**National Textile University, Faisalabad**



**Department of Computer Science**

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**DOCUMENTATION TASK B**

**Objective:**  
 To control an LED and buzzer using a single button. A short press toggles the LED ON or OFF, while a long press (more than 1.5 seconds) activates the buzzer. An OLED display is used to show the current status of the system.

## **Introduction:**

This project demonstrates the use of a single button to perform multiple actions based on the duration of the button press. It is implemented using the ESP32 microcontroller and uses an OLED screen to display system feedback. The system intelligently distinguishes between a short press and a long press using time-based logic.

## **Hardware Components:**

1. ESP32 NodeMCU
2. LED
3. Active Buzzer
4. Push Button
5. OLED Display (I2C-based)
6. Jumper Wires

## **Pin Configuration:**

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| --- | --- | --- |
| **Component** |  | **ESP32 Pin Number** |
| Button |  | GPIO 32 |
| LED |  | GPIO 16 |
| Buzzer |  | GPIO 17 |
| OLED SDA |  | GPIO 21 |
| OLED SCL |  | GPIO 22 |

## **Working Principle:**

### **Short Press (Less than 1.5 Seconds)**

* The LED toggles its state.
* If the LED is OFF, it turns ON. If it is ON, it turns OFF.
* The OLED displays either “LED ON” or “LED OFF”.

### **Long Press (More than 1.5 Seconds)**

* The buzzer starts playing a tone continuously while the button is held.
* The OLED displays “BUZZER”.

### **When Button is Released**

* If it was a long press, the buzzer stops immediately.
* If it was a short press, only the LED toggles.
* The system resets to detect new inputs.

## **Features:**

* Single button performs two different actions.
* Debouncing is used to avoid false button presses.
* OLED display provides user feedback.
* Uses millis() for non-blocking timing.
* Demonstrates interrupt-like behavior using simple logic.

## **Software Logic Explanation:**

1. The button is connected using INPUT\_PULLUP mode.
   1. Button not pressed = HIGH
   2. Button pressed = LOW
2. When the button is pressed, the program records the time using millis().
3. If the button is held longer than 1.5 seconds, it is considered a long press and the buzzer is activated.
4. If the button is released before 1.5 seconds, it is considered a short press and the LED state is toggled.
5. OLED display shows real-time status messages such as “LED ON”, “LED OFF”, “BUZZER”, and “Ready”.

## **Concepts Used:**

* Digital Input with Pull-Up Resistor
* Debouncing Technique
* Timing using millis() Function
* Pulse Width Modulation (PWM)
* I2C Communication with OLED

## **Conclusion:**

This project efficiently demonstrates how a single button can perform multiple actions using press-duration detection. It is a practical approach commonly used in smart devices and IoT applications, where minimal hardware is used to perform maximum functionality. The integration of an OLED display provides an interactive user interface, enhancing project usability.

## **Applications:**

* Smart home devices
* IoT controls
* Power toggles and mode switching in gadgets
* Embedded systems with limited buttons