

National Textile University, Faisalabad



Department of Computer Science

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Course Name:	Embedded IoT and Systems
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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;

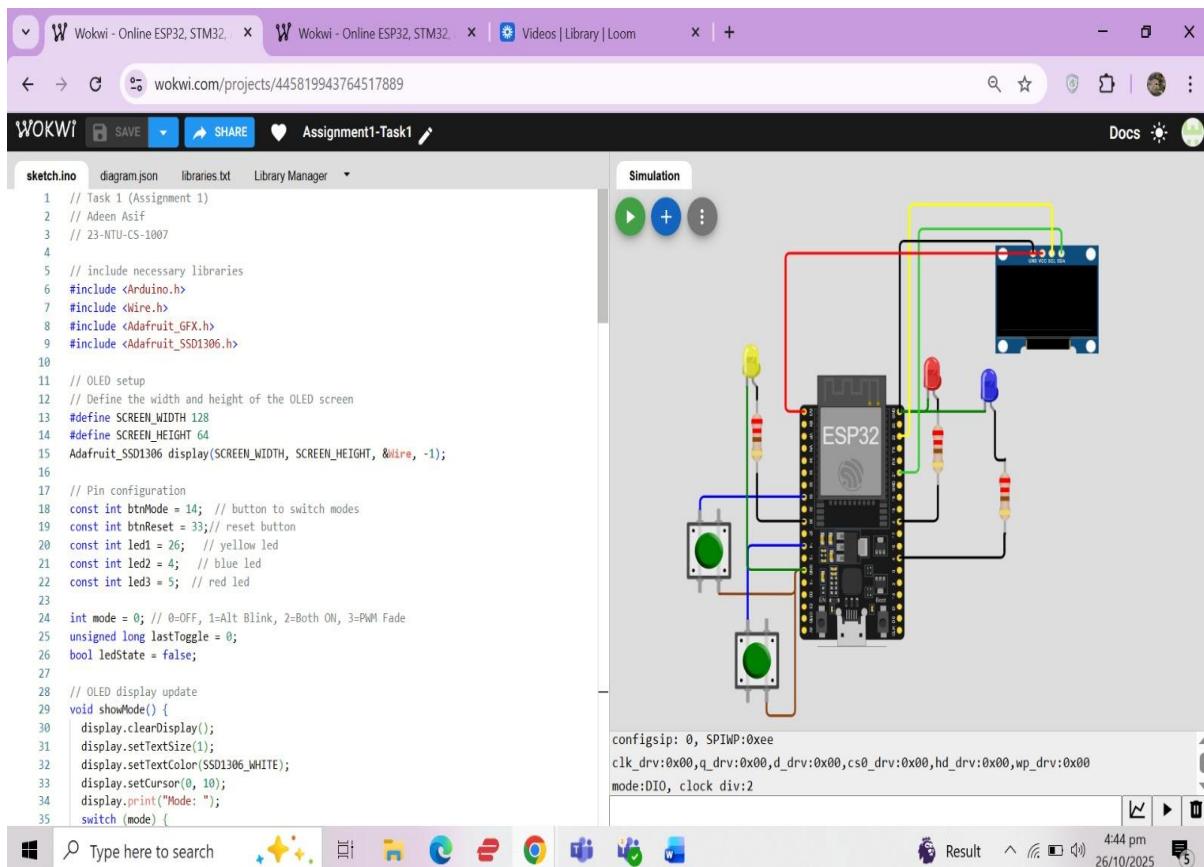
    case 1: // Alternate blink
        if (millis() - lastToggle >= 500) // toggle every 500ms
        {
            lastToggle = millis();
            ledState = !ledState;
            digitalWrite(led1, ledState);
            digitalWrite(led2, !ledState);
            digitalWrite(led3, ledState);
        }
        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:



Initially, Both LEDs are OFF:

The screenshot shows the Wokwi online simulation interface. On the left is the code editor with the file 'sketch.ino' containing the initial code for the project. In the center is the simulation window showing an ESP32 development board connected to three LEDs (yellow, blue, red) and two push buttons. The OLED screen displays "Mode: Both OFF". At the bottom right, the status bar shows the time as 4:46 pm and the date as 26/10/2025.

```
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) {
```

Alternative LEDs:

The screenshot shows the Wokwi online simulation interface. The code editor on the left contains the modified code for the "Alternative LEDs" mode. The simulation window on the right shows the same hardware setup as before, but the OLED screen now displays "Mode: Alternative Blink". The status bar at the bottom right indicates the time is 4:46 pm and the date is 26/10/2025.

```
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) {
```

Alternative LEDs showing third LED:

The screenshot shows the Wokwi online simulation environment for an ESP32 project. The top navigation bar includes tabs for 'Wokwi - Online ESP32, STM32...', 'Videos | Library | Loom', and a search bar with the URL 'wokwi.com/projects/445819943764517889'. The main workspace is titled 'Assignment1-Task1' and contains a sketch file named 'sketch.ino'. The code implements a logic circuit where three buttons (green, red, blue) control three LEDs (yellow, red, blue) via an ESP32 microcontroller. The simulation window shows the circuit and its state. A digital display on the right shows 'Mode: Alternate Blink'. The bottom status bar indicates the time as 4:46 pm and the date as 26/10/2025.

```
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) {
```

Both LEDs are ON:

This screenshot shows the same Wokwi simulation environment as the previous one, but with a different configuration. The digital display now shows 'Mode: Both ON'. The logic circuit has been modified so that both the green and red buttons are active simultaneously, causing both the yellow and red LEDs to be illuminated. The rest of the setup, including the blue button, blue LED, and the ESP32 microcontroller, remains the same. The simulation window and status bar are identical to the first screenshot.

```
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
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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) {
```

FWM Fades:

The screenshot shows the Wokwi online simulation environment. On the left, the code for "sketch.ino" is displayed:

```
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
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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 central part of the interface shows a breadboard-style schematic with an ESP32 microcontroller at the center. It is connected to three LEDs (yellow, blue, red) via resistors. A green pushbutton is connected to digital pin 14 (labeled "btnMode"). A yellow pushbutton is connected to digital pin 33 (labeled "btnReset"). The OLED display on the right shows the text "Mode: FWM Fade". Below the display, the serial monitor window shows the following text:
rst_out: (PULLDOWN_RESET),0000,0012 (SPI_FLASH_BOOT)
configSip: 0, SPIWP:0xee
clk_drv:0x00,q_drv:0x00,d_drv:0x00,cs0_drv:0x00,hd_drv:0x00,wp_drv:0x00

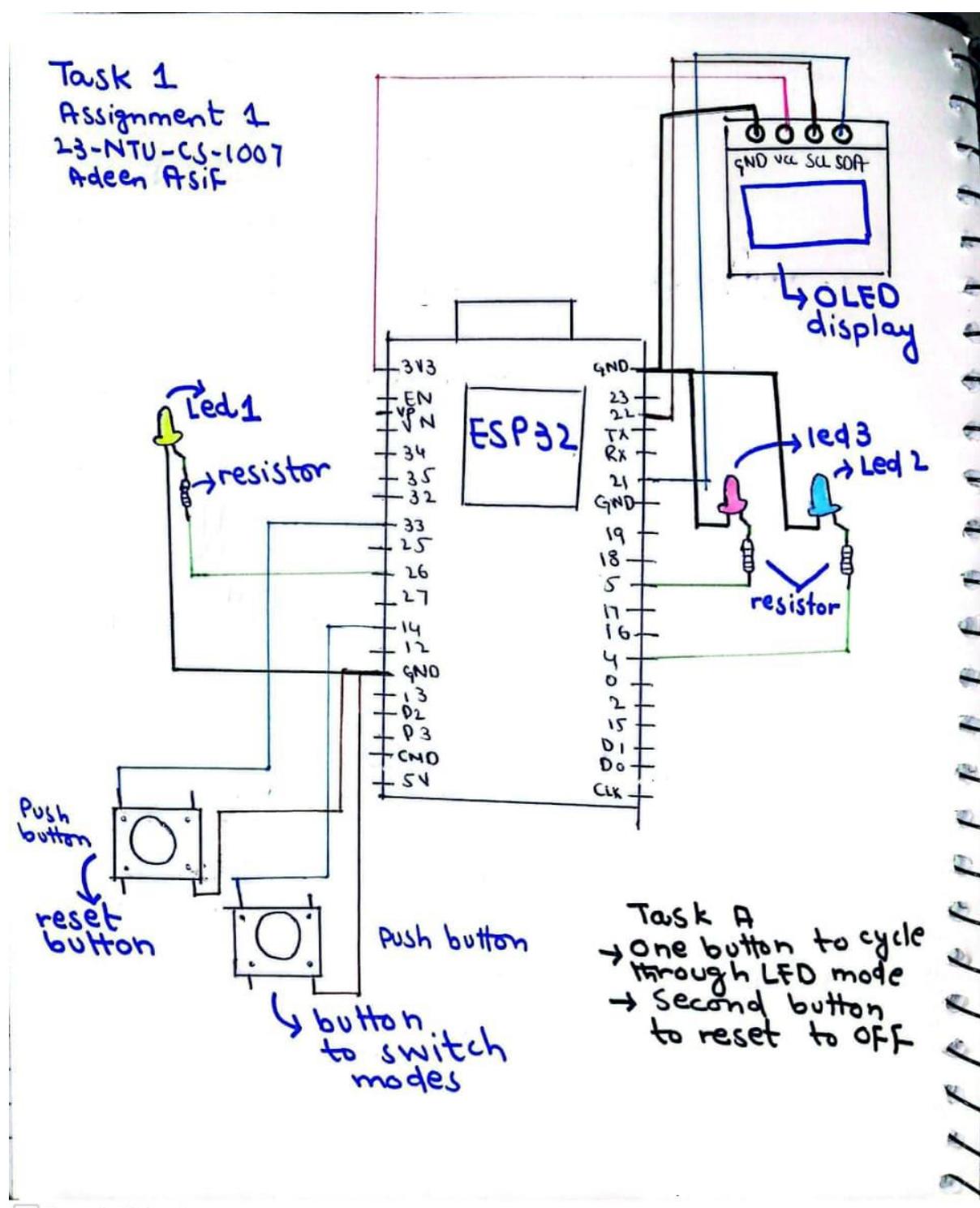
Reset Both LEDs (Reset button is pressed):

The screenshot shows the Wokwi online simulation environment. The code remains the same as the previous screenshot:

```
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>
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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 central part of the interface shows the same breadboard-style schematic with the ESP32 microcontroller. The green pushbutton (labeled "btnMode") is now highlighted in green, indicating it has been pressed. The yellow pushbutton (labeled "btnReset") is also highlighted in green. The OLED display on the right shows the text "Mode: Both OFF". Below the display, the serial monitor window shows the following text:
rst_out: (PULLDOWN_RESET),0000,0012 (SPI_FLASH_BOOT)
configSip: 0, SPIWP:0xee
clk_drv:0x00,q_drv:0x00,d_drv:0x00,cs0_drv:0x00,hd_drv:0x00,wp_drv:0x00

Sketching:



Scanned with CamScanner

Wokwi Link:

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

Loom Video Link:

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