

# National Textile University, Faisalabad



## Department of Computer Science

<b>Name:</b>	Adeen Asif
<b>Class:</b>	BSCS-A
<b>Registration No:</b>	23-NTU-CS-1007
<b>Course Name:</b>	Embedded IoT and Systems
<b>Submitted To:</b>	Sir Nasir Mehmood
<b>Submission Date:</b>	26 <sup>th</sup> October,2025

## **Task-1:**

### **Multimode LED Control with OLED Display**

#### **Description:**

This project contains three LEDs, two pushbuttons and OLED display.

#### **OLED setup:**

```
#define SCREEN_WIDTH 128 // Define the width of the OLED screen
#define SCREEN_HEIGHT 64 // Define the height of the OLED screen
Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire, -1);
```

#### **Pin Configuration:**

```
const int btnMode = 14; // button to switch modes
const int btnReset = 33; // reset button
const int led1 = 26; // yellow led
const int led2 = 4; // blue led
const int led3 = 5; // red led
```

Firstly, OLED displays the "System Ready" message. You can use one pushbutton to cycle through different modes and second push button to reset the state.

It has four mode:

- Both OFF (all LEDs are turned OFF)
- Alternate Blink (LEDs blink alternatively)
- Both ON (all LEDs are turned ON)
- PWM Fade (LED smoothly fades in and out)

The OLED screen updates to show the current state, so that it's easy to know which event is occurring.

**Code:**

```
// Task 1 (Assignment 1)
// Adeen Asif
// 23-NTU-CS-1007

// include necessary libraries
#include <Arduino.h>
#include <Wire.h>
#include <Adafruit_GFX.h>
#include <Adafruit_SSD1306.h>

// OLED setup
// Define the width and height of the OLED screen
#define SCREEN_WIDTH 128
#define SCREEN_HEIGHT 64
Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire, -1);

// Pin configuration
const int btnMode = 14; // button to switch modes
const int btnReset = 33; // reset button
const int led1 = 26; // yellow led
const int led2 = 4; // blue led
const int led3 = 5; // red led

int mode = 0; // 0=OFF, 1=Alt Blink, 2=Both ON, 3=PWM Fade
unsigned long lastToggle = 0;
bool ledState = false;

// OLED display update
void showMode() {
```

```
display.clearDisplay();
display.setTextSize(1);
display.setTextColor(SSD1306_WHITE);
display.setCursor(0, 10);
display.print("Mode: ");
switch (mode) {
    case 0: display.print("Both OFF"); break;
    case 1: display.print("Alternate Blink"); break;
    case 2: display.print("Both ON"); break;
    case 3: display.print("PWM Fade"); break;
}
display.display();
}

void setup() {
    // pin setup
    pinMode(led1, OUTPUT);
    pinMode(led2, OUTPUT);
    pinMode(led3, OUTPUT);
    pinMode(btnMode, INPUT_PULLUP);
    pinMode(btnReset, INPUT_PULLUP);

    // OLED initialization
    if (!display.begin(SSD1306_SWITCHCAPVCC, 0x3C)) {
        Serial.println(F("SSD1306 allocation failed"));
        for (;;)
    }

    // first message display
    display.clearDisplay();
```

```
display.setTextSize(1);
display.setTextColor(SSD1306_WHITE);
display.setCursor(10, 10);
display.print("System Ready"); // OLED display
display.display();
delay(1000); // display message for 1 sec
showMode(); // show current mode
}

void loop() {
    static int lastBtnState1 = HIGH; // last button state
    static int lastBtnState2 = HIGH; // for reset button

    int btn1 = digitalRead(btnMode); // read button mode
    int btn2 = digitalRead(btnReset); // read reset button

    // Button 1 (cycle through LED modes)
    if (btn1 == LOW && lastBtnState1 == HIGH) {
        mode++; // next mode
        if (mode > 3) mode = 0;
        showMode(); // show on display
        delay(200); // debounce
    }

    // Button 2 (reset to OFF)
    if (btn2 == LOW && lastBtnState2 == HIGH) {
        mode = 0; // turn everything OFF
        showMode(); // show on display
        delay(200); // debounce
    }
}
```

```
lastBtnState1 = btn1;
lastBtnState2 = btn2;

// LED behavior
switch (mode) {
  case 0: // Both OFF
    digitalWrite(led1, LOW);
    digitalWrite(led2, LOW);
    digitalWrite(led3, LOW);
    break;

  case 1: // Alternate blink
    if (millis() - lastToggle >= 500) // toggle every 500ms
    {

      lastToggle = millis();
      ledState = !ledState;
      digitalWrite(led1, ledState);
      digitalWrite(led2, !ledState);
      digitalWrite(led3, ledState);
    }
    break;

  case 2: // Both ON
    digitalWrite(led1, HIGH);
    digitalWrite(led2, HIGH);
    digitalWrite(led3, HIGH);
    break;
```

```

case 3: // PWM fade on LED1
    for (int i = 0; i <= 255; i++) {
        analogWrite(led1, i);
        delay(5);
    }
    for (int i = 255; i >= 0; i--) {
        analogWrite(led1, i);
        delay(5);
    }
    break;
}
}

```

## Output:

The screenshot displays the Wokwi online IDE interface. The left pane shows the sketch code, and the right pane shows a simulation of the hardware.

**Sketch Code:**

```

1 // Task 1 (Assignment 1)
2 // Adeen Asif
3 // 23-NTU-CS-1807
4
5 // include necessary libraries
6 #include <Arduino.h>
7 #include <Wire.h>
8 #include <Adafruit_GFX.h>
9 #include <Adafruit_SSD1306.h>
10
11 // OLED setup
12 // Define the width and height of the OLED screen
13 #define SCREEN_WIDTH 128
14 #define SCREEN_HEIGHT 64
15 Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire, -1);
16
17 // Pin configuration
18 const int btnMode = 14; // button to switch modes
19 const int btnReset = 33; // reset button
20 const int led1 = 26; // yellow led
21 const int led2 = 4; // blue led
22 const int led3 = 5; // red led
23
24 int mode = 0; // 0=OFF, 1=Alt Blink, 2=Both ON, 3=PWM Fade
25 unsigned long lastToggle = 0;
26 bool ledState = false;
27
28 // OLED display update
29 void showMode() {
30     display.clearDisplay();
31     display.setTextSize(1);
32     display.setTextColor(SSD1306_WHITE);
33     display.setCursor(0, 10);
34     display.print("Mode: ");
35     switch (mode) {

```

**Simulation Hardware:**

- ESP32:** The main microcontroller board.
- OLED Display:** Connected to the ESP32 via I2C (pins 4, 5, 26, 33).
- LEDs:** Three LEDs (yellow, blue, red) are connected to the ESP32. The yellow LED is connected to pin 26 (led1), the blue LED to pin 4 (led2), and the red LED to pin 5 (led3).
- Buttons:** A reset button is connected to pin 33 (btnReset), and a mode switch button is connected to pin 14 (btnMode).

**Simulation Output:**

```

configsip: 0, SPIWP:0xee
clk_drv:0x00,q_drv:0x00,d_drv:0x00,cs0_drv:0x00,hd_drv:0x00,wp_drv:0x00
mode:DIO, clock div:2

```

Initially, Both LEDs are OFF:

The screenshot shows the Wokwi online IDE interface. On the left, the 'sketch.ino' file contains the following code:

```
1 // Task 1 (Assignment 1)
2 // Adeen Asif
3 // 23-NTU-CS-1007
4
5 // include necessary libraries
6 #include <Arduino.h>
7 #include <Wire.h>
8 #include <Adafruit_GFX.h>
9 #include <Adafruit_SSD1306.h>
10
11 // OLED setup
12 // Define the width and height of the OLED screen
13 #define SCREEN_WIDTH 128
14 #define SCREEN_HEIGHT 64
15 Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire, -1);
16
17 // Pin configuration
18 const int btnMode = 14; // button to switch modes
19 const int btnReset = 33; // reset button
20 const int led1 = 26; // yellow led
21 const int led2 = 4; // blue led
22 const int led3 = 5; // red led
23
24 int mode = 0; // 0=OFF, 1=Alt Blink, 2=Both ON, 3=PWM Fade
25 unsigned long lastToggle = 0;
26 bool ledState = false;
27
28 // OLED display update
29 void showMode() {
30   display.clearDisplay();
31   display.setTextSize(1);
32   display.setTextColor(SSD1306_WHITE);
33   display.setCursor(0, 10);
34   display.print("Mode: ");
35   switch (mode) {
```

The simulation window on the right shows an ESP32 board connected to an OLED display, three LEDs (yellow, blue, red), and a push button. The OLED display shows "Mode: Both OFF". The simulation is running, with a timer at 00:09.062 and 58% completion.

Alternative LEDs:

The screenshot shows the Wokwi online IDE interface. On the left, the 'sketch.ino' file contains the following code:

```
1 // Task 1 (Assignment 1)
2 // Adeen Asif
3 // 23-NTU-CS-1007
4
5 // include necessary libraries
6 #include <Arduino.h>
7 #include <Wire.h>
8 #include <Adafruit_GFX.h>
9 #include <Adafruit_SSD1306.h>
10
11 // OLED setup
12 // Define the width and height of the OLED screen
13 #define SCREEN_WIDTH 128
14 #define SCREEN_HEIGHT 64
15 Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire, -1);
16
17 // Pin configuration
18 const int btnMode = 14; // button to switch modes
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20 const int led1 = 26; // yellow led
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22 const int led3 = 5; // red led
23
24 int mode = 0; // 0=OFF, 1=Alt Blink, 2=Both ON, 3=PWM Fade
25 unsigned long lastToggle = 0;
26 bool ledState = false;
27
28 // OLED display update
29 void showMode() {
30   display.clearDisplay();
31   display.setTextSize(1);
32   display.setTextColor(SSD1306_WHITE);
33   display.setCursor(0, 10);
34   display.print("Mode: ");
35   switch (mode) {
```

The simulation window on the right shows the same ESP32 board setup. The OLED display now shows "Mode: Alternate Blink". The yellow LED (led1) is lit, while the blue (led2) and red (led3) LEDs are off. The simulation is running, with a timer at 00:11.878 and 52% completion.



## Alternative LEDs showing third LED:

Wokwi - Online ESP32, STM32

wokwi.com/projects/445819943764517889

WOKWI Assignment1-Task1

```
1 // Task 1 (Assignment 1)
2 // Adeen Asif
3 // 23-NTU-CS-1007
4
5 // include necessary libraries
6 #include <Arduino.h>
7 #include <Wire.h>
8 #include <Adafruit_GFX.h>
9 #include <Adafruit_SSD1306.h>
10
11 // OLED setup
12 // Define the width and height of the OLED screen
13 #define SCREEN_WIDTH 128
14 #define SCREEN_HEIGHT 64
15 Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire, -1);
16
17 // Pin configuration
18 const int btnMode = 14; // button to switch modes
19 const int btnReset = 33; // reset button
20 const int led1 = 26; // yellow led
21 const int led2 = 4; // blue led
22 const int led3 = 5; // red led
23
24 int mode = 0; // 0=OFF, 1=Alt Blink, 2=Both ON, 3=PWM Fade
25 unsigned long lastToggle = 0;
26 bool ledState = false;
27
28 // OLED display update
29 void showMode() {
30   display.clearDisplay();
31   display.setTextSize(1);
32   display.setTextColor(SSD1306_WHITE);
33   display.setCursor(0, 10);
34   display.print("Mode: ");
35   switch (mode) {
```

Simulation

00:12.612 51%

Mode: Alternate Blink

ESP32

Result 4:46 pm 26/10/2025

## Both LEDs are ON:

Wokwi - Online ESP32, STM32

wokwi.com/projects/445819943764517889

WOKWI Assignment1-Task1

```
1 // Task 1 (Assignment 1)
2 // Adeen Asif
3 // 23-NTU-CS-1007
4
5 // include necessary libraries
6 #include <Arduino.h>
7 #include <Wire.h>
8 #include <Adafruit_GFX.h>
9 #include <Adafruit_SSD1306.h>
10
11 // OLED setup
12 // Define the width and height of the OLED screen
13 #define SCREEN_WIDTH 128
14 #define SCREEN_HEIGHT 64
15 Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire, -1);
16
17 // Pin configuration
18 const int btnMode = 14; // button to switch modes
19 const int btnReset = 33; // reset button
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21 const int led2 = 4; // blue led
22 const int led3 = 5; // red led
23
24 int mode = 0; // 0=OFF, 1=Alt Blink, 2=Both ON, 3=PWM Fade
25 unsigned long lastToggle = 0;
26 bool ledState = false;
27
28 // OLED display update
29 void showMode() {
30   display.clearDisplay();
31   display.setTextSize(1);
32   display.setTextColor(SSD1306_WHITE);
33   display.setCursor(0, 10);
34   display.print("Mode: ");
35   switch (mode) {
```

Simulation

00:16.128 52%

Mode: Both ON

ESP32

Result 4:46 pm 26/10/2025

## FWM Fades:

The screenshot shows the Wokwi online IDE interface. On the left, the sketch.ino file contains the following code:

```
1 // Task 1 (Assignment 1)
2 // Adeem Asif
3 // 23-NTU-CS-1007
4
5 // include necessary libraries
6 #include <Arduino.h>
7 #include <Wire.h>
8 #include <Adafruit_GFX.h>
9 #include <Adafruit_SSD1306.h>
10
11 // OLED setup
12 // Define the width and height of the OLED screen
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15 Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire, -1);
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17 // Pin configuration
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24 int mode = 0; // 0=OFF, 1=Alt Blink, 2=Both ON, 3=PWM Fade
25 unsigned long lastToggle = 0;
26 bool ledState = false;
27
28 // OLED display update
29 void showMode() {
30   display.clearDisplay();
31   display.setTextSize(1);
32   display.setTextColor(SSD1306_WHITE);
33   display.setCursor(0, 10);
34   display.print("Mode: ");
35   switch (mode) {
```

The simulation window on the right shows an ESP32 board connected to an OLED display, three LEDs (yellow, blue, red), and two buttons. The OLED display shows "Mode: PWM Fade". The simulation is running, with a timer at 00:18.911 and 73% completion.

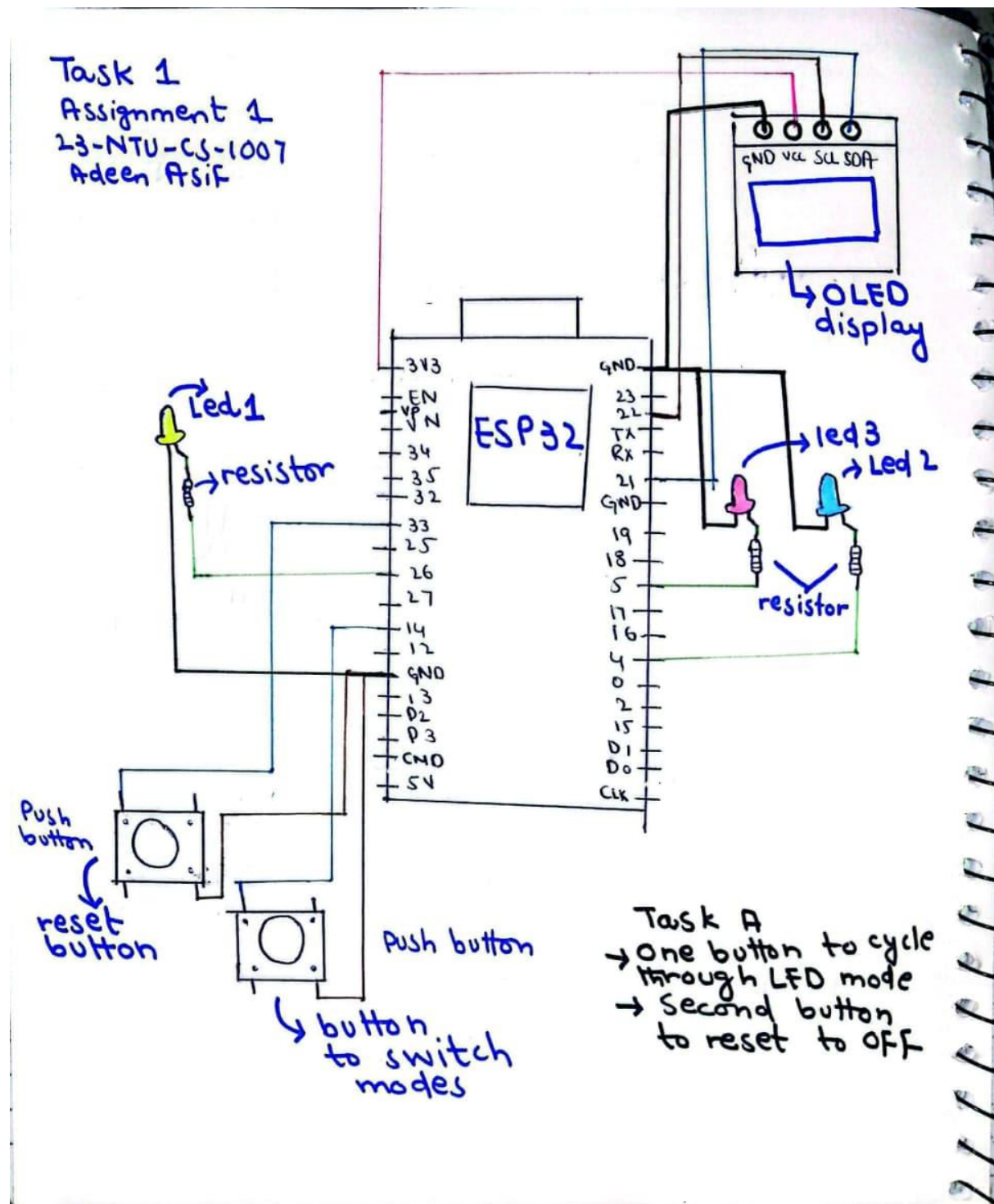
## Reset Both LEDs (Reset button is pressed):

The screenshot shows the Wokwi online IDE interface. On the left, the sketch.ino file contains the following code:

```
1 // Task 1 (Assignment 1)
2 // Adeem Asif
3 // 23-NTU-CS-1007
4
5 // include necessary libraries
6 #include <Arduino.h>
7 #include <Wire.h>
8 #include <Adafruit_GFX.h>
9 #include <Adafruit_SSD1306.h>
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11 // OLED setup
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15 Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire, -1);
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17 // Pin configuration
18 const int btnMode = 14; // button to switch modes
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22 const int led3 = 5; // red led
23
24 int mode = 0; // 0=OFF, 1=Alt Blink, 2=Both ON, 3=PWM Fade
25 unsigned long lastToggle = 0;
26 bool ledState = false;
27
28 // OLED display update
29 void showMode() {
30   display.clearDisplay();
31   display.setTextSize(1);
32   display.setTextColor(SSD1306_WHITE);
33   display.setCursor(0, 10);
34   display.print("Mode: ");
35   switch (mode) {
```

The simulation window on the right shows the same ESP32 board setup. The OLED display now shows "Mode: Both OFF". The simulation is running, with a timer at 00:26.361 and 49% completion.

Sketching:



Scanned with CamScanner

Wokwi Link:

<https://wokwi.com/projects/445819943764517889>

Loom Video Link:

<https://www.loom.com/share/b598a6246ad9412593423428afb0e865>