Work Completed

At the laboratory session last Friday the group encountered many problems that were addressed this week. The first problem the group encountered was how the linear actuator worked. The group expected to simply attach the blade to the end of the motor to eventually cut the pill. Upon further inspection the group quickly discovered that the end of the motor rotates and thus attaching a blade to the end of the motor would not be possible since the blade would rotate as well. The majority of the beginning of the week for me involved devising a way so that the current motor could be used. Figure 1.1 shows my design of the cutting element.

![Cutting Mechanism Diagram]

The idea behind the design is that the motor would push the blade towards the pill with some resistance from springs. In this design the motor would push the blade but would not be connected. Once the cutting is finished the motor would retract and the springs would bring the blade back to its original position. Calculations were done to find the maximum resistance the springs could provide, using 85% of the maximum force of the motor and 115% of the minimum force needed to cut the pills. These 15% safety factors
would ensure that the system would work in all situations. The minimum force to cut the pill was determined through testing of pills done in the previous semester. Table 1.1 outlines the data used for calculations.

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<table>
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<tbody>
<tr>
<td>Maximum Output by motor</td>
<td>6.88lb</td>
</tr>
<tr>
<td>85% of Maximum Output by Motor</td>
<td>5.84 lb</td>
</tr>
<tr>
<td>Minimum Force to Cut Pills</td>
<td>3.08 lb</td>
</tr>
<tr>
<td>115% of Minimum Force to Cut Pills</td>
<td>3.54 lb</td>
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I then drew a free body diagram showing the various forces acting on the blade. Since the blade needs to exert at least 3.54 lb on pill, all forces acting on the blade must add to at least 3.54 lb in the direction of the pill. After this analysis I found that the two springs combined could exert a force no greater than 2.30 lb or 1.15 lb per spring since two springs are being used. The force exerted by a spring is the spring constant multiplied by the distance the spring is extended. Once we have a better idea on how far the blade must go in the actual design I will purchase springs that meet the necessary requirements.

The design consists of a spring loaded blade. The original design called for compression springs but upon further review there was not an available attachment location for the opposite side of the compression springs. Extension springs could easily be attached to the blade and the location where the motor would be mounted. The design calls for the motor, the rails and the extension springs to be attached to one piece. The piece would have a hole in it to make sure that the other end of the motor could move freely.

To stabilize the blade throughout the pill cutting process, rails will be included on both sides. The blade will slide along the rails to make sure that the blade is always perpendicular to the pill being cut and thus making the cut accurate. One potential problem with the design is friction between the blade and the rails. The idea right now is to coat both the blade and the rails with a material that reduces friction. In my calculations to find the forces exerted by the springs I neglected friction to make the calculations easier. I plan on speaking with Tim so he can give a recommendation on the best coating material to use.

Once the spring loaded blade system was designed I turned my focus to the microprocessor. Chris and I found a microprocessor that was designed specifically for motors. Since the motors are the most important element of the design we decided that purchasing a microprocessor that has been proven to work with motors would be wise. The major problem with this particular microprocessor, however, is that it does not have a fail safe feature on the real time clock. This is a problem because the batteries in the device may die if not charged properly. If we used only the microprocessor each time the batteries died the entire device would have be reprogrammed. This is not practical for persons who live an active lifestyle and do not have time to go to the pharmacist each time the power runs out.
After research of ways to correct this problem Chris and I settled on a real time clock (RTC) chip. This chip has a fail safe element as well as an alarm element. We hope to utilize the alarm function because it would greatly reduce the amount of programming involved. We hope that it will be able to send a signal to LEDs, the text-to-speech module and the vibrating motor. If it is able to do this the microprocessor would only have to control the motors when the button on the device is pressed. Much of the work over the next week or two will focus on programming the RTC chip to accomplish the necessary tasks.

The remainder of my time this week has been spent on researching the drive circuit for the motor. The motor we purchased is a stepper motor that does not work by simply attaching it to a power source. A circuit that sends pulses to the motor must be used. Chris and I found the necessary parts for the circuit but the shipping was too expensive. I looked at newark.com and was able to find the parts for a much more reasonable price. The vast majority of the parts we found we needed upon further inspection of the design are now purchased and should be arriving this week.

**Future Work**

During this week I plan on learning as much as possible about the Bluetooth technology. I feel this will be one of the more difficult elements of the project and thus it should be started early. I also plan on looking into the capabilities of the RTC circuit and begin programming once it arrives. If I can get the RTC to work as I hope this will greatly reduce the complexity of the programming and will make the project go much smoother. I also want to start working on the code for the microprocessor. The rotational motor we purchased should be in early this week. Once both motors are in I can begin to work on how to sync up the motors so the device works correctly.

**Project Review**

The group quickly realized last week that the complexity of the design was greater than anticipated. A large obstacle was overcome once the blade system was designed. I think we have a much better idea how to program the overall device as well as all of the components that will be needed. I felt we may have been behind last week but all of the planning and groundwork done throughout this week by the group has caught us up. The direction and progress of the project will become clearer as the programming starts. We believe we have a good idea how to program the device but our progress will depend on how well the idea actually works once the programming begins.

**Hours Worked**

14