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California State University, Northridge
Department of Manufacturing Systems Engineering

Lab Experiment 4: Lighting up LEDs

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Introduction:

The purpose of this experiment is to understand and implement a program to write to the address in memory that controls the pins connected to the microcontroller. The pins will be set into GPIO mode and an output mode that will output the values written to memory. The specific GPIO port pins we are using are pins 8 - 15 which control 8 LEDs on the LPC2148 board. The overall result that is expected is to turn on and off the LEDs.

Procedure:

In order to control, pins 8 - 15, the base address for the pins were located in memory at 0xE002C000.

Zeroes were written the PINSEL0 address to put the pins into General Purpose Input/Output mode with the following code.

```
PINSEL0 EQU 0xE002C000
MOV r0,#0
LDR r1,=PINSEL0
STR r0,[r1]
```

Then the pins were put into output mode by writing “1”s to the IO0DIR address which is at 0xE0028008 with the following code.

```
IO0DIR EQU 0xE0028008
ALLPIN EQU 0x0000FF00
MOV r0,#ALLPIN
LDR r1,=IO0DIR
STR r0,[r1]
```

To control, the values that were output by the pins. 32bit values were stored to the IO0PIN address at 0xE0028000

For task 1, the LEDs are turned on by writing 0s to all the values at IO0PIN with the following code.

```
IO0PIN EQU 0xE0028000
ALLPIN EQU 0x0000FF00
```

```
MOV R0,#0
LDR R1,=IO0PIN
STR R0,[R1]
```

For task 2, writing all 1s would turn off all the LEDs.

```
MOV R0,#ALLPIN
LDR R1,=IO0PIN
STR R0,[R1]
```

In task 3, writing a value of 0xAA00 to address IO0PIN would write a pattern of 10101010 to the LEDs. 1 being off and 0 being on.

```
MOV r0,#ALTPIN
LDR r1,=IO0PIN
STR r0,[r1]
```

Results:

After flashing the code for task 1, the resulting LEDs showed all on, which is expected for writing all 0s to IO0PIN.

After flashing the code for task 2, the resulting LEDs all turned off when reset, which is expected for writing all 1s to IO0PIN.

For task 3, the resulting LEDs showed a pattern of off, on, off, on, off ,on, off, on, off, on which follows the code for 10101010.

Conclusion:

Over all the experiment went as expected. The task were successfully completed by displaying the LEDs as on and off, and then in alternating pattern.

The experiment provided a better understanding of loading and reading from memory using the LDR and STR commands. One thing that was confusing before conducting this experiment, was the use of LDR as a MOV function when the immediate value is a value less than eight bits or can be represented by eight bits and any shift.

The experiment also provides a better understanding of how the microcontroller works by reading from the memory and how the EEPROM controls the hardware.

The experiment requires the code to be recompiled and re flashed for each individual task. A way to improve this would be to add a delay in the program and then display the results for each task at a different time. Another way this experiment could be improved would be to require shifting to locate the address of IO0DIR and IO0PIN, which are a few shifts away from PINSEL0. This would give a better understanding of a common technique of shifting used for locating addresses.

Answers to questions:

1. Since the diodes on the LEDs need to be forward biased, the output voltage should be low at 0v.
2. The MOV instruction would not work as 0xE002C000 can not be represented by eight bits and any shift.
3. In the point of view of the microcontroller it is outputting a voltage to the LEDs.
4. Bits 8 - 15 need to be set to 1 to output, so 0x0000FF00 needs to be written to IO0DIR.
5. 0x00000300 can be represented by 0x3 and shifted left 8 times, so it will work with a MOV function.