After last week’s meeting, Kevin reminded me about an issue he had realized the day before about our meeting involving the steering wheel control system. The DC Motor Speed Controller kit we had purchased that fit our application perfectly, by using a potentiometer that measured the angle of a steering wheel turn in either direction, and outputted either a positive or negative ramped up voltage from -12 to 0 to 12 volts to turn the motor one direction or the other depending the direction the steering wheel was turned. We had a design that sent the output from the motor controller directly to the linear actuator at the front of the go-kart to result in causing the wheels to either turn left or right depending if the signal sent was positive or negative, but this was not going to operate exactly how we expected it would. If the steering wheel remains in the center, 0 volts are sent to the Linear Actuator as expected so that the wheels won’t be forced to turn a direction. The problem that we discovered revolved around the notion that as the steering wheel was turned from one side to another, a voltage that can be calculated linearly between 0 and either -12 or 12 volts compared to the output voltage from the potentiometer, measuring how far the steering wheel is turned, would be sent to the Linear Actuator. When the steering wheel is turned to a side then returned to its center position, the Linear Actuator motor will operate in the desired direction at a certain speed for a specific amount of time, all dependent on how far the wheel is turned to a side and for how long it is held in that direction before returning to the center position. Once returned to the center position, the motor controller sends 0 volts to the motor as expected and the steering wheel is then positioned in the center position, but the wheels remain in the same turned direction. We realized quickly that we needed to send a signal back to the Linear Actuator at the exact magnitude and for the same amount of time as before, but it needed to be the opposite voltage sign of the first signal sent. One other large concern we had dealt with making sure the wheels would be straight every time the steering wheel was back in its center position.

I spent a couple nights brainstorming ideas and potential solutions by reading about electronic components and different ways to manipulate them. My biggest concern was with trying to solve this problem with as little changes and expenses and possible. I spent a long time trying to see if there was a way of measuring the time and recording the voltage that the motor controller originally sends to the Linear Actuator, and then right as the motor controller returns to outputting 0 volts, meaning the steering wheel is in the center position, I wanted to send an identical signal to the linear actuator, but with the opposite sign. I figured a capacitor might be able to fit in this position by recording the output voltage sent to the Linear Actuator by running parallel to the signal and simply absorbing the same sized signal. Two large concerns with this were that the capacitor
doesn’t charge and discharge at the same rate, and also if the steering wheel was held in one direction for a long enough time then the capacitor would fill up and stop recording how much voltage was actually sent to the Linear Actuator. I also read into the background of timing circuits and diagrams that can record time periods. None of my options were working so I went onto another part of the go-kart, the Linear Actuator. Having spent a lot of time researching and learning about these items while I found a company and ordered a custom, I had remembered reading that some models actually come with built in potentiometers. The potentiometers send out a signal that helps to act as a feedback from the Linear Actuator about its specific location along its travel path.

Slowly after finding different solutions for specific problems that we felt would be encountered in the future, and then adding all these new components to the go-kart system we were able to figure out a way to fix our problem. We need to install an identical potentiometer to the shaft of the Linear Actuator. The voltage from the steering wheel potentiometer will be compared to the voltage outputted from the potentiometer on the shaft so that if they are different, a signal will be sent to the motor speed controller to either send a -12, 0 or 12 volt signal out to the Linear Actuator to move accordingly. A continuous feedback loop between the two potentiometers and the resulting signal to the motor speed controller kit will be controlled with the use of a PIC. The PIC will act as a difference amplifier to subtract the two input potentiometer signals and then deduce whether the wheels need to turn right or left depending on the sign convention.

The diagrams, figures, and model that I had produced to clearly show how I would be building an encasement for the steering assembly and motor controller now needed to be changed. I also had to contact the companies I had ordered a box and grommet last week for building the enclosure from and luckily they both gave rebates. I am now ready to order a new box and have found the one that will fit our new enclosure size and contain the necessary internal components.

**Future Work**

In the next week, I plan on immediately ordering and finding the components I need to build this upper enclosure. I will also be around during the week off, so I am hoping to get a lot of work done and catch my section of our project up to its original deadlines at this point in the semester. I also need to spend a lot of time designing and helping Mike mount the Linear Actuator, potentiometer with a correct gear system to turn it at a proper speed, and also building a protective, waterproof enclosure around these two components on the front of the go-kart. There are also several other small jobs on the go-kart that need to be done, and I hope to tackle a few of these by the end of the week off.

**Project Review**

After spending several hours reading and searching the internet to learn about electronics, one of my weaker fields of knowledge in my major, I am starting to feel much more confident in my final decisions. I am also glad that I have picked up very rigorous knowledge about different types of op-amps, circuits, comparators, PICs,
troubleshooting circuits, and finally feeling confident enough to have conversations and backup my choices and reasons for building the circuit a certain way. Kevin made one good move for the group this week by asking for a list from each of us stating any things we thought might still need to be accomplished on the go-kart. He took the list and hung it up in the lab along with names next to each of the tasks that need to be accomplished, to help remind each of us to not leave tasks until the end.

**Hours Worked**

Hours spent working on the project, Week 5 (2/20/08- 2/27/08): 14