LAB-1

1. Challenge-1 (Simulation and Implementation)

Design and implement an embedded system that controls a sequence of four LEDs using a single push button. The system should allow the user to start, stop, and resume the sequence with the same button.

The system must meet the following conditions:
- When the button is pressed for the first time, the four LEDs should start blinking one after another from left to right, changing every one second (1 s).
- When the button is pressed again, the sequence should pause at its current position.
- When the button is pressed a third time, the sequence should resume from where it stopped.
- The behavior should be cyclic: every press of the button toggles between "running" and "stopped" states.

2. Challenge-2 (Simulation)

Measuring Weight with a Load Cell, HX711, and LCD

Design and Implement an embedded system to read the weight (until 50kg) from a load cell connected through an HX711 amplifier, display the measured value in real-time on an LCD screen (16x2), and print it to the Serial Monitor.

3. Challenge-3 (Simulation and Implementation)

Weather Station

Design and implement an embedded system to measure temperature and humidity using two sensors: DHT22 (temperature and humidity) LM75. The system must read the sensors every 5 seconds using a non-blocking approach, display the temperature and humidity values locally on an LCD, and send them through the Serial Monitor for remote observation or debugging.

4. Challenge-4 (Implementation)

Design and implement an embedded system that allows you to adjust and control the speed of the MOTOR-ENCODER connected to the ESP32 via an H-bridge and that meets the following requirements:

a. When starting (or restarting) the program, the motor must be stopped (this condition must be guaranteed).
b. The speed set point must be entered from the serial console (terminal) as follows:
- Define a KEY to enter the set point input state. Note that this KEY is pressed from the computer keyboard and that no other KEY should have any effect on the operation of the system.
- The set point is between 0 and (+/-)150 RPM. Use the sign to determine the direction of rotation.
- When the ENTER key is pressed, the set point becomes effective, and the motor must reach that speed.
- Be aware of situations where an invalid set point is entered (symbols that do not correspond or are outside the range) and a message must be sent to the terminal indicating this event. After this, you must re-enter the set point entry state to try again to enter a new set point.

c. The LCD screen and serial console (terminal) must display the set point (in RPM), the speed being measured (in RPM), and the error (in RPM).
d. The speed control strategy must be clearly defined, as this is a feedback system.
e. (5p) The X KEY will be used to stop the motor immediately.

5. Methodology

For Challenges 2-4 use the methodology of six steps (except step 6):

1. Requirement Analysis
2. System Analysis and Design (Architecture & Components)
3. Hardware Design and Integration
4. Firmware Design and Development
5. Testing and Validation
6. Deployment and Optimization

Design the firmware as an FSM (Finite State Machine) and present the algorithm using pseudocode.

6. Deliveries

- **Code repository in GitHub(well organized, README with build/run steps).**
- A short technical report including:
    - Requirement Analysis
    - System Analysis and Design (Architecture & Components)
    - Hardware Design and Integration
    - Firmware Design and Development
    - Testing and Validation