National Textile University, Faisalabad

Department of Computer Science

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Class:	CS 5th (A)
Registration No:	23-NTU-CS-1021
Assignment:	1
Course Name:	Embedded IOT
Submitted To:	*Sir Nasir*
Submission Date:	26/10/2025

Title:

“ESP32 Multi-Mode LED and Buzzer Control with OLED Display”

Project Overview:

This project shows how the multiple LEDs and Buzzer control with push buttons on ESP32 and their results shown on OLED display screen.

In **Task A** one button handles the different modes of LEDs e.g ON , OFF , Alternative Blink and PWM fade while the second button resets the whole system means all OFF.

In **Task B** one button detects the short and long press , the short press toggles the LED while the long press activates the buzzer tone.

Tool Used:

Wokwi used to test ESP32 virtually

Question 3 — Implementation

Circuit Diagram: Design a Wokwi circuit and draw a neat hand-sketch including:

• 2 push buttons
• 3 LEDs
• 1 buzzer
• 1 OLED

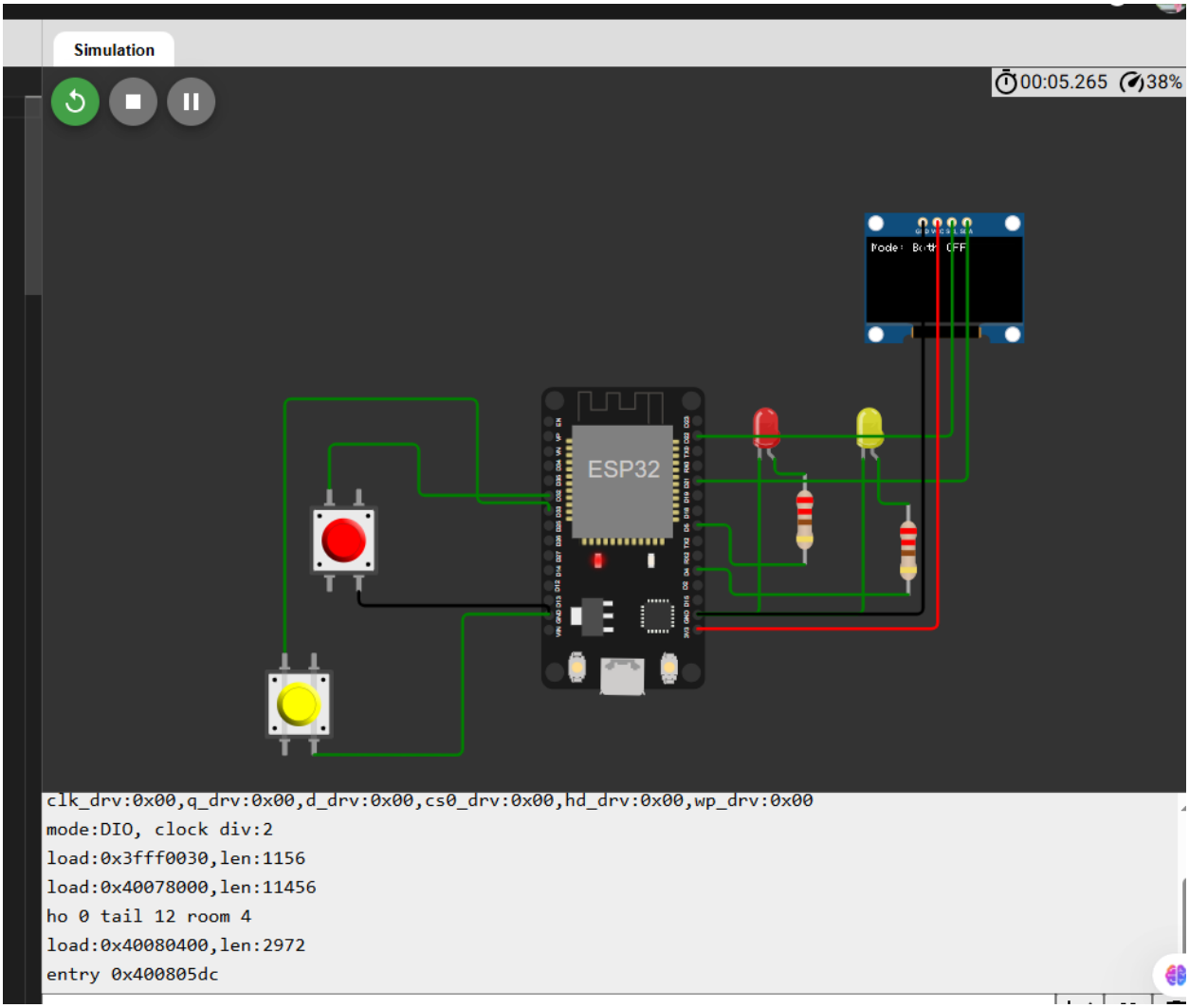
Task A

Coding: Use one button to cycle through LED modes (display the current state on the OLED):

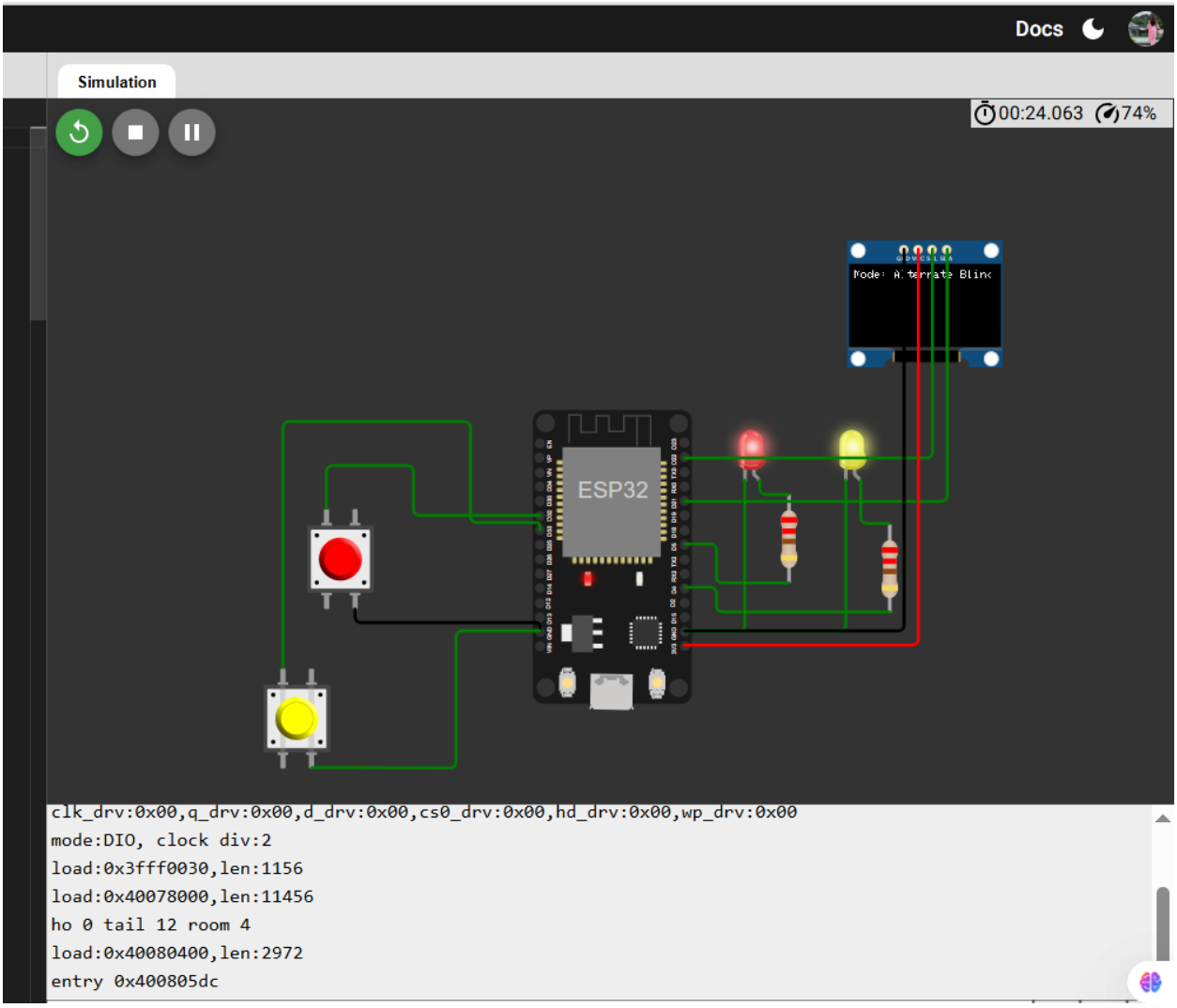
1. Both OFF
2. Alternate blink
3. Both ON
4. PWM fade

Use the second button to reset to OFF.

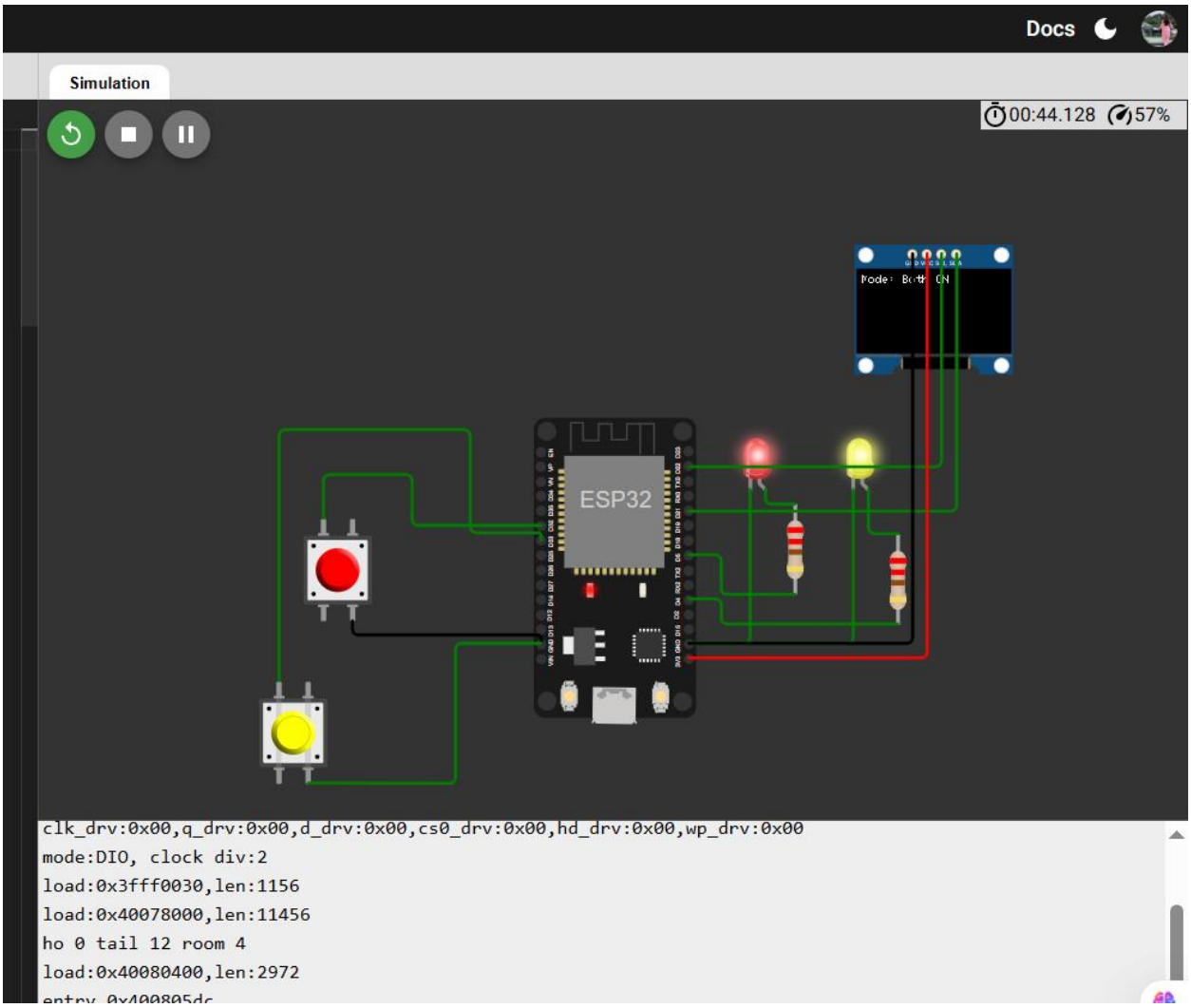
Both OFF:



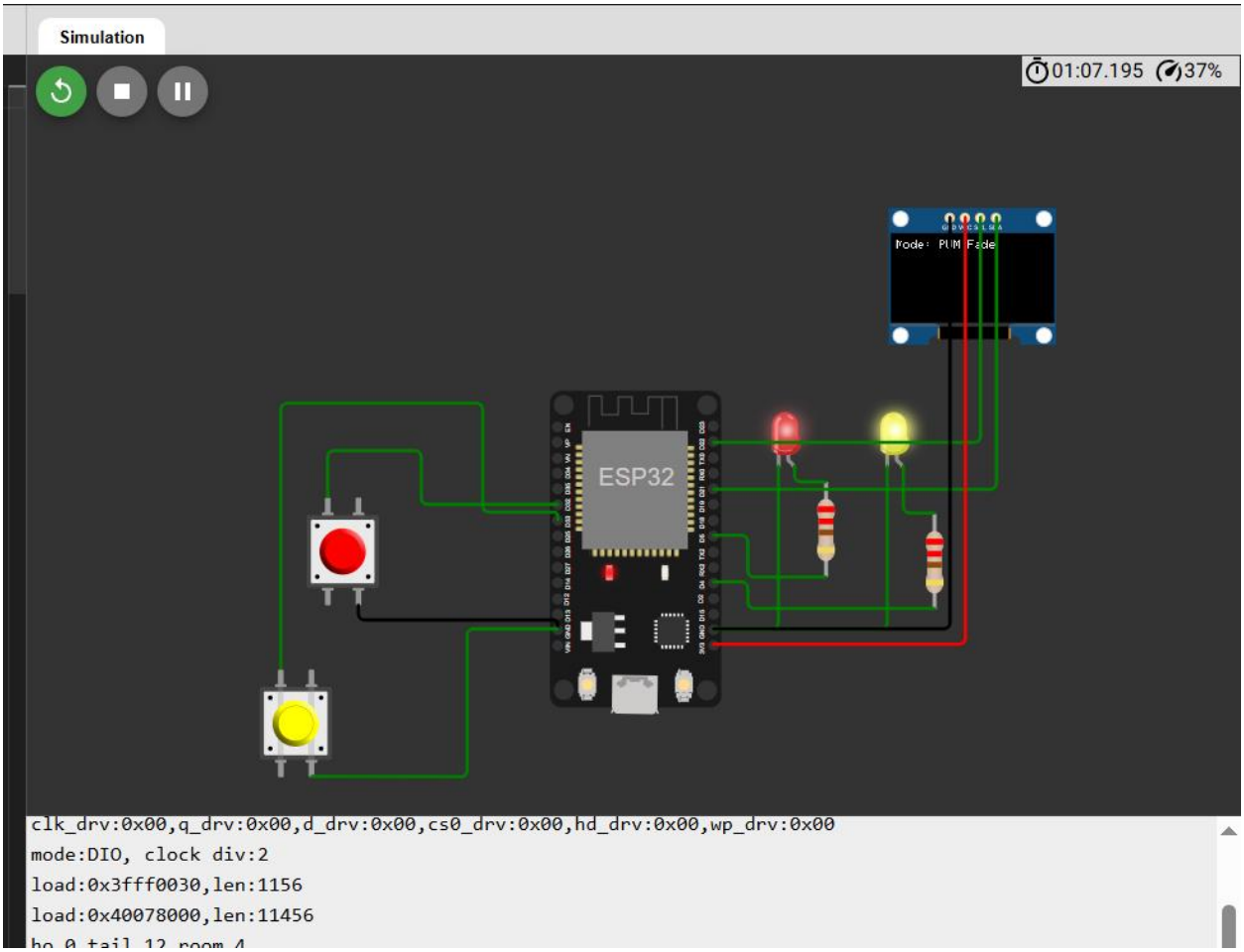
2. Alternate Blink:



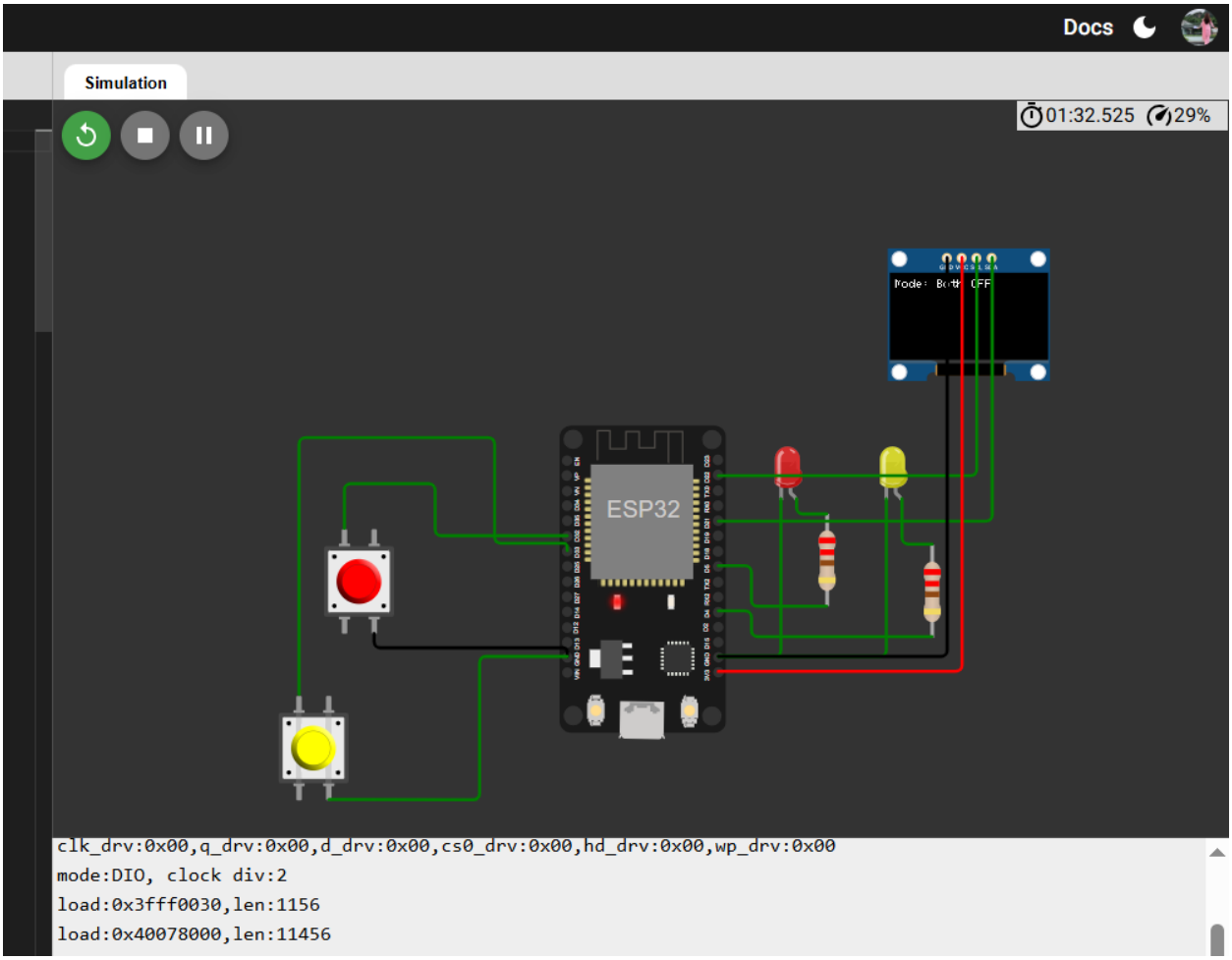
3. Both ON


Docs
Simulation
00:44.128
57%
ESP32
clk_drv:0x00,q_drv:0x00,d_drv:0x00,cs0_drv:0x00,hd_drv:0x00,wp_drv:0x00
mode:DIO, clock div:2
load:0x3fff0030,len:1156
load:0x40078000,len:11456
ho 0 tail 12 room 4
load:0x40080400,len:2972

4. PWM fade:


Simulation
01:07.195
37%
Mode: PWM Fade
ESP32
clk_drv:0x00,q_drv:0x00,d_drv:0x00,cs0_drv:0x00,hd_drv:0x00,wp_drv:0x00
mode:DIO, clock div:2
load:0x3fff0030,len:1156
load:0x40078000,len:11456

Use the second button to reset to OFF



Short Clip:

Assignment 1_Task A (1021).mp4

https://www.loom.com/share/008458f6f49240bd966f4213a2bd1a88

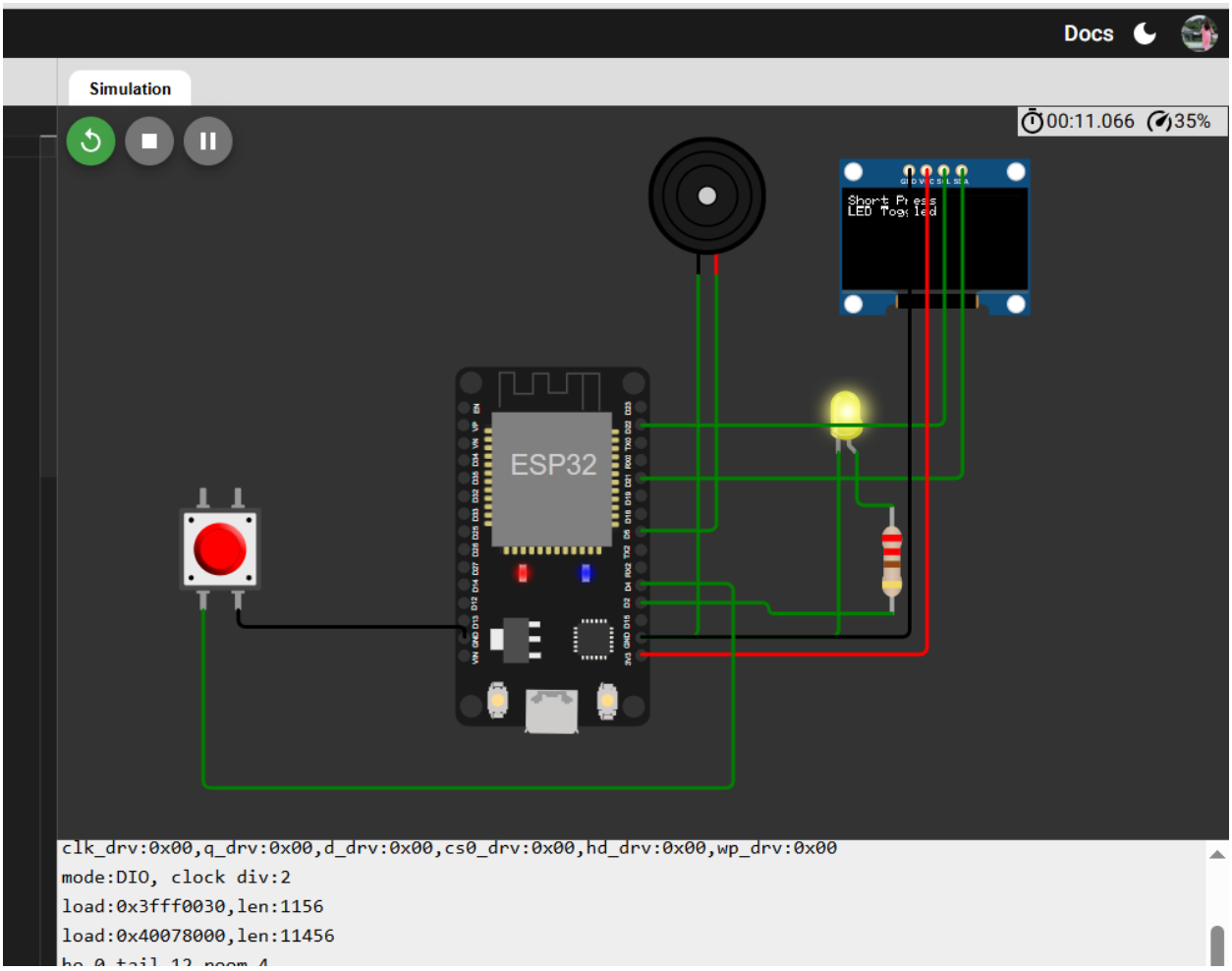
Wokwi Link:

https://wokwi.com/projects/445722481831695361

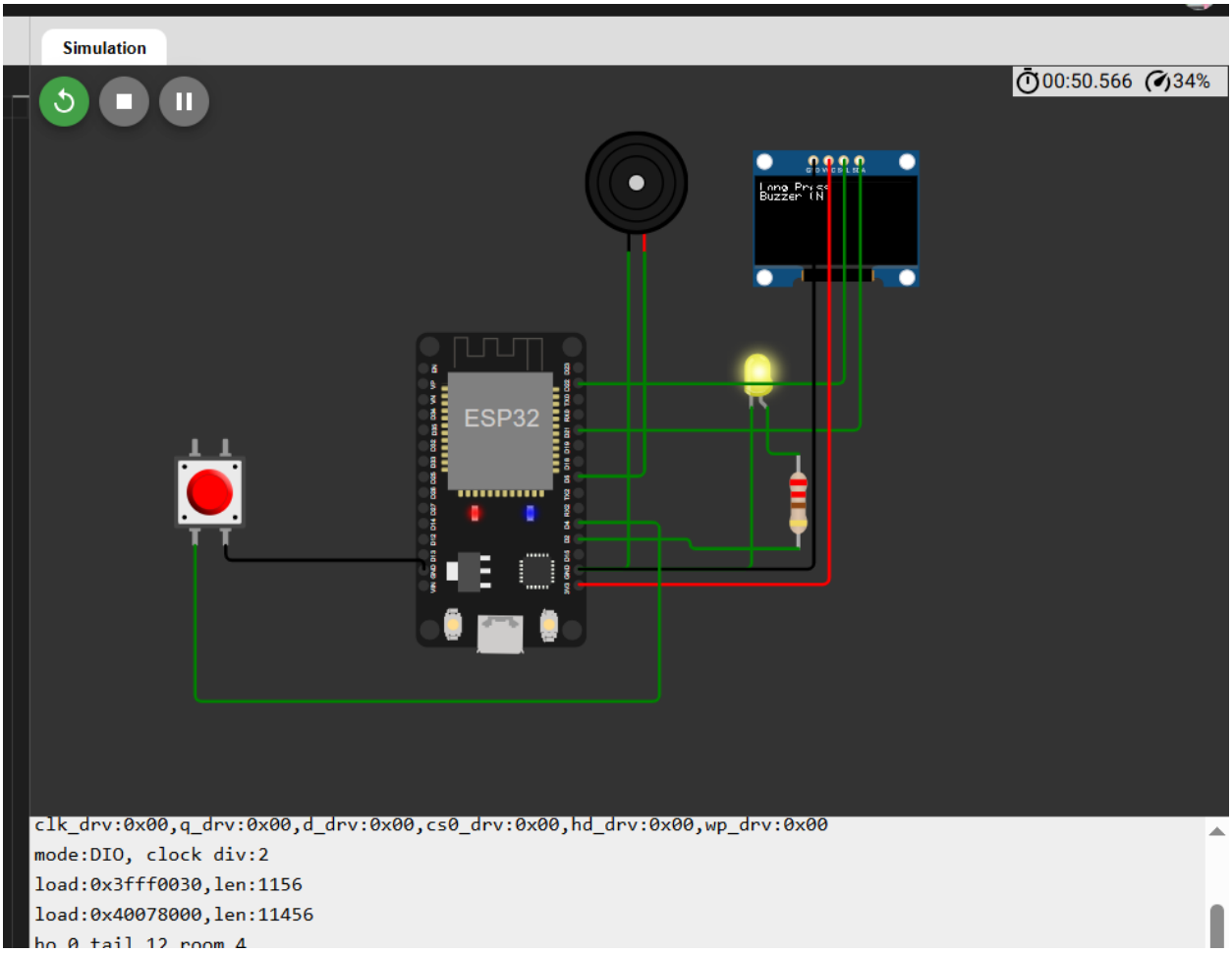
Task B:

Use a single button with press-type detection (display the event on the OLED)
• Short press → toggle LED
• Long press (> 1.5 s) → play a buzzer tone

Short Press:



Long Press:



Short Clip:

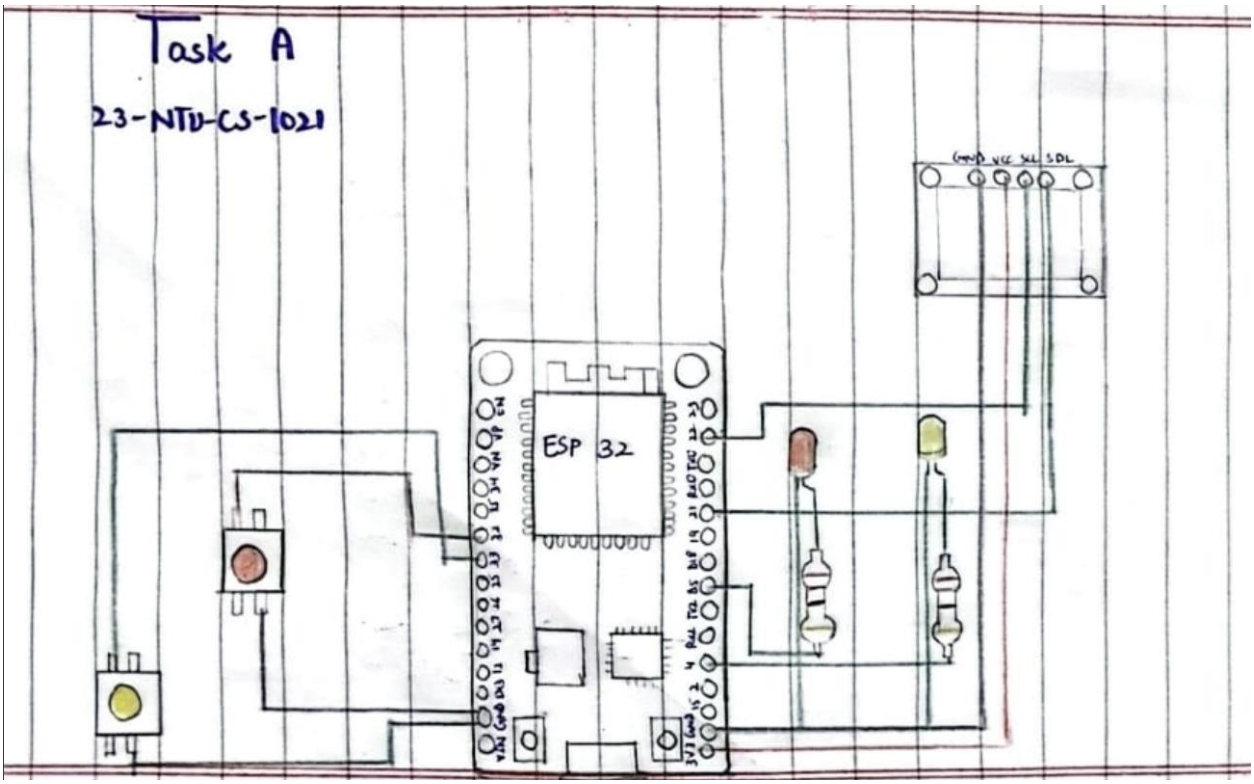
Assignment 1 Task B (1021).mp4

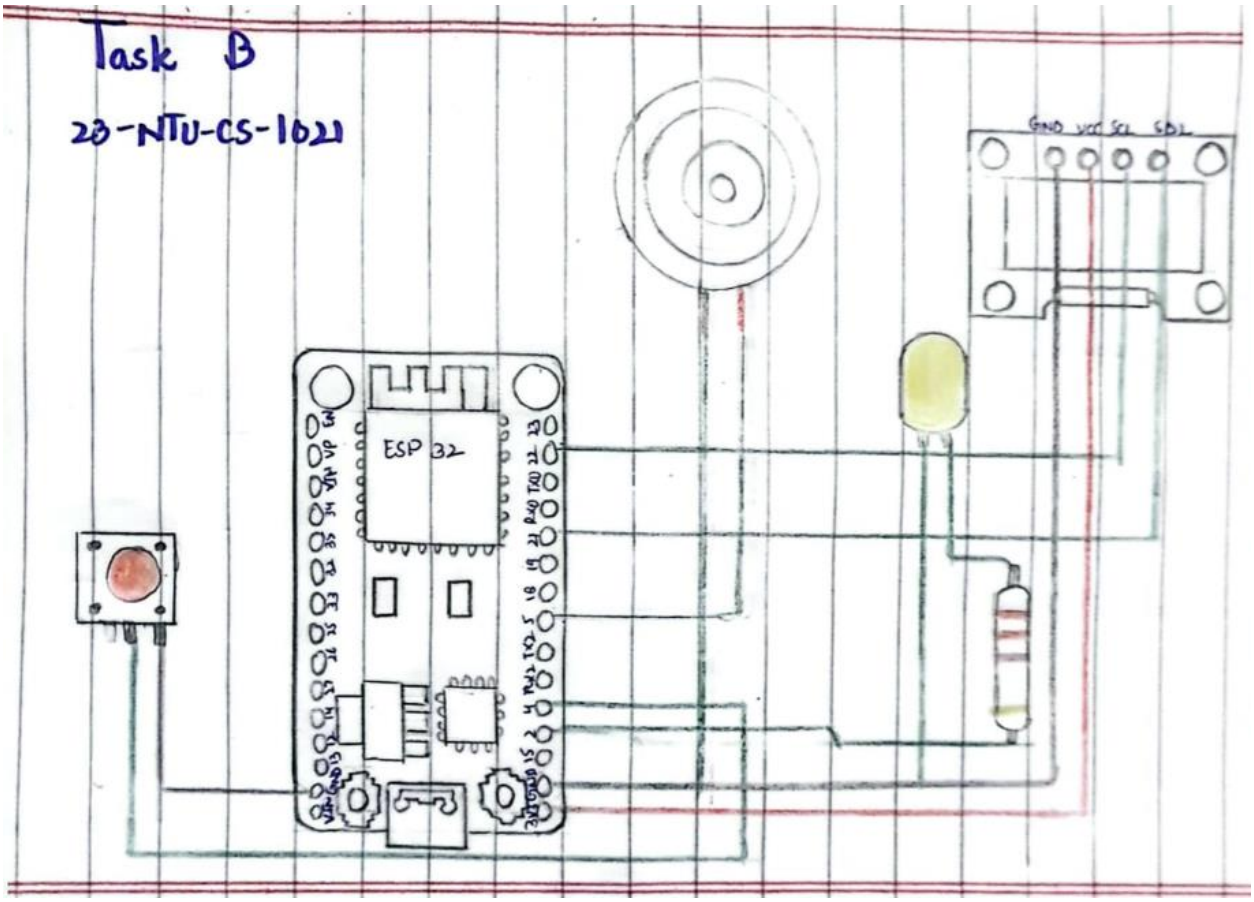
https://www.loom.com/share/4e66fa34267048079ec12a8751aa7606

Wokwi Link:

https://wokwi.com/projects/445722393261615105

Hand Sketch:





Task A

Code:

```
// ------------------------------------------------------------------
// Title      : LED Mode Control with OLED Display (Task A)
// Author     : Ayesha Iftikhar
// Reg. No.   : 23-NTU-CS-1021
// Section    : BSCS 5th (A)
// Course     : Internet of Things (IoT)
// Instructor : [Your Teacher's Name]
// Date       : [Date of Submission]

// Description:
// This program uses two push buttons and an OLED display to control LEDs
// and a buzzer connected to an ESP32 microcontroller.
```

```
// - Button 1 cycles through four LED modes:
//   1. Both OFF
//   2. Alternate Blink
//   3. Both ON
//   4. PWM Fade

// - Button 2 resets the system back to the OFF state.
// The current mode is displayed on the OLED screen in real time.

// Tools Used:
// - Wokwi (for circuit simulation)
// - Arduino IDE (for programming)
// ------------------------------------------------------------

#include <Wire.h>
#include <Adafruit_GFX.h>
#include <Adafruit_SSD1306.h>

#define SCREEN_WIDTH 128
#define SCREEN_HEIGHT 64
Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire, -1);

const int button1Pin = 32;
const int button2Pin = 33;
const int led1Pin = 5;
const int led2Pin = 4;
const int buzzerPin = 15;

volatile bool button1Pressed = false;
volatile bool button2Pressed = false;

unsigned long lastDebounceTime1 = 0;
unsigned long lastDebounceTime2 = 0;
const unsigned long debounceDelay = 150;

bool led1State = LOW;
bool led2State = LOW;

int mode = 0;  // 0=OFF, 1=Alternate Blink, 2=Both ON, 3=PWM Fade
unsigned long lastBlinkTime = 0;
int fadeValue = 0;
int fadeStep = 5;
unsigned long lastFadeTime = 0;
```

```
void IRAM_ATTR handleButton1() {
  button1Pressed = true;
}

void IRAM_ATTR handleButton2() {
  button2Pressed = true;
}

void setup() {
  pinMode(button1Pin, INPUT_PULLUP);
  pinMode(button2Pin, INPUT_PULLUP);
  pinMode(led1Pin, OUTPUT);
  pinMode(led2Pin, OUTPUT);
  pinMode(buzzerPin, OUTPUT);

  attachInterrupt(digitalPinToInterrupt(button1Pin), handleButton1, FALLING);
  attachInterrupt(digitalPinToInterrupt(button2Pin), handleButton2, FALLING);

  // --- OLED setup ---
  display.begin(SSD1306_SWITCHCAPVCC, 0x3C);
  display.clearDisplay();
  display.setTextSize(1);
  display.setTextColor(WHITE);
  display.setCursor(0, 0);
  display.println("Mode: Both OFF");
  display.display();
}

void loop() {
  unsigned long currentTime = millis();

  // --- Handle Button 1 (Mode Change) ---
  if (button1Pressed && (currentTime - lastDebounceTime1 > debounceDelay)) {
    button1Pressed = false;
    lastDebounceTime1 = currentTime;
    if (digitalRead(button1Pin) == LOW) {
      mode = (mode + 1) % 4;  // Cycle through modes
      updateDisplay();
    }
  }

  // --- Handle Button 2 (Reset to OFF) ---
  if (button2Pressed && (currentTime - lastDebounceTime2 > debounceDelay)) {
    button2Pressed = false;
    lastDebounceTime2 = currentTime;
```

```
  if (digitalRead(button2Pin) == LOW) {
    mode = 0;
    updateDisplay();
  }
}

// --- Handle each mode ---
if (mode == 0) {  // Both OFF
  digitalWrite(led1Pin, LOW);
  digitalWrite(led2Pin, LOW);
  digitalWrite(buzzerPin, LOW);
}

else if (mode == 1) {  // Alternate blink
  if (currentTime - lastBlinkTime >= 500) {
    lastBlinkTime = currentTime;
    led1State = !led1State;
    led2State = !led2State;
    digitalWrite(led1Pin, led1State);
    digitalWrite(led2Pin, led2State);
    digitalWrite(buzzerPin, led1State);
  }
}

else if (mode == 2) {  // Both ON
  digitalWrite(led1Pin, HIGH);
  digitalWrite(led2Pin, HIGH);
  digitalWrite(buzzerPin, HIGH);
}

else if (mode == 3) {  // PWM Fade (non-blocking)
  if (currentTime - lastFadeTime >= 15) {  // Adjust fade speed
    lastFadeTime = currentTime;
    fadeValue += fadeStep;
    if (fadeValue <= 0 || fadeValue >= 255) fadeStep = -fadeStep;

    // Simulate PWM brightness
    int brightnessDelay = map(fadeValue, 0, 255, 1, 15);
    digitalWrite(led1Pin, HIGH);
    digitalWrite(led2Pin, LOW);
    delayMicroseconds(brightnessDelay * 100);
    digitalWrite(led1Pin, LOW);
    digitalWrite(led2Pin, HIGH);
    delayMicroseconds(brightnessDelay * 100);
```

```
      digitalWrite(buzzerPin, fadeValue % 2);
    }
  }
}

// --- OLED update function ---
void updateDisplay() {
  display.clearDisplay();
  display.setCursor(0, 0);
  display.setTextSize(1);
  display.setTextColor(WHITE);
  display.print("Mode: ");
  if (mode == 0) display.println("Both OFF");
  else if (mode == 1) display.println("Alternate Blink");
  else if (mode == 2) display.println("Both ON");
  else if (mode == 3) display.println("PWM Fade");
  display.display();
}
```

Task B :

Code:

```
// ---------------------------------------------------------------
// Title      : Button Press Type Detection with OLED Display (Task B)
// Author     : Ayesha Iftikhar
// Reg. No.   : 23-NTU-CS-1021
// Section    : BSCS 5th (A)
// Course     : Internet of Things (IoT)
// Instructor : [Your Teacher's Name]
// Date       : [Date of Submission]

// Description:
// This program detects short and long presses of a single push button
// using an ESP32 and displays the event on an OLED display.

// Functions:
// - Short press (< 1.5 seconds): Toggles the LED ON or OFF.
// - Long press (> 1.5 seconds): Plays a buzzer tone for 0.5 seconds.
```

```
// The system uses the Adafruit SSD1306 OLED library for display
// and the built-in tone() function for generating buzzer sound.

// Tools Used:
// - Wokwi (for simulation)
// - Arduino IDE (for programming)
// ---------------------------------------------------------------



#include <Wire.h>
#include <Adafruit_GFX.h>
#include <Adafruit_SSD1306.h>

#define BUTTON 4
#define LED 2
#define BUZZER 5

Adafruit_SSD1306 display(128, 64, &Wire, -1);

unsigned long pressTime = 0;
bool buttonState = false;
bool lastButtonState = false;
bool ledState = false;

void setup() {
  pinMode(BUTTON, INPUT_PULLUP);
  pinMode(LED, OUTPUT);
  pinMode(BUZZER, OUTPUT);

  display.begin(SSD1306_SWITCHCAPVCC, 0x3C);
  display.clearDisplay();
  display.setTextSize(1);
  display.setTextColor(WHITE);
  display.setCursor(0, 0);
  display.println("Ready...");
  display.display();
}

void loop() {
  buttonState = digitalRead(BUTTON) == LOW;

  if (buttonState && !lastButtonState) {
    pressTime = millis(); // button just pressed
```

```
  }

  // when button released
  if (!buttonState && lastButtonState) {
    unsigned long pressDuration = millis() - pressTime;

    display.clearDisplay();
    display.setCursor(0, 0);

    if (pressDuration < 1500) {
      // short press → toggle LED
      ledState = !ledState;
      digitalWrite(LED, ledState);
      display.println("Short Press");
      display.println("LED Toggled");
    }
    else {
      // long press → buzzer tone
      display.println("Long Press");
      display.println("Buzzer ON");
      tone(BUZZER, 1000, 500); // 1kHz tone for 0.5s
    }

    display.display();
  }
  lastButtonState = buttonState;
}
```