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Section (BSCS 5th A)

Documentation

ESP32 LED Control with OLED Display

This demonstrates how to control three LEDs using an ESP32 microcontroller. The user can switch between multiple LED modes using two buttons — one for mode selection and another for resetting. The OLED display shows the current active mode. The program uses non-blocking timing logic for smooth LED transitions without delays.

Hardware Components

1. ESP32 Microcontroller
2. Three LEDs (connected to GPIO 16, 17, and 18)
3. Two Push Buttons (Mode and Reset on GPIO 32 and 33)
4. 0.96-inch OLED Display (I2C communication)
5. Resistors and jumper wires for connections

Pin Configuration

LED1 → GPIO 16
LED2 → GPIO 17
LED3 → GPIO 18
Mode Button → GPIO 32
Reset Button → GPIO 33
OLED SDA → GPIO 21
OLED SCL → GPIO 22

Working Explanation

1. The program starts by initializing all pins and the OLED display.
2. The OLED shows the current mode of operation.

3. The Mode button changes between 4 modes:
   - Mode 0: All LEDs OFF
   - Mode 1: LEDs blink alternately (one by one)
   - Mode 2: All LEDs ON
   - Mode 3: LEDs fade in and out using software PWM
4. The Reset button immediately resets everything to Mode 0.
5. Non-blocking code using 'millis()' ensures the program runs smoothly without freezing.

OLED Display Role

The OLED display provides real-time feedback to the user by showing the current mode, such as 'All OFF', 'Alternate Blink', 'All ON', or 'PWM Fade'. This makes it easier to understand what the ESP32 is currently doing.

Software PWM Explanation

The ESP32 in Wokwi does not use 'analogWrite()', so software PWM is implemented. PWM (Pulse Width Modulation) controls LED brightness by rapidly turning the LED on and off. The 'brightness' value defines how long the LED stays ON in each cycle.

Debouncing Concept

Debouncing prevents false triggers when pressing buttons. The program waits a short delay (like 300ms) after each button press before accepting the next input.