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California State University, Northridge

Department of Electrical and Computer Engineering

Lab Experiment 6: Reading Inputs with Logic Operations

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Introduction

_____The purpose of this experiment is to understand the function of basic logic and comparison instructions such as AND, BIC,ORR , CMP and TST by using them to write to the IO0PIN of the the general purpose input and output pins. The lab also covers the use of masks which will be used to select which bits change and which bits to keep. Lastly, the lab also introduces use of keil tools such as the GPIO slow interface to debug the results of the experiment.

In the lab, a push button is used to turn on 8 individual LEDs once at a time. The value expected to be read is low.

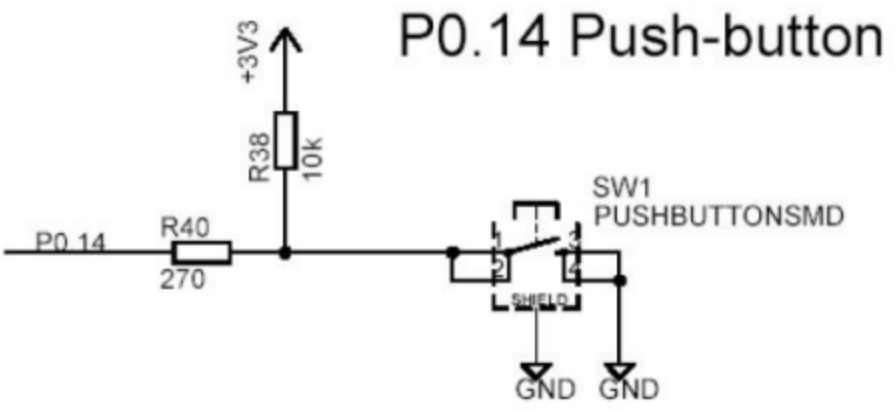

Figure 1. Push-button design on board circuit.

Procedure

_____The goal of Task 1 was to write a program that would turn on 1 LED at a time by pressing a button, lighting up all 8 LEDs after 8 presses.

Pins 8 through 15 were set to GPIO.

```
MOV R0, #0
LDR R1,=0xE002C000;        PINSEL0
STR R0, [R1]
```

The direction of pins 8-15 were set to output except for pin 14 which was input.

```
MOV R0, #0xBF00
LDR R1, = 0xE0028008 ;     IO0DIR
STR R0,[R1]
```

Using IO0SET, the LEDs were set to off.

```
OFF   MOV R0,#0xFF00
      LDR R1, =0xE0028004;     IO0SET
      STR R0, [R1];
```

Before entering a loop, a counter was set to keep track of button presses and R2 was used to keep track of the OR mask

```
MOV R0, #0;
MOV R2,#0x100
```

The main loop was used to read and write to IO0CLR
Within the main loop, bit 14 was compared to 0 to see if the push button was pressed

```
LOOP LDR R1, =0xE0028000; IO0PIN
        LDR R3, [R1];
        TST R3,#0x400;  ANDs pin 14 with one and sets the flags
        BEQ SET
        BNE LOOP
```

If the button was pressed it would increment the counter, store IO0CLR with the mask, and shift the mask left by one.

```
SET     ADDEQ R0,R0,#1
        MOVEQ R2,R2,LSL#1
        LDR R1, =0xE0028000;       IO0CLR
        STR R2,[R1];
```

A Delay was used at the end of the loop to account for bouncing of the push button.

```
Delay LDR R0, =186A0
        SUBS R0,R0,#1
        BNE Delay
```

Added to the loop was code to compare the counter to 10, and reset if true.

```
        CMP R0,#10
        BEQ OFF
        B MAIN
```

Results

When flashed and reset, the LPC2048 device displayed all the LEDs as off as expected. When the button 14 was pressed. The LED for P0.8 turned on and sequential presses resulted in P0.9 to turn on and P0.10 and so forth. This occurred until P0.14 which was always displayed as off because the hardware limited to a certain amount of pins and P0.14 could not be an input and output at the same time.

For task 2, once all 8 LEDs were on, an additional two presses would result in the reset of all 8 LEDs. Monitoring the registers, the LEDs specifically reset when the counter in R0 was equal to 10 and the CMP was stepped through.

Conclusions

The experiment was successful in the goal of turning on all 8 LEDs sequentially while using the push button. The experiment properly demonstrated the use of logical and comparing functions to read certain bits, and then modify the output to be sent to the LEDs. Task 2 was a success as well as the LEDs were properly reset when the button was pressed 10 times.

The experiment was also a success that in using a delay that would solve the problem of debouncing on the button. The experiment was also a success in using the debugger to solve issues in the code using the GPIO slow interface.

Questions

1. The microcontroller reads a 0 when push button is pressed and a 1 when not pressed.
2. In order to read the value on the push button P0.14 needs to be set as an input.
3. To clear bit 14, it can either be ANDed with a 0 or BIC can be used.
   For example, AND R1,R1,0xFFFFBFFF or BIC R1,R1,0x4000.
4. Since the input is read as 0 when the button is pressed, the P0.14 pin is unchecked to simulate the pressing action.