CMPE 322: Micro-controllers and Interfacing

Lab #2
Due 10/25/2023 at 4pm

Fall 2023

Introduction and requirements

In this lab we want to control I/O ports of the PIC micro-controller. The Basys MX 3 board has 8 LEDs connected to port A as follows

Label	Schematic Name	PIC32 Pin	Description
LD0	LED0	TMS/CTED1/RA0	Led 0
LD1	LED1	TCK/CTED2/RA1	Led 1
LD2	LED2	SCL2/RA2	Led 2
LD3	LED3	SDA2/RA3	Led 3
LD4	LED4	TDI/CTED9/RA4	Led 4
LD5	LED5	TDO/RA5	Led 5
LD6	LED6	TRCLK/RA6	Led 6
LD7	LED7	TRD3/CTED8/RA7	Led 7

The board has eight switches connected as follows

Label	Schematic Name	PIC32 Pin	Description
SW0	SW0	RPF3/RF3	Switch 0
SW1	SW1	RPF5/PMA8/RF5	Switch 1
SW2	SW2	RPF4/PMA9/RF4	Switch 2
SW3	SW3	RPD15/RD15	Switch 3
SW4	SW4	RPD14/RD14	Switch 4
SW5	SW5	AN11/PMA12/RB11	Switch 5
SW6	SW6	CVREFOUT/AN10/RPB10/CTED11PMA13/RB10	Switch 6
SW7	SW7	AN9/RPB9/CTED4/RB9	Switch 7

All the pins for the switches must be defined as digital input: their corresponding TRIS bit must be set to 1, and analog function must be disabled for the pins with the analog feature. Recall

- To configure a pin as an input pin, you can use: RISFbits.TRISFx = 1;
- To desiable analog: ANSELBbits.ANSBx = 0;

In this lab we use the switches to control the LEDs and implement other functions.

Part 1: Controlling LEDs using switches

1. From the table above, which pins have the analog feature?
2. Write code to control the LEDs using the switches. If a switch is closed, the corresponding LED turns on or blinks.

Part 2: Binary to gray code conversion

Gray code belongs to a family of codes that are characterized by minimum change. In Gray code, only one-bit changes between a binary number and the next one. The rules below are used to obtain Gray code from binary

- To convert binary to Gray code, simply start on the most significant bit and use it as the Gray MSB.
- Compare the MSB binary with the next binary bit. If they are the same, then the corresponding Gray code bit is 0. If they are different, then is the corresponding Gray bit is 1.
- Repeat with the next bits until you reach the LSB.

Example

Ordinary binary	Gray code
10011001	11010101
10011000	11010100

1. Write PIC 32 code that converts binary to Gray code. The switches are the inputs corresponding to binary and the LEDs are the outputs corresponding to Gray code.
2. Verify your results for the fallowing binary numbers
   (a) 01111111
   (b) 10000001
   (c) 10000010

Part 3: Car alarm system

Figure 1 shows a diagram for an automobile alarm system used to detect certain undesirable conditions. The three switches are used to indicate the status of the door by the driver's seat, the ignition, and the headlights, respectively. Design the logic circuit with these three switches as inputs so that the alarm will be activated whenever either of the following conditions exists:

1. The headlights are on while the ignition is off.
2. The door is open while the ignition is on.

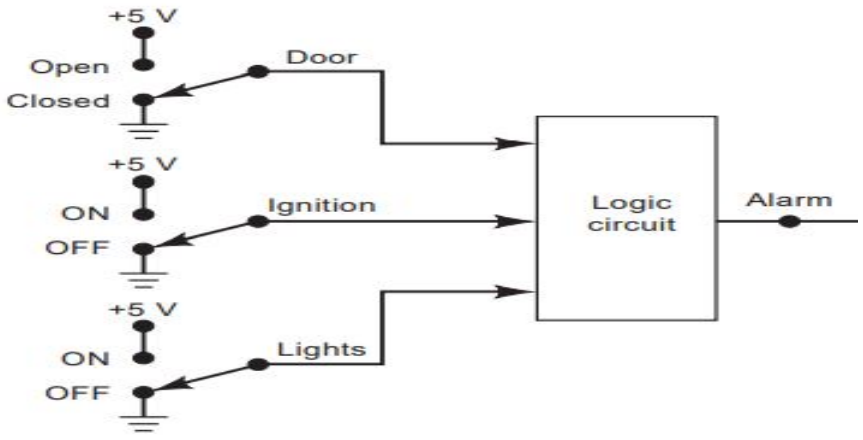

Figure 1: Car alarm system

We use the following notations:

- Door: Use letter D. This input is high when door is open.
- Ignition: Use letter I. This input is high when ignition is on.
- Lights: Use letter L. This input is high when lights are on.
- Alarm: Use letter A.

Write PIC code to implement the car alarm system. THe following input,output assignment can be used:

D	SW0
I	SW1
L	SW2
Alarm	One of the LEDs

Demonstrations

- Answer the questions and attach your code, and submit the answers before the due date.
- Demonstrations will take place in the last 30 minutes of class.

Notes

1. You may need to disable the JTAG port using command: DDPCONbits.JTAGEN = 0;
2. The configuration bits may need to be modified.

References

- Basys MX3 Reference Manual
- PIC32MX370 data sheet