# CSE 3442/5442: Embedded Systems 1
# Lab 6: Building a Watch - Timers and Interrupts

## Overview
The purpose of this lab is to understand how Timers and Interrupts function within the PIC18.

## Problem Statement
Design and implement a 24-hour clock using the QwikFlash board. The time is to be displayed on the LCD in 1 sec update intervals. For this lab, you should use timer-0 to get an interrupt signal every 1 second (or as precise as possible). Use 2 switches and 2 push buttons on the IDL to control the clock:

- **Switch 1** (interrupt) will be responsible for running/stopping the clock.
  - When SW1 = 0 the clock should be in running mode (updating LCD)
  - When SW1 = 1 the clock is in stop mode (paused with LCD still displaying)
- **Switch 2** (not an interrupt) will be responsible for setting a new clock values and allowing manual incrementing. Clock value can be changed only if SW1 = 1.
- **Push button 1** (interrupt) is used to clear the clock and reset everything back to 0. When PB1 is pressed the clock should be cleared in ANY mode/state.
- **Push button 2** (not an interrupt) will be used to set the time when SW1 and SW2 are set. Pressing PB2 should increment the clock value in a fast speed (until the desired time is reached).

For clarification…
>           High Priority Interrupts: INT0 (PB1)
>           Low Priority Interrupts: TMR0, INT1 (SW1)

| SW 1<br>Run/Pause<br>(Interrupt)<br>INT1/B1 | SW 2<br>Allow ++<br>(Reg. I/O)<br>B2 | PB 1<br>Clear/Reset<br>(Interrupt)<br>INT0/B0 | PB 2<br>++<br>(Reg. I/O)<br>B3 | Function/Operation |
|:---:|:---:|:---:|:---:|:---:|
| 0 | 0 | 0 | 0 | Normal Operation |
| 1 | 0 | 0 | 0 | LCD/Timer Paused |
| 1 | 1 | 0 | 0 | LCD/Timer Paused |
| 1 | 1 | 0 | 1 | Increment Timer (Show on LCD in real-time) |
| X | X | 1 | X | Reset Timer (Show on LCD in real-time) |
| 0 | 0 | 0 | 1 | N/A (nothing changes) |
| 0 | 1 | 0 | 1 | N/A (nothing changes) |
| 0 | 1 | 0 | 0 | N/A (nothing changes) |
| 1 | 0 | 0 | 1 | LCD/Timer Paused but PB2 has no effect |

X = Any State/Don't Care

Display the time on line 1 of the LCD and display Running/Paused/++ messages on line 2.

Toggle the QwikFlash's LEDs every time the timer is Cleared/Reset (PB1 is pressed)
LEDs: D4 (RA3) - D5 (RA2) - D6 (RA1) → ● ● ● → ● ● ● → ● ● ●

Note: Ensure you have a common GND between the QwikFlash and the IDL.