Driver Project 4: IO Interrupts, Timers and UART Display Drivers (Group Project)

Due Date: As per D2L.

Assignment:

Using the Microcontroller and the driver topics on IOs, Timers, interrupts and UART display drivers covered so far, you will design a simple IO controller to test out IO and Timer Interrupts with display drivers. Design a state machine to turn on, turn off and blink a LED connected to port RB8 based on the push buttons (PBs) connected to the input ports RA2, RA4 and RB4 as shown in the schematic in the lecture slide 'HW and IO Control.pdf'. PB1, PB2 and PB3 represent push buttons connected to ports RA2, RA4 and RB4 respectively. The state machine should operate as follows:

User input(s)	**Output(s)**
While PB1 is pressed	LED blinks at approx. 0.5 sec intervals (0.5 sec on and 0.5 sec off) **"PB1 is pressed"** is displayed on PC terminal
While PB2 is pressed	LED blinks at approx. 2 sec intervals (2 sec on and 2 sec off) **"PB2 is pressed"** is displayed on PC terminal
While PB3 is pressed	LED blinks at approx. 3 sec intervals (3 sec on and 3 sec off) **"PB3 is pressed"** is displayed on PC terminal
While 2 PBs are pressed together	LED stays on without blinking **"PB_ and PB_ are pressed" is displayed on PC terminal. " The blanks __ should display the corresponding PB numbers pressed**
While all 3 PBs are pressed together	LED stays on without blinking **"All PBs pressed" is displayed on PC terminal**
No PBs pressed	LED stays off "Nothing pressed" is displayed on the PC terminal

Additional info:

1. Implement the above controller using the hardware kit and your code, which will be designed using basic ANSI C commands; IO and Timer interrupts; and Display driver functions provided.
2. Use of polling and manufacturer-provided timer functions instead of interrupts will lose points. Function names: Students can use any convention when naming functions or organizing code.
3. Display instructions: **All displays on the PC terminal window should be on a single line**. Note that display functions carried out at 32 kHz (300 Baud) can affect timer delays. Your code should account for such delays when producing delays specified in the table above.

4. Interrupts: Interrupt ISR names are provided in the lecture slides. As specified in lecture, IO (CN interrupts) are triggered on rising and falling edges and due to any debounce effects of the push buttons. A debounced switch will result in several hi to lo and lo to hi fluctuations at the Microcontroller input before stabilizing to a steady and fixed voltage when the switch is pressed. Your code should filter out any such effects.

Note:

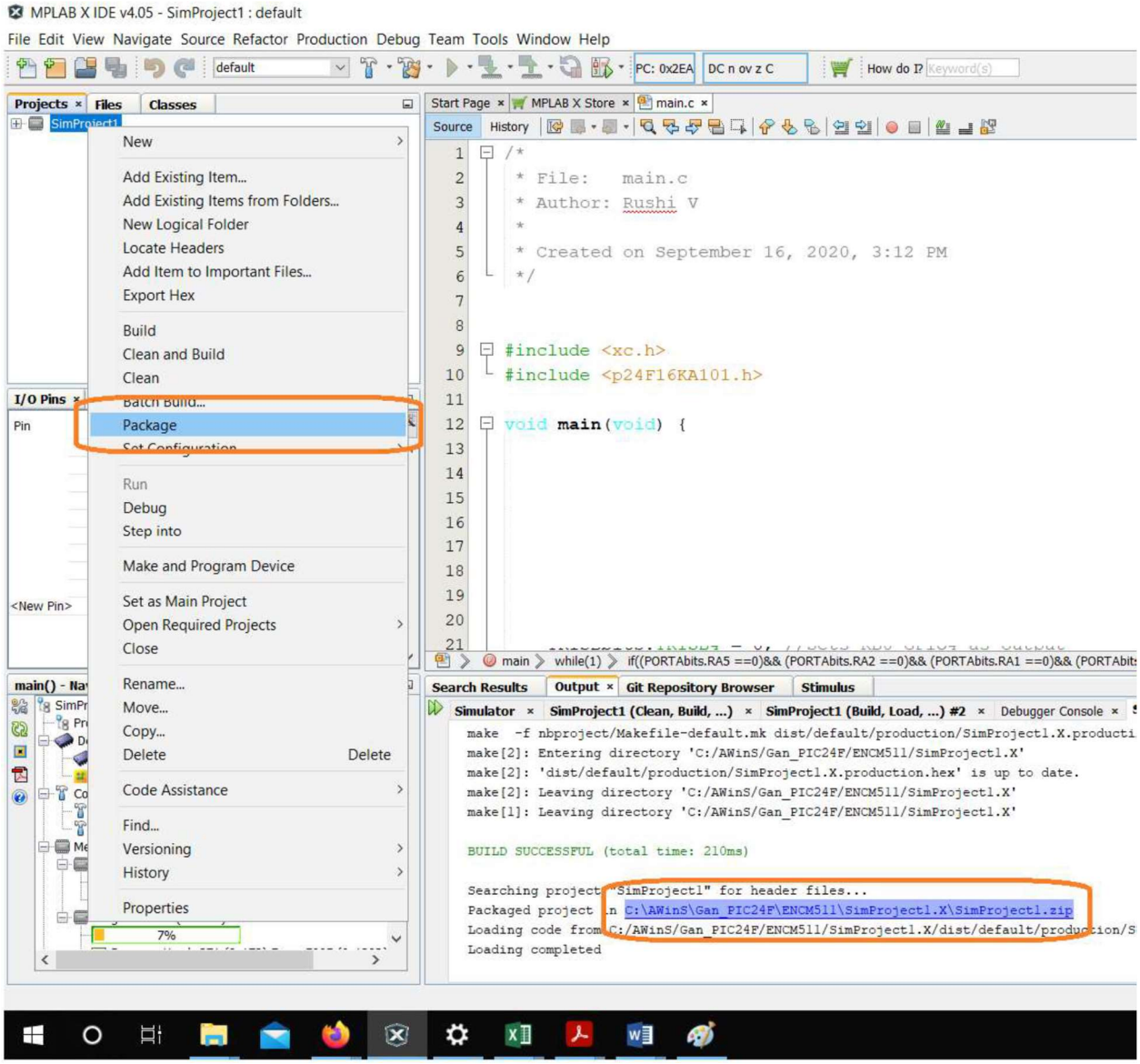
Port RA2 is one of those exceptional ports that is also multiplexed to the input for an external oscillator and an analog input port. To be able to use it as a digital input with a pushbutton, it's multiplexed analog input has to be disabled by including the following line of code in your IOinit() function. We will revisit this multiplexing when we look at ADC converters in a couple of weeks.

```
AD1PCFG = 0xFFFF; // Turn all analog pins as digital
```

Deliverables:

This is a group project. Each group should upload the following onto their respective group D2LDropbox folder created:

1. **Zipped up file of the project. MPLAB projects can be zipped up by right clicking on the project and selecting package (See screenshot below). The zipped project is saved in the same project folder created by user. Make sure your driver code is commented properly especially any mathematical computations used if applicable.**
2. **Link to your video demo uploaded on youtube, Vimeo or similar video hosting website along with the zipped up project. Dropbox or Google or OneDrive links are allowed as well but ensure that videos are in .mp4 or .mov format. Videos uploaded in any other format will lose points. Video demo should be as follows:**
    a. **Single recording no more than 2 mins long**
    b. **Show UCID or government issued ID cards of one of the group members placed in front of the computer with MPLAB and/or hardware running**
    c. **Demo of the code and hardware operation showing the following:**
        i. **Each of the PBs pressed individually - showing LED status and UART display**
        ii. **2 PBs pressed simultaneously – showing LED status and UART display**
        iii. **3 PBs pressed simultaneously – showing LED status and UART display**
        iv. **No PBs pressed - Showing LED status and UART display**
        v. **Repeat one of the PBs pressed individually - showing LED status and UART display (to show if there are any code hangups in previous states)**
    d. **Explanation of the code organization in MPLAB including any special power or time saving features (i.e. interrupts, clock switching, sleep/idle) used, and respective contribution of each group member towards code development and hardware/software testing.**


MPLAB X IDE v4.05 - SimProject1 : default
File Edit View Navigate Source Refactor Production Debug Team Tools Window Help
Projects
Files
Classes
SimProject1
New
Add Existing Item...
Add Existing Items from Folders...
New Logical Folder
Locate Headers
Add Item to Important Files...
Export Hex
Build
Clean and Build
Clean
Package
Run
Debug
Step into
Make and Program Device
Set as Main Project
Open Required Projects
Close
Rename...
Move...
Copy...
Delete
Code Assistance
Find...
Versioning
History
Properties
I/O Pins
Pin
<New Pin>
Start Page
MPLAB X Store
main.c
Source
History
/*
* File: main.c
* Author: Rushi V
*
* Created on September 16, 2020, 3:12 PM
*/
#include <xc.h>
#include <p24F16KA101.h>
void main(void) {
Search Results
Output
Git Repository Browser
Stimulus
Simulator
SimProject1 (Clean, Build, ...)
SimProject1 (Build, Load, ...) #2
Debugger Console
make -f nbproject/Makefile-default.mk dist/default/production/SimProject1.X.producti
make[2]: Entering directory 'C:/AWinS/Gan_PIC24F/ENCM511/SimProject1.X'
make[2]: 'dist/default/production/SimProject1.X.production.hex' is up to date.
make[2]: Leaving directory 'C:/AWinS/Gan_PIC24F/ENCM511/SimProject1.X'
make[1]: Leaving directory 'C:/AWinS/Gan_PIC24F/ENCM511/SimProject1.X'
BUILD SUCCESSFUL (total time: 210ms)
Searching project "SimProject1" for header files...
Packaged project in C:\AWinS\Gan_PIC24F\ENCM511\SimProject1.X\SimProject1.zip
Loading code from C:/AWinS/Gan_PIC24F/ENCM511/SimProject1.X/dist/default/production/S
Loading completed

Grading rubric

-Correct Peripheral setup, Program logic and working of all PB IO states = 16 points (3.2 points per state)
-Code (including properly uploaded code with comments) = 2 points
-Proper video demo (includes one UCID card displayed, meeting of demo time limit, brief explanation of Hardware and software operation) = 2 points

Driver Project Generic Rubric – Fall 2023

	Fails to meet expectations	**Minimally meets expectations**	**Adequately Meets Expectations**	**Exceeds Expectations**	**Score awarded**
Peripheral Configuration and Use	None of the peripherals and states working correctly **0 to 2 points**	Some of the peripherals and states working correctly **4 points**	Most of the peripherals and states working correctly **6 points**	All peripherals and states correctly working **8 points**	
Program Logic	Does not provide evidence of appropriate program flow **0 to 2 points**	Provides evidence of attempting to use C control statements but has some errors or does not cover all scenarios **4 points**	Provides evidence of attempting to use C control statements to cover most but not all scenarios or has some errors **6 points**	Provides evidence of appropriate C control statements and implements all scenarios correctly **8 points**	
Code Quality	No evidence of code commenting or reasonable variable names **0 points**	Some evidence of code comments, but infrequent or incomplete **1 point**	Evidence that most elements of the code are commented **1.5 points**	Evidence that all important elements of the code are commented meaningfully **2 points**	
Demonstration and Video Upload	Demo does not appear to work or does not align with project specifications or Video not provided **0 points**	Demo does not cover all scenarios or no explanation provided **1 point**	Demo shows the design working, covering most states but not all states or proper explanation for all states not provided or Video runs over time limit. **1.5 points**	Demo shows the design working, covering all states. Video meets time limit and contains proper explanation of hardware and software operation **2 points**	
				Total (20):	

Overall

Fails to meet expectations 0 - 8

Minimally meets expectations 9 - 12

Adequately Meets Expectations 13 - 17

Exceeds Expectations 18 - 20