KON309E Microcontroller Systems

Midterm Project

2022/10/28

Subject:

You are expected to write a LED flashlight with variable intensity. It will use 1 LED and 1 button in Task 1, and an extra potentiometer in Task 2.

Task 1:

The flashlight will work as follows:

- At power on: LED is OFF.
- When the LED is OFF, a short press of the button will turn the LED on to the last adjusted brightness. The power on default is 20% of maximum.
- When the LED is ON:
  - A long press will cause the brightness of the LED to change. The brightness will change as long as the button is pressed.
  - The direction of change will be opposite of the last direction. That is, the first long press may increase the brightness, the next press will decrease it and so on. Default direction at power on is in to increase the brightness.
  - A double click will start blinking the flashlight at a period of 1s (500ms on, 500ms off), without changing the brightness. Another double click will bring it to constant illumination and so on.
  - A single click will cause the flashlight to switch OFF.

We have the following definitions:

- A short press or click is defined as a press with duration shorter than 1s.
- A long press is defined as a press with duration longer than 1s.
- A double click is two short presses with a time gap of max. 200ms in between.

In the project you must demonstrate the following methods and competencies:

1. Use PWM generated by a timer. PWM frequency must be 100Hz, and PWM resolution (ARR value) must be 1000 steps. Set up the timer accordingly.
2. Use the Sytick INT for generating the time base for the gradual brightness change ramp during long press. The brightness must change from 0% to 100% in 4 seconds.

3. Use a countdown timer to measure the time gap between double clicks. In the falling edge of the first click start the timer to expire in 200ms. If a second click is detected before the timer expires, it can be considered as a double click.
4. Your program must be based on a finite state machine (FSM). Draw the FSM using Drawio (https://app.diagrams.net/). The state names in the drawing must match the state names in the program. The double click routine must also be in the FSM.
5. There must be no glitches in the operation. Every time the button is pressed, the LED must respond as expected.

Task 2:

Implement the flashlight as in Task 1, but the brightness must be controllable by the potentiometer. Task 2 has the following properties:

1. After power on, the flashlight brightness will depend on potentiometer position.
2. The ON, OFF and blink controls will work as in Task 1.
3. The ADC must be triggered periodically every 50ms, from a timer (that is different from the PWM generating timer)
4. The ADC must write the result to a global variable that is used by the main function through an end of conversion (EOC) interrupt.

Design essentials:

For this project, it is crucial that you get two items correctly before attempting the design:

1. Select the peripheral devices carefully! Decide on which pin for the button, which timer to control brightness and which timer for triggering the ADC. Decide on which ADC to use.
2. Work on an algorithm that reads the button press correctly and without a glitch. At every press you should get a clean result.
3. Design the FSM correctly before starting to code! Especially the long short and double press ideas must be solidly implemented.

Report contents:

Your report must be in a formal report format and contain the following:

1. The peripheral device assignment list. (See item 1 in Design essentials)
2. FSM design. Show the state transition diagram that you save from Drawio application.
3. Your source code. Attach source code **only to the electronic submission** and not the paper submission. **Do not attach as a screenshot,** but as text so that the TA's can replicate your code.
4. The report must be submitted in PDF format.

5. Upload your code after compressing it in ZIP format. (RAR format is proprietary and **will not be accepted**.)

Remember: Do not code in front of the computer, code on a piece of paper!

If there is anything you do not understand, please contact the class assistants.