Class Project: Control Temperature for Temperature Chamber by using ESP32

4 persons/group (30 marks)

Figure 1: aMG Temperature Chamber

Abstract

Temperature control refers to the processes aimed at maintaining the temperature at a certain level within a specific range. Most industrial applications need temperature control in various applications, especially the temperature control for a chamber.

aMG Temperature Control LAB has been particularly designed as a low-cost LAB Kit for uses to demonstrate and teach fundamental concepts in Feedback Temperature Control Theory.

aMG Temperature Chamber (Plant Model) consists of:

- 2 Fans
- 1 Heating Element
- Temperature sensor
- 3 Switches (control main power supply, heating element, and fans separately.)
- 12V 3A DC Power Supply

Schematic Diagram

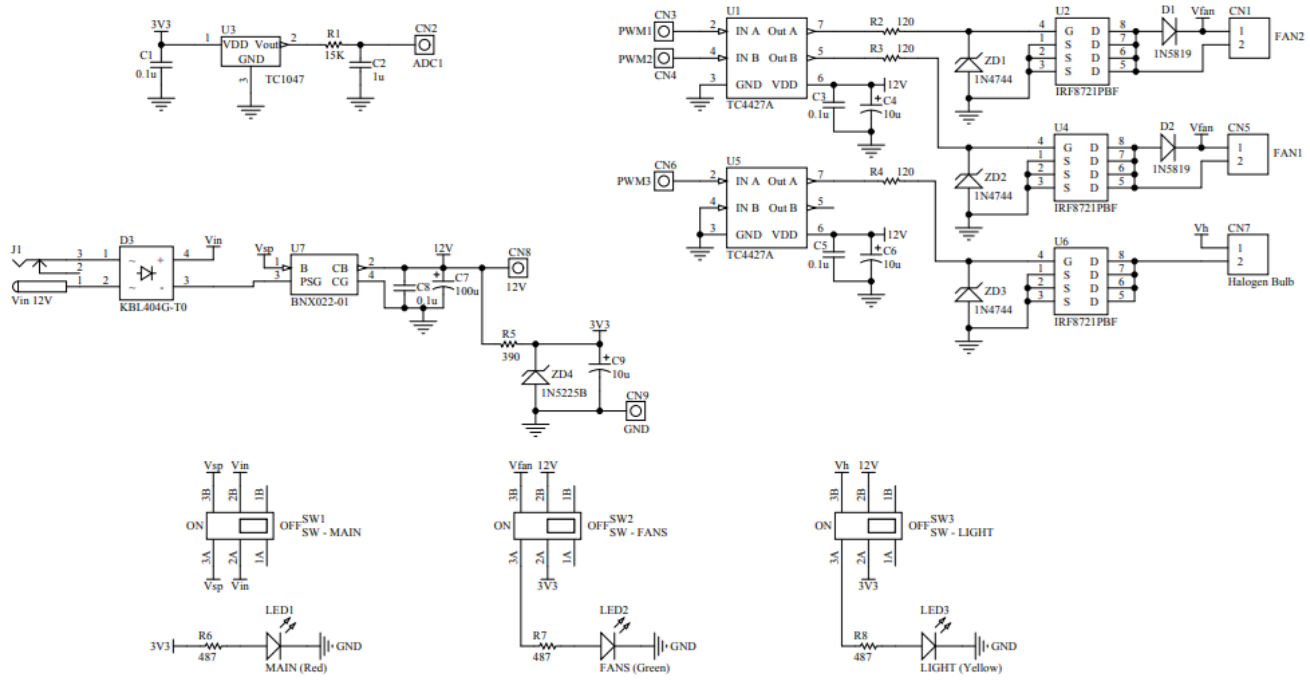

Figure 2: aMG Temperature Chamber schematic

Assignment objectives:

- Using Arduino IDE, ESP32, and Android applications for temperature control
- Follow the requirements from the function requirement topics.

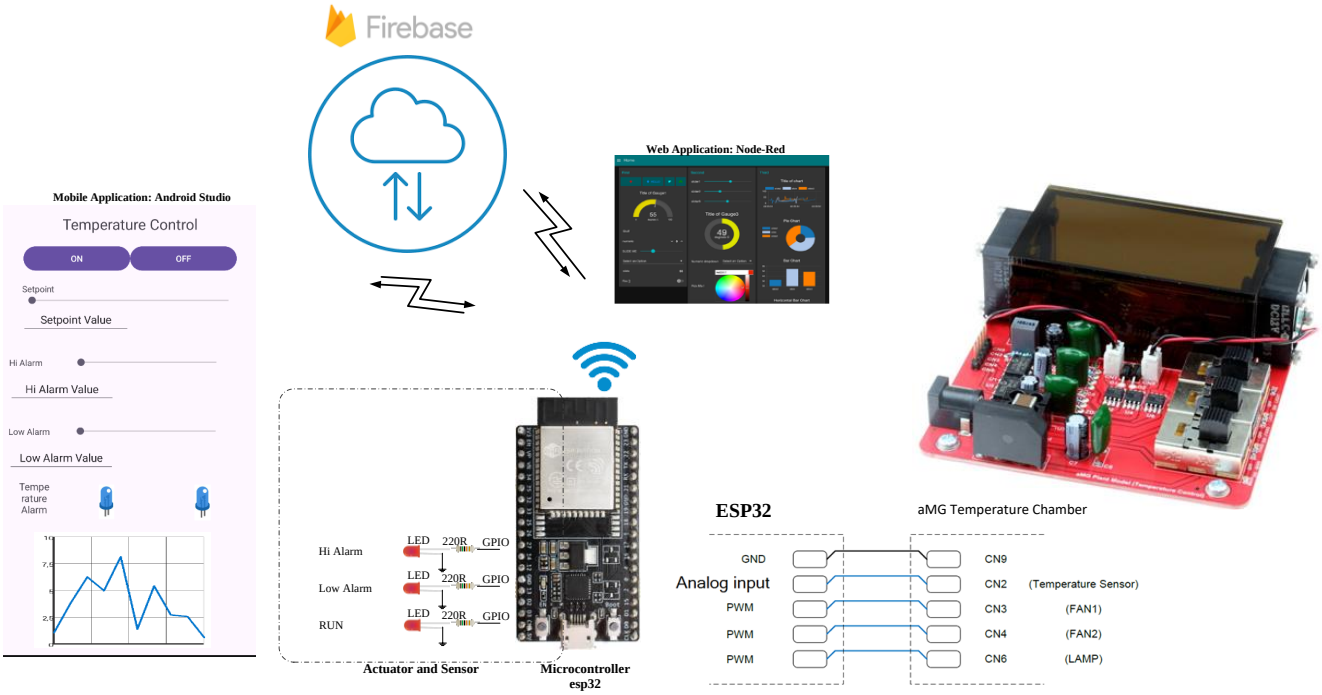

Figure 3: aMG Temperature Chamber, ESP32 diagram

- Design UI with Android Studio for temperature control with an ON-OFF controller for temperature control, as shown in Figure 4.

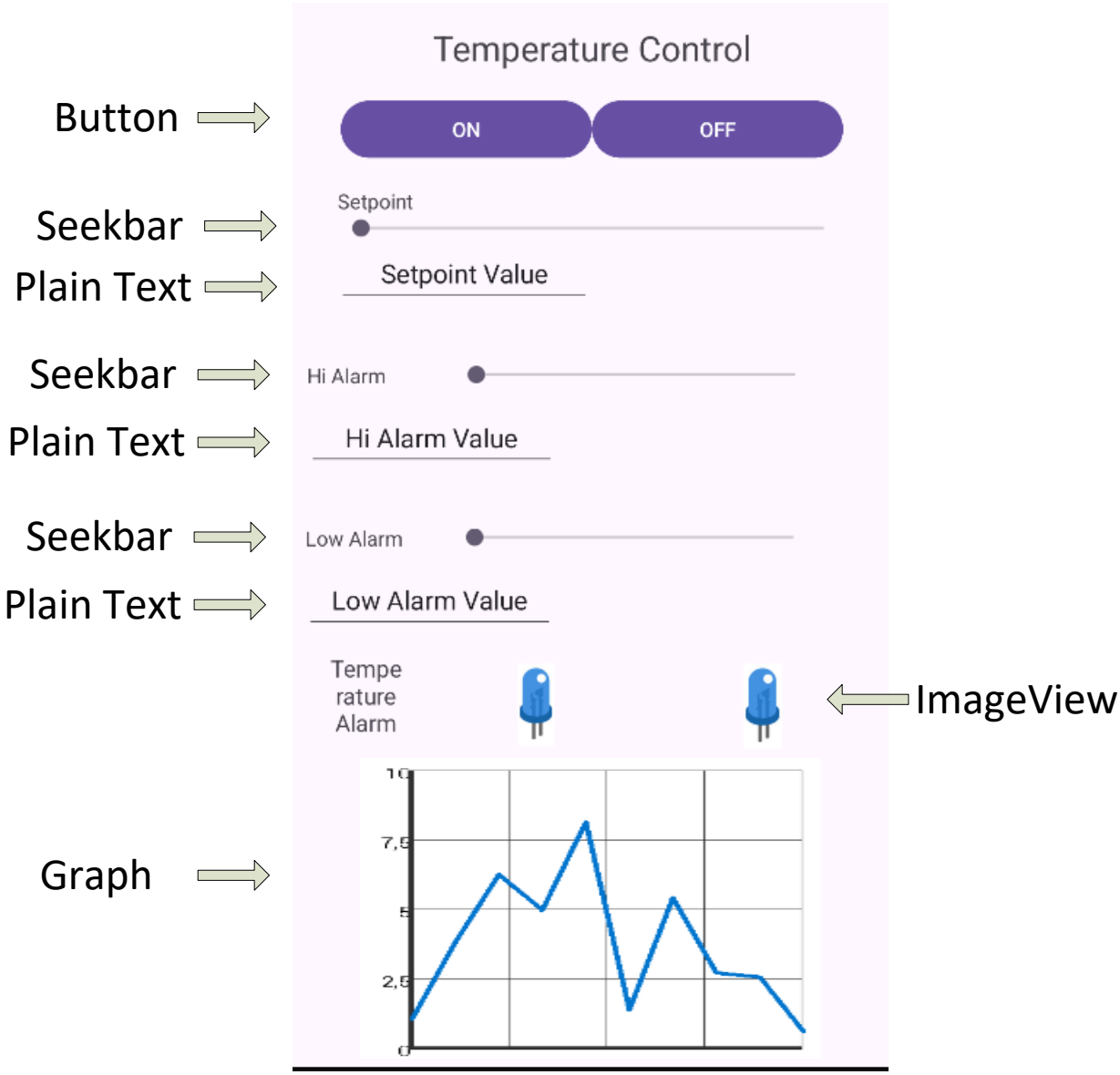

Figure 4: UI for the Android Mobile Application.

ON-OFF Controller Algorithm

An ON-OFF controller, also known as a two-position controller or a bang-bang controller, is a simple and basic type of feedback control system used in various applications to maintain a process variable (e.g., temperature, pressure, level) at a desired setpoint. It operates by switching a control element (like a valve, heating element, or motor) between two discrete states: fully ON or fully OFF, based on the error between the setpoint and the actual process variable.

Define temperature error (ER) as: $ER = SP - PV$ eq.1

Where SP = Setpoint or Set Value (Deg)

PV = Process Variable (Current temperature read from sensor, Deg)

Conditions for Lamp,

$$Lamp = \begin{cases} ON & \text{When } ER > 0 \\ OFF & \text{When } ER \leq 0 \end{cases} \quad \text{eq.2}$$

Function requirement From Figure 3, design UI on mobile by Android application for

- **(2 marks)** Temperature control can be turned on or off using the buttons on the UI. When it's turned off, all LEDs are also turned off.
- **(4 marks)** The Temperature value display by Graph (Plot SP compared with PV) on Android Studio and Node-Red.
- **(2 marks)** Using Seekbar to change temperature Set Point (25 – 60 Deg) and Hi-Alarm (25 – 60 Deg).
- **(2 marks)** Using the LED on ESP32 to display "Hi Alarm" by blinking with Timing Diagram 2 when PV is greater than the "Hi Alarm" level and display the Hi Alarm status on UI.
- **(2 marks)** Use the LED on ESP32 to display "Low Alarm" by blinking with Timing Diagram 2 when PV is less than the "Low Alarm" level and display the Low Alarm status on UI.
- **(2 marks)** Use the LED on ESP32 to display Controller Run by blinking with Timing Diagram 1; otherwise, the LED is off.
- **(2 marks)** Display the temperature control status on/off on the Node-Red.
- **(2 marks)** Display the alarm status Hi Alarm and Low Alarm on the Node-Red with the same group.

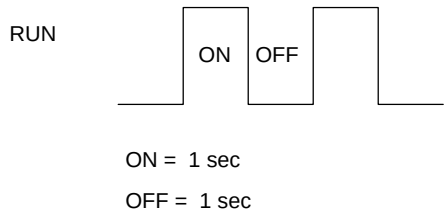

Figure 5: Timing Diagram 1

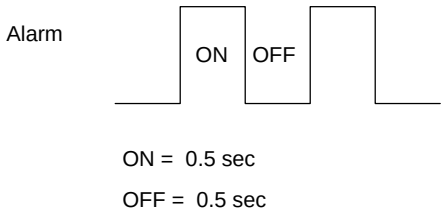

Figure 6: Timing Diagram 2

Instructions:

1. Document your work in a full report, including describing the source code, Introduction, Methodology Results, Discussion, and Conclusion. **(10 marks)**

2. Create Video Demonstrations for the ON-OFF Controller with the Blynk Application. **(10 marks)**
3. Submit a full report and source code (All in .zip file) to Ms-Team.
4. Group Presentation with PowerPoint **(10 marks)** 4 Persons/Group.
5. This class project will contribute to 30 % of the total semester points.