ECE 2140 Design of Logic Systems

Lab Report V: 7-Segment Displays and Karnaugh Maps

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1. Purpose

The purpose of this lab was to program into a Basys board in order to display hexadecimal digits upside down on a seven segment display. This was to be done by designing a logic system which would output to the seven segment display the necessary outputs to illuminate the segments used for the given number.

1. Equipment

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| **Equipment** |
| Xilinx ISE Design Suite 13.2 |
| Digilent Basys Board |
| Digilent Adept Software, Version 2.3.0 |
| Basys Board Schematic Drawings |
| USB to MicroUSB Connection |
| Windows 7 Office PC |

1. Design

The Design of this laboratory did not involve circuit construction. Instead, the design of this lab contained two major components. The first portion of the lab required the calculation of a logic equation which resulted in an output signal when a prime number is input. The input was four-bit ad consisted of four switches, each of which acted as a digit of the binary number being input. Seven Karnaugh maps, and thus seven equations, needed to be calculated. Each equation corresponded to one of the seven outputs which input into the seven segment display. The equations are meant to send a signal if the particular segment of the seven segment display needed to be lit in order to display the number. The corresponding segments of the display can be seen in figure 1. These equations were then programmed as the outputs in the Xilinx program. The following seven equations were found by the student:

**Note: ABCD represent the respective bits of the input**

The second part of the lab involved mirroring the output. To do this, the pins associated with each segment were assigned the equation of the segment opposite across the middle of the display. For example, equation “a” was assigned segment “d” and equation “b” was assigned segment “c.” The program was then uploaded to the Basys Board and tested.

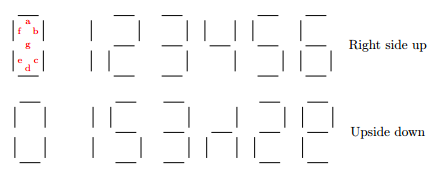


Figure 1 – Seven Segment Display Configuration

Example of a Karnaugh Map

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 00 | 01 | 11 | 10 |
| 00 | 1 | 0 | 1 | 1 |
| 01 | 0 | 1 | 1 | 1 |
| 11 | 1 | 0 | 1 | 1 |
| 10 | 1 | 1 | 0 | 1 |

Karnaugh Map a

1. Observations

After programming the Basys Board, all numbers were tested to check if the logic equation used was correct. At first the board displayed unintelligible configurations. This signaled that one of the equations was not done properly. As it turned out, equation b was wrong and had to be redone. After this, the board displayed the numbers properly, meaning upside down. This means that the equations only gave an output for numbers that needed segments illuminated for the given number. For example, for the number 2, given in 4-bit binary as 0010, equations a, b, d, e, and g would output a signal of one because those segments needed to be lit to display the number 2 (see figure 1). In the equation, A, C, and D equal 0 while B equals 1. Therefore, plugging these values into the equations above, only a, b d, e, and g would output a value of 1 and illuminate their corresponding segments. Since the display correctly showed the numbers upside down, the pin configuration was shown to be correct.

1. Conclusion

The equations used for the design of the lab were correct as it resulted in the lighting of the correct segments of the display. Furthermore, the pin configuration written in the code was also correct as it resulted in the display of the equations in a mirrored form compared to the standard output of the display. Lastly, the coded version of the equation using Xilinx was written correctly and did not cause any errors.

**References**

GWU SEAS ECE Department, "[7-Segment Displays and Karnaugh Maps:  Lab Specification](https://blackboard.gwu.edu/bbcswebdav/pid-7046210-dt-content-rid-15460960_2/xid-15460960_2)" The ECE 2140 Blackboard Page. Labs. Spring 2016.