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 various amounts 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 opaque level, passengers can enjoy beautiful scenes from 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 situation.

Figure 1: Airplane smart windows [1]

In this project, you will be working **individually** 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 limited resources available on the lab board, we assume there are four windows to control. Each window is represented by two LED bars, as demonstrated in Figure 2.

- The opaque level of each window is represented by its brightness. The brighter the LEDs, the darker the window.

- We assume a window has four states or four opaque levels: clear (0), light opaque (1), medium opaque (2), and dark (3). It takes some time for a window to change from one state to another, for example, 0.5 second between adjacent states.

- There are three controlling situations: individual control, central control, and automatic emergency response. Among the three controlling situations, the emergency response has a highest priority, followed by the central control; the individual control can be overwritten by any of the other two control operations. Specifically,
    - on emergency, all windows will be immediately set to clear; 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 states and the local controls are allowed to be done in parallel.

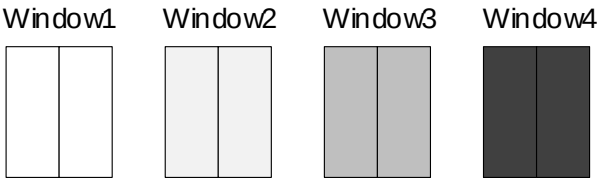

Figure 2: LED pairs used to represent windows in the simulation

The basic designs of the input and output for the simulation are specified below.

Input:

- The local and central controls can be done by using keys on the keypad.
    - For each window, two keys are used, as indicated in Figure 1, one for increasing the window opaque level and one for decreasing the level..
    - The central control only 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. When the button is pushed, an emergency happens and all windows are set to clear.

Output:

- Four LEDs pairs are used to indicate the opaque level for the four windows.

- Apart from using the LED indicator, LCD is used to provide textual information about the simulation. The LCD display consists of two parts: the left part shows the state of the simulation and the right part shows the opaque 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
- Central control (C:), all windows can only be set either to clear or to dark.
- Emergency (!!), all windows are set to clear

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

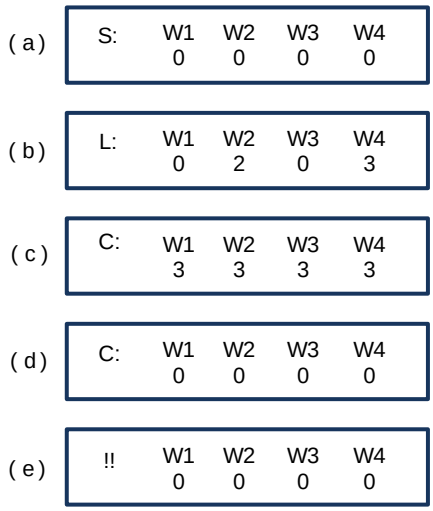

Figure 3: Examples of LCD display (a) in the initial state, all windows are set to clear (b) in a local control state, where windows W2 and W4 are adjusted to different opaque levels (c) in a central control state, where all windows are set to dark (d) in a central control state, where all windows are set to clear (e) in the emergency state, all windows are set to clear.

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 Information

The following items should be submitted:

- Source code. Your program should be well commented.
- Design manual (about 5 pages). The manual describes how the simulation system is designed. The manual should be well written. A person with knowledge about the subject and the lab board should understand how your system is designed and how to operate and modify your system after reading the manual.

Grading

The project is worth 15% of your final result and will be marked under the following criteria:

- Implementation to be demonstrated in lab (65%):
- Code Style (5%):
    - Easy to understand
    - Well commented
- Design Manual (30%)
    - Good presentation
    - Clear and easy to understand

Demonstration time: your lab class in Week 10
Submission time: Friday, Week 10