

Final Project Title

Subtitle as needed

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Abstract—Succinct summary description of your project: purpose, major findings, conclusions, and main recommendations. DO NOT USE SPECIAL CHARACTERS, SYMBOLS, OR MATH IN YOUR TITLE OR ABSTRACT.

I. INTRODUCTION

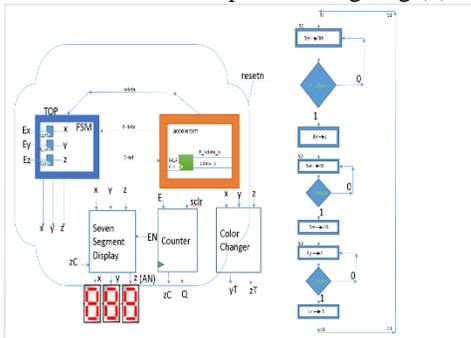
The scope of the project how to program a nexy's board so that it understand what orientation it is in the x,y, and z plane. The motivation for this project is numerous one is so an object can know its orientation when moving in a three dimension space. Another one is when you're working with a tablet and are shifting from landscape to portrait it will shift with the force of gravity on the accelerometer. The project covers many topics from class one is a shift register another is FSM (FiniteStateMachine), a counter, an accelerometer, and a seven segment display. The topics that we learned on our own were the uses of the accelerometer and what objects it used for today.

II. METHODOLOGY

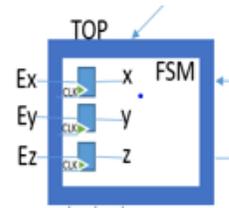
This is the body of your report. Here you explain how you designed your project.

A. First Section

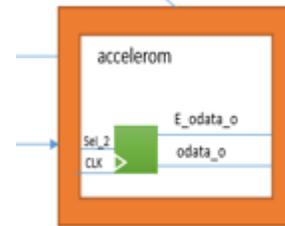
A look from the top level design fig (1)



We will start with the FSM fig (2)

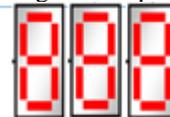


Accelerometer fig(3)



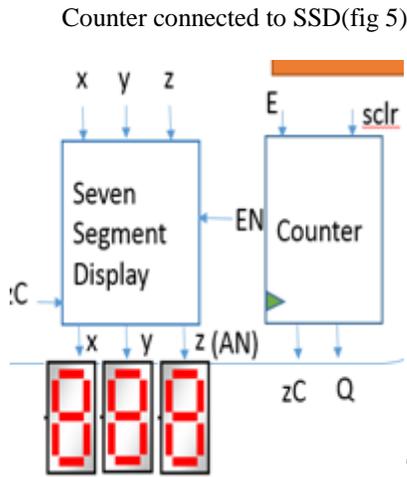
The design has multiple stages for the (FiniteStateMachine) aka FSM was first conceived in a flow chart design which had three states and each state was coordinated with a enable in one of the three dimensions x, y, and z. Each enable is controlled by a data line from the accelerometer which is called edata. The enables Ex, Ey, and Ez are controlled by a selector coming from the FSM. There is only three options for the selector and that is (00), (01), (10). When the sel (selector) is in sequence (00) which makes Ex enable high odata (8bit signal) will update the (8bit) shift register and output a signal x. This signal x will go into and color changer and the seven segment display simultaneously. This will then change the color of the LEDs: green for the x plane, red for the y plane, and blue for the z plane.

Seven segment display fig (4)

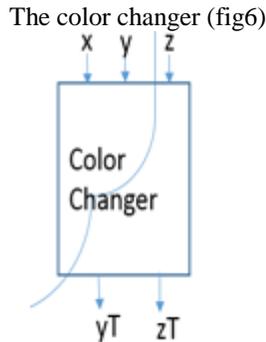


The seven segment display will show numbers from 0 to F this is for the user of the nexy's chip so they can know when they have the correct orientation for the accelerometer, for example when the seven segment display shows (040) that means the nexy's chip is orientated in the y axis. When the

nexy's board is orientated in the x axis the seven segment display will show (C00), and when the nexy's board is orientated on the z axis the seven segment display will show



The counter was used to fix a glitch in the seven segment display the clock pulse was running every ten nano seconds so to fix this the counter was used to make the clock 1000 times longer so the seven segment display had enough time to update properly if this wasn't done then the seven segment display's would of looked faded by the high frequency.



This is the color changer it's inputs are the same as the seven segment display but the major difference is its output which are three bits to send data to each LED when to light up as discribed previously when the nexy's board is orientated in the x axis the color will be green and zT and yT will equal (100) and when in the y axis zT and yT will equal (010) and the color will be red, and in the z axis zT and yT equal (001) and the color will be blue. The resetn is used to clear everthing and start from the beginning.

III. EXPERIMENTAL SETUP

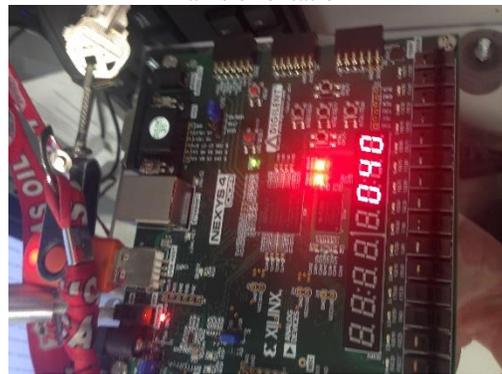
The tool used to make sure the project was working was the seven segment display the way it works is if the accelerometer is picking up a value other than zero in the display. That means that nexy's chip isn't orientated properly on the axis's for example if you were getting a reading of

(1F0) and the user was trying to get the chip orientated on the y axis the user would have to move it out of the x plane and get the result (040) so the chip is orientated on the y axis. Also when the nexy's chip is mentioned that also can go hand in hand with accelerometer orientation since that is what is ultimately controlling what the nexy's chip displays on the LEDs and SSD.

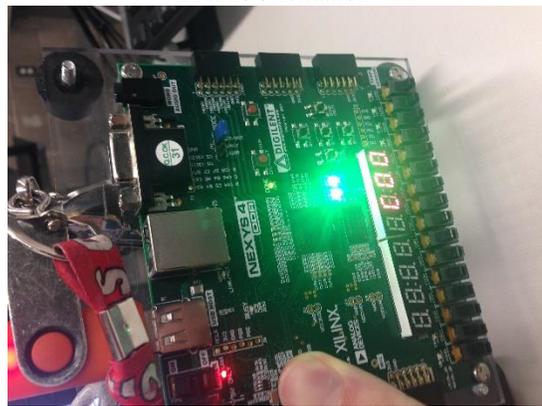
IV. RESULTS

Here are some pictures of what the board is trying do when orientated properly and when it is orientated correctly. There was no issues that couldn't be explained the seven segment display fading was do to a timing error. The second problem was about the LEDs lighting up green twice once for when the nexy's chip is orientated in the x and y axis. That problem was fixed when the coders realized that there code was backwards after that fix no other problems appeared.

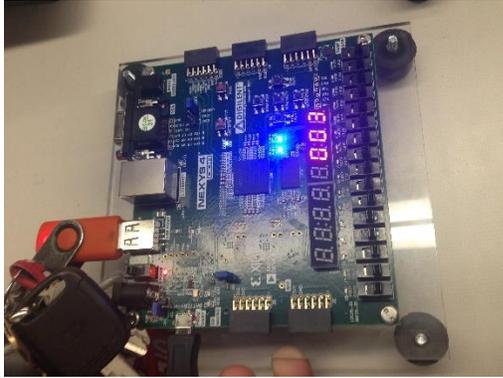
Y axis orientation



X axis orientation



Z axis orientation



CONCLUSIONS

The main takeaways from this project is that an accelerometer can be used to make whatever object you want to know which axis it is orientated on in three dimensions. This is useful for many applications like airplanes, missiles, computer hard drives and many others. What was learned was the large amount of applications that an accelerometer is used for also that when a smart phone is moved on its axis and goes from portrait to landscape mode that it's an accelerometer that controls that action, and that accelerometer is reacting to the force of gravity acting upon it. There were no issues that needed to be resolved. The improvements that could be made is in the demonstration of this project, and that improvement is a holder that can orientate the nexy's board perfectly in each axis so that the user of the board doesn't have to waste time moving it up and down slightly to get the right result.

REFERENCES

- 1) "Nexys4 DDR™ FPGA Board Reference Manual." Digilent. <http://www.digilentinc.com/>. Revised April 11, 2016.
- 2) "Micropower Three-Axis $\pm 2g/\pm 4g/\pm 8g$ Digital-Output MEMS Accelerometer." Analog Devices. 2012.