EN2853: Embedded Systems and Applications
Programming Assignment 2

Name: John Doe
Index No: XXXXX

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This is an individual assignment!
Due Date: 18 May 2025 by 11.59 PM

Instructions

In this assignment, you will enhance the Medibox, based on what you learned in class. As you already know, Medibox is a device that assists users in managing their medication schedules effectively. This assignment aims to enhance the basic features of the Medibox and implement additional features to improve the device's functionality. Below are the features that you need to implement as a part of the assignment.

- It is essential to monitor light intensity when storing certain medicines as they may be sensitive to sunlight.
  - To measure the intensity of light, it is recommended to use a Light Dependent Resistor (LDR).
  - The LDR readings should be taken at regular intervals of 5 seconds (default). These readings must be averaged over a period of 2 minutes (default), and the average value should be sent to the Node-RED dashboard.
  - Both the sampling interval (default 5 seconds) and the data sending interval (default 2 minutes) should be configurable by the user from the Node-RED dashboard.
  - Use a separate group to display the light intensity information on the Node-RED dashboard. Within this group, include:
    - A numerical display showing the most recent average light intensity.
    - A plot (chart) to visualize the historical average values over time.
    - Two sliders to adjust:
      - The sampling interval - t_s (in seconds)
      - The sending interval - t_u (in seconds or minutes)
  - To ensure consistency in the display of intensity values, use a range of 0 to 1, where 0 represents the minimum possible value of intensity and 1 represents the maximum possible value of intensity.
- A shaded sliding window has been installed to prevent excessive light from entering the Medibox.
  - The shaded sliding window is connected to a servo motor responsible for adjusting the light intensity entering the Medibox. The motor can adjust its angle between 0–180 degrees based on the lighting and temperature conditions. This enables the system to dynamically regulate the amount of light entering the Medibox to ensure optimal storage conditions for sensitive medicines.
  - In addition to the light sensor, a temperature sensor (DHT11) should be used to measure the ambient temperature inside the storage area.

- The following equation represents the relationship between the motor angle and the environmental conditions:

$$\theta = \theta_{\text{offset}} + (180 - \theta_{\text{offset}}) \times I \times \gamma \times \ln\left(\frac{t_s}{t_u}\right) \times \frac{T}{T_{\text{med}}}$$

  where,

  * θ is the motor angle
  * θ_{offset} is the minimum angle (default value of 30 degrees)
  * I is the intensity of light, ranging from 0 to 1
  * γ is the controlling factor (default value of 0.75)
  * t_s is the sampling interval (in seconds)
  * t_u is the sending interval (in seconds)
  * T is the measured temperature (in degrees Celsius)
  * T_{med} is the ideal storage temperature for the medicine (default value of 30°C)

- Different medicines may have different requirements for the minimum angle, controlling factor, and ideal storage temperature used to adjust the position of the shaded sliding window.
  - To enable the user to adjust these parameters, create a new group in the Node-RED dashboard.
  - Use three slider controls in the Node-RED dashboard within this group:
    * The first slider should range from 0 to 120, allowing the user to adjust the minimum angle (θ_{offset}) of the shaded sliding window.
    * The second slider should range from 0 to 1, enabling the user to adjust the controlling factor (γ) used to calculate the motor angle.
    * The third slider should range from 10°C to 40°C, allowing the user to set the ideal storage temperature for the medicine (T_{med}).

Figure 1 shows a sample dashboard for the project. Note: **This does not include all the required features**. This is to get an idea about the dashboard. You are free to choose colors and placements of components.

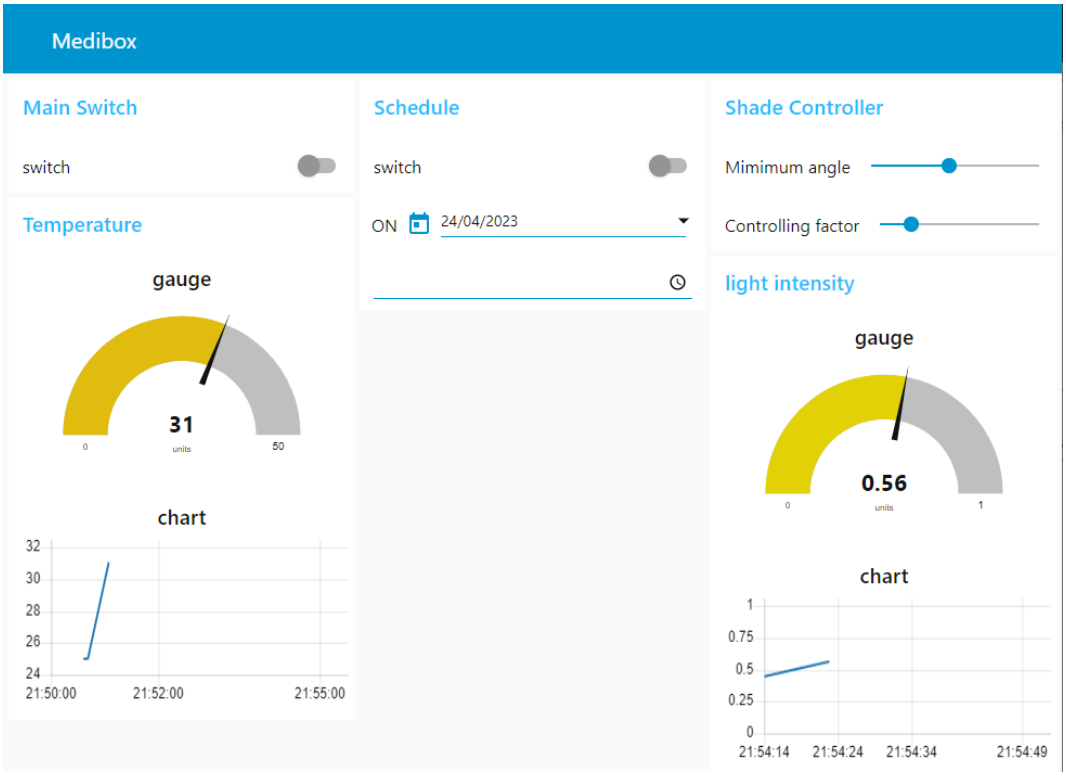

Figure 1: Sample dashboard.

Figure 2 shows the basic architecture of the project. **Use, test.mosquitto.org/ as the broker**.

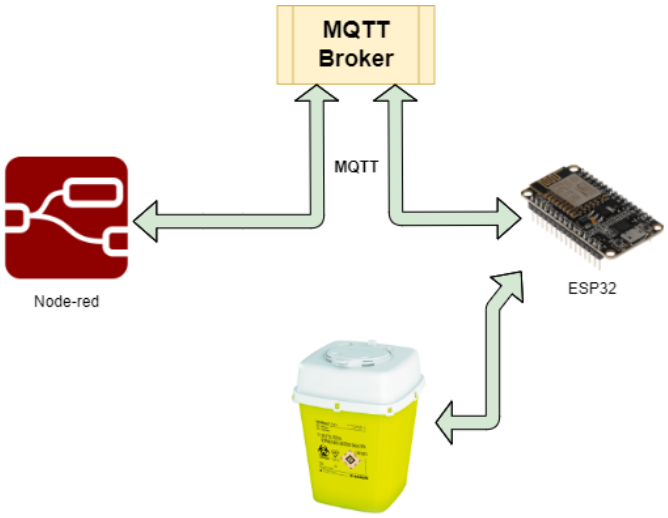

Figure 2: High-level architecture.

Marking Rubric

This assignment accounts for 20% of your final grade. The marks allocation for the required functionality is as follows.

Table 1: Marks Allocation.

Criteria	**Allocated Marks**
Taking LDR input properly	5%
Taking DHT11 temperature input properly	5%
Adjusting Sampling rate and sending intervals of LDR	15%
Sending LDR data to the dashboard via MQTT	5%
Visualize light intensity with a plot and a gauge	5%
Setting up a servo motor properly	10%
Programming ESP32 to control the servo angle with the given equation	15%
Setting sliders in the node-RED dashboard for controlling parameters	10%
Sending parameters to ESP32 and setting them to the equation	20%
Creativity and neatness	10%

Submission

Add the Node-RED flow as a JSON file and Arduino code to the same folder. Make a .zip file with these files and submit it to Moodle as XXXXX.zip, where XXXXX is your index number. You need to include a video as well. Instructions for the video:

- Length: Maximum 5 minutes
- Begin your video by stating your name and index number.
- When discussing your code, provide a step-by-step walkthrough explaining key functions and logic used in your code.
- Explain the approaches selected for the implementation of different features.
- Please keep your video camera turned on throughout the entire video presentation. This will help us see and connect with you as you explain your code and make the presentation more engaging. Make sure that your video does not obstruct the important visuals on the screen.