COMP9032 Project

Smart Airplane Window Controller

Description

Traditionally, an airplane window has a pull-down plastic shade. The shade can only be manually opened or closed by the person seating beside the window, which is not convenient to the flight crew.

The smart window overcomes this problem. The window can be controlled both locally and remotely and can be adjusted to let in different amount of light, as illustrated in Figure 1, where the window can change from clear (equivalent to “shade is open”) to opaque and to complete dark (equivalent to “shade is closed”).

By locally controlling the window’s opacity level, passengers can enjoy beautiful outside scenes from the plane without being dazzled by the strong sunlight. By centrally controlling all windows, the flight attendants do not need to repeatedly ask passengers to open the window shade during takeoff and landing [2]. Furthermore, with the centralized control, the “window shades” can be automatically opened in an emergency.

Figure 1: Airplane smart windows [1]

In this project, you will be working **in group** to develop a simulation system with the AVR Development board, to simulate the window control operations in an airplane.

Here we have the following assumptions:

- Due to the limited resources available on the lab board, we assume there are only two windows to control, and the state of each window is represented by a pair of two LEDs, as demonstrated in Figure 2.

- The opacity level of each window is represented by the brightness of the LEDs. The brighter the LEDs, the darker the window. We assume a window has four opacity levels: 0-clear, 1-light opaque, 2-medium opaque, and 3-dark, as illustrated in Figure 2.

- There are three operation modes: individual control, central control, and emergency response. Among the three modes, the emergency response has the highest priority, followed by the central control; the individual control can be overwritten by any of the other two control operations. Specifically,

- On an emergency, all windows will be immediately set to clear (namely, all window shades should be open); otherwise
- If there is a central operation, all windows will be either set to clear or dark; else
- An individual window can be adjusted anytime by the local passenger to one of the four levels and the local controls on different windows are allowed to be performed in parallel.

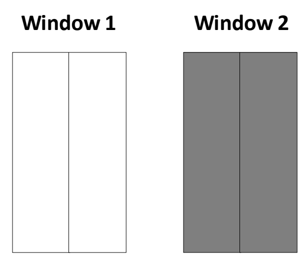

Figure 2: LED pairs used to represent windows in the simulation

The basic requirements for the input and output of the simulation are listed below.

Input:

- The local and central controls should be done by using keys on the keypad. Specifically,
  - For each window, two keys are used, as indicated in Figure 1, one for increasing the window opacity level and one for decreasing the level.
  - The central control also uses two keys, one for setting all windows to clear and one for setting all windows to dark.

- Emergency is simulated by using a push button.
  - Pushing the button will trigger the emergency
  - Pushing the button again will dismiss the emergency and all windows will be set back to their previous state.

Output:

- As mentioned above, two LED pairs are used to indicate the opacity level for the two windows. We also use a group of four LEDs to indicate the emergency; The LED group will flash when an emergency happens.

- In addition, we use LCD to provide text information about the simulation. The LCD display consists of two parts: the left part shows the state of simulation, and the right part shows the opacity level of each window. The simulation can have four states:
  - Initial state (S:) -- Simulation starts, and all windows are set to clear.
  - Local control (L:) -- Windows are individually controlled by passengers.

- Central control (C:) -- All windows are controlled by crew and can only be set to either clear or dark.
- Emergency (!!!:) -- All windows are set to clear, and the 4-LED group is flashing

* LED and LCD should be updated regularly. You need to design the update frequency for correction information to be displayed.

Some examples of the LCD display are given in Figure 3.

(a)	S:	W1 0	W2 0
(b)	L:	W1 0	W2 1
(c)	L:	W1 1	W2 2
(d)	C:	W1 0	W2 0
(e)	C:	W1 3	W2 3
(f)	!!!:	W1 0	W2 0

Figure 3: Examples of LCD display. (a) in the initial state, all windows are set to clear; (b) and (c) in a local control state, where windows 1 and 2 are adjusted to different opacity levels; (d) and (e) in a central control state, where all windows are set to clear or dark; (e) in the emergency state, all windows are set to clear.

Note: For other information that is not provided in this document but you think you need to consider in your design, you can make reasonable assumptions.

Reference:

[1] https://guardianlv.com/2014/03/boeing-787-windows-show-passengers-the-joy-of-flying/

[2] https://www.independent.co.uk/travel/news-and-advice/airline-staff-reveal-why-window-shades-must-be-kept-open-during-takeoff-and-landing-a6899681.html

Submission and Assessment

The project submission is divided into two parts: group demonstration and individual project report, as detailed below.

1) Group demonstration (65 points), due **your lab session in Week 10**

The demonstration is run in the following way:

- One member demonstrates the overall design with the lab board.
- Other members each explain part of the code developed in the project.

The group mark, *G*, from the demonstration is based on whether your group design meets all requirements given in the project specification and whether you can explain your design.

The mark of an individual member will be determined by your contribution voted by your group members and be capped by the maximum 65 points, as given by the formula below

$$MIN(\frac{a}{b} * G, 65),$$

where a is your contribution (in percentage) voted by your group mates, b the expected contribution and $b= 100\%/(group\_size)$.

A form will be available in Week 10 for you to input the group members' contributions.

2) Individual project report (35 points), due **12noon Monday, Week 11 (Nov. 22)**

The report submission consists of two files:

- Source code (10 points)
  The code should be
  - well-commented by you
  - easy to read

  Note: Your report may **not** necessarily score the same as those submitted by your group members. For example, your version of code may provide clear and logic comments that make the code easy to read and maintain and hence earn you a higher score.

- Project report (25 points).
  The report is about four pages long with a font size of 11pt. The report should provide
  - the general description about the project development, management, and the contributions of each group member
  - the overview of the project design, which includes:

    - hardware components used and the related interfacing design
    - software code structure and execution flow, and
    - how software and hardware interact with each other
  - conclusive remarks about the project

The *give* submission system for the project report will be open in Week 10.