EN2853: Embedded Systems and Applications
Programming Assignment 2

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Index No: XXXXX

March 29, 2024

This is an individual assignment!
Due Date: 12 May 2024 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, two Light Dependent Resistors (LDRs) are required. The LDRs are placed on either side of the Medibox to capture the light properly.
  - Use a separate group to display the highest light intensity on the Node-RED dashboard (highest value from two LDRs). Within this group, it is recommended to use a gauge to display the real-time highest intensity and a plot to visualize past variations. Also, you need to indicate from which LDR the highest light intensity is obtained (whether it is the left LDR or the right LDR).
  - To ensure consistency in the display of intensity values, use a range of 0 to 1, where 0 represents the minimum possible intensity value (when analog reading is zero) and 1 represents the maximum possible intensity value (when analog reading is 1023).
- 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 conditions. This enables the system to dynamically regulate the amount of light entering the Medibox to ensure optimal storage conditions for sensitive medicines.
  - The following equation represents the relationship between the motor angle and the intensity of light entering the Medibox:
    $\theta = \min\{\theta_{\text{offset}} \times D + (180 - \theta_{\text{offset}}) \times I \times \gamma, 180\}$
    where,
    - θ is the motor angle
    - θ_{offset} is the minimum angle (default value of 30 degrees)
    - I is the max intensity of light, ranging from 0 to 1
    - γ is the controlling factor (default value of 0.75)
    - $D = 0.5$ if right LDR gives max intensity, $D = 1.5$ if left LDR gives max intensity

- Different medicines may have different requirements for the minimum angle and the controlling factor used to adjust the position of the shaded sliding window.
  - To enable the user to adjust the minimum angle and controlling factor, create a new group in the Node-RED dashboard.
  - To adjust the system's minimum angle and the controlling factor, it is recommended to use two slider controls in the Node-RED dashboard. The first slider control should range from 0 to 120, allowing the user to adjust the minimum angle of the shaded sliding window as needed. The second slider control should range from 0 to 1, enabling the user to adjust the controlling factor used to calculate the motor angle.
  - Additionally, include a dropdown menu with options for commonly used medicines, such as Tablet A, B, and C, as well as a custom option. If the user selects the custom option, they can manually change the values for the minimum angle and controlling factor. If a specific medicine is selected from the dropdown menu, the predefined values for the minimum angle and controlling factor should be applied automatically.

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.

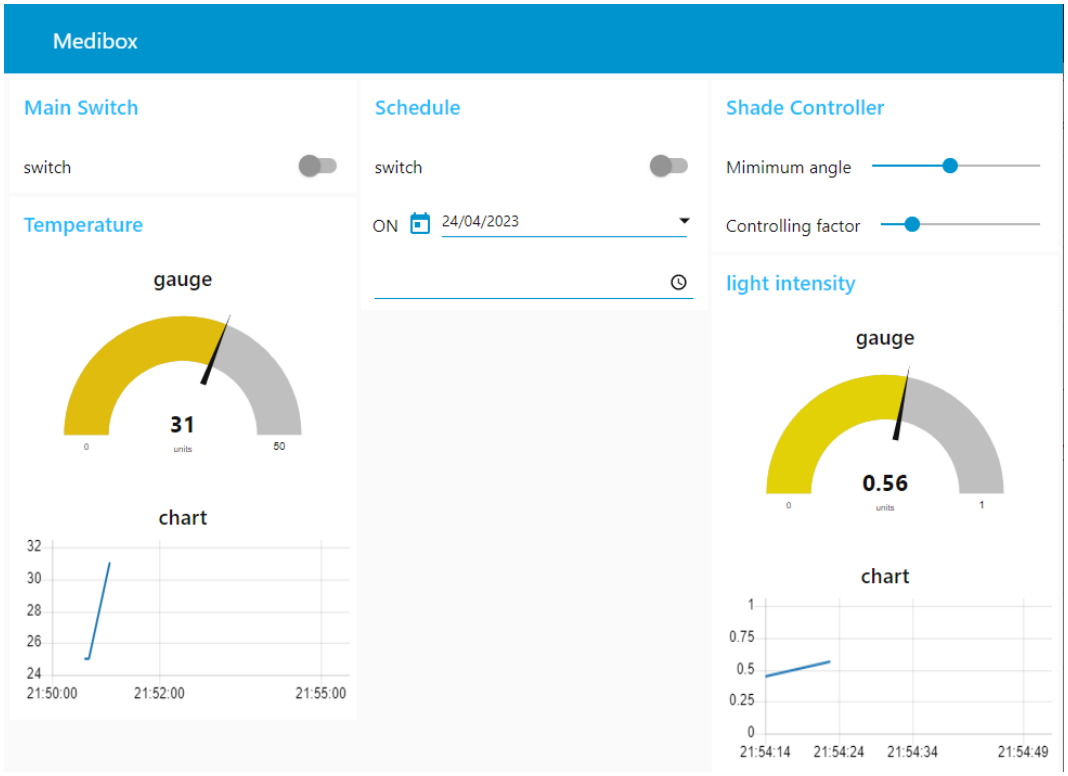

Figure 1: Sample dashboard.

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

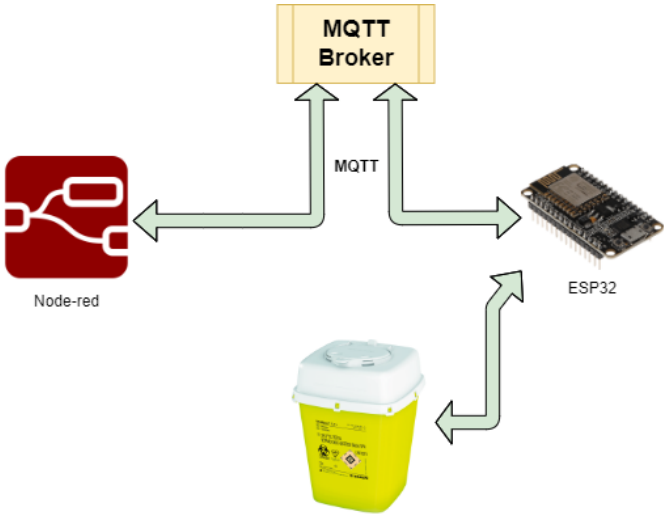

Figure 2: High-level architecture.

Marking Rubric

This assignment accounts for 30% of your final grade. The marks allocation is as follows.

Table 1: Marks Allocation.

Criteria	**Allocated Marks**
Taking LDR input properly	10%
Sending LDR data to the dashboard via MQTT	15%
Visualize light intensity with a plot and a gauge	10%
Setting up a servo motor properly	10%
Programming ESP32 to control the servo angle with the given equation	15%
Setting sliders and drop-downs 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

Submit a zip file named XXXXX.zip, containing the Node-RED flow as a JSON file, Arduino code, and a screen video demonstrating the working simulation with explanations of the code and flow, where XXXXX is your index number. 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.