  // distance in cm
  distance = duration * 0.034 / 2;

  // Print in serial
  Serial.print("Distance: ");
  Serial.print(distance);
  Serial.println(" cm");

  // Display the distance on the LCD
  lcd.setCursor(0, 1);
  lcd.print("Distance: ");
  lcd.print(distance);
  lcd.print(" cm       ");

  // Set the led color and print
     message on lcd based on the distance
  lcd.setCursor(0, 0);
  if (distance < 5) {
    setColor(0, 255, 255);
    lcd.print("You are to close ");
  } else if (distance < 10) {
    setColor(0, 0, 0);
    lcd.print("Hello Raofin     ");
  } else if (distance < 15) {
    setColor(0, 255, 0);
    lcd.print("Hello Ira        ");
  } else if (distance < 20) {
    setColor(0, 0, 255);
    lcd.print("Hello Sezan      ");
  } else if (distance < 25) {
    setColor(255, 255, 0);
    lcd.print("Hello Shopnil    ");
  } else if (distance < 30) {
    setColor(80, 0, 80);
    lcd.print("Hello Atiya      ");
  } else {analogWrite(redPin, 0);
    lcd.print("Hello RichardSir ");
    setColor(255, 200, 0);
  }

  unsigned long currentMillis = millis();

  // Play a tone on the buzzer every 200
     milliseconds
  if (currentMillis - previousMillis >=
200 && distance < 5) {
    previousMillis = currentMillis;

    if (buzzerState) {
      noTone(buzzerPin);
      buzzerState = false;
    } else {
      tone(buzzerPin, 1000);
      buzzerState = true;
    }
  } else {
    noTone(buzzerPin);
  }
}

void setColor(int redValue, int
greenValue, int blueValue) {
  analogWrite(redPin, redValue);
  analogWrite(greenPin, greenValue);
  analogWrite(bluePin, blueValue);
}
```

Code/Program Explanation

This code is an Arduino program for a device that uses an ultrasonic sensor to measure distance and display the results on an LCD screen, as well as changing the LED color based on the distance measured. The program also includes a buzzer that sounds when the distance measured is less than 5 cm.

The program starts by including the necessary libraries for I2C communication with the LCD screen and defining the pins used for the various components such as the ultrasonic sensor, LEDs, and buzzer. In the setup() function, the serial port is initialized, the pins are set to input or output as appropriate, and the LCD screen backlight is turned on.

The loop() function continuously reads the distance from the ultrasonic sensor, converts it to centimeters, and displays it on the LCD screen. Based on the distance measured, the LED color is adjusted and a message is displayed on the LCD. If the distance measured is less than 5 cm, the buzzer will sound every 200 milliseconds. The setColor() function is used to set the RGB values of the LED.

Overall, this code demonstrates how various components can be integrated in an Arduino project to create a device that can measure distance and provide visual and auditory feedback based on that measurement.

Discussion and Conclusion

The experiment involved connecting an ultrasonic sensor to the Arduino board along with LEDs, a buzzer, and an LCD screen. The ultrasonic sensor was used to measure distance, which was then converted to centimeters and displayed on the LCD screen. Depending on the distance measured, the LED color was adjusted and a message was displayed on the LCD screen. Additionally, the buzzer would sound every 200 milliseconds when the distance measured was less than 5 cm.

Through this experiment, we gained a better understanding of how microprocessors can be used to build devices that interact with the physical world. We learned about the importance of careful planning and testing to ensure that all components work together seamlessly. Additionally, we learned about the challenges of debugging code when things don't work as expected.

Overall, this experiment provided us with valuable hands-on experience in building and programming a device using an Arduino board. We gained knowledge and skills that are applicable not only to other microprocessor-based projects but also to many real-world applications.

References

- https://www.rapidtables.com/web/color/RGB_Color.html
- https://www.arduino.cc/
- ATMega328 manual