**Work Completed**

This week we have made steps toward solving many small problems which had impeded our forward progress. As a team we went to Mansfield Supply as well as Willard’s down the street on 195. At Mansfield Supply we brainstormed about possible solutions based on everyday items we found. In addition we found that a piece of 8 ft x 4 ft x ½ in plywood is $22. This wood is used to support the patient on the bed, and is planed to be covered in padding to make it more comfortable. In addition, we found some potential casings for the electrical circuit, as well as for the control handle. On Monday, we had an opportunity to discuss potential ways of attaching the motor to the scissor jack with Serge & Rich in the machine shop.

We also continued our experimentation with the DC motor. This week we built on our previous experiment regarding the rotational speed of the motor and the voltage drawn by the motor. This time we were testing the effect load on the motor has on the current drawn by the motor. The ideal way to test this would be to use a constant voltage, and change the load on the motor, then read the current drawn by the motor. However, we had a limited number of weights.
Instead, we opted to use a weight in the higher load range of the motor and changed the voltage. As you can see in the graph below, with a relatively high load, the current remains fairly level even with a large increase in rotational speed. However, we did observe that there is a large spike in current at start up, as well as when the motor is operating at an exceptionally low speed.

![Current vs Rotational Speed](image)

We also managed to test the spring constant of the springs using a simple weight scale, weight and length scale. This test worked by measuring the initial length of the spring, then placing it on the scale with a weight on it. We could then measure the change in length of the spring, and the weight scale was used to properly measure the force being applied to the spring. Then using the equation $F=kx$, where $F$ is the force on the spring, $k$ is the spring constant, and $x$ is the change in length, we were able to calculate the actual spring constant. Surprisingly, each of our springs displayed the proper spring constant of 20 lb/in.

This week, I finished the dynamic analysis of the bed/scissor jack system. This analysis allows us to determine an optimal placement of the scissor jack. An optimal location will maximize lift height, while maintaining a low force as well as minimizing the change in angle of the jack. A minimized jack angle change makes the system more stable and limits complications related to jack movement. This analysis also gives us a greater understanding of the movement involved at all stages of bed operation, allowing us to provide proper clearance as well as structure. Shown below is a sample set of data, showing the general trends in the system relative to the bed back angle change.
I began to sketch out ideas for the fixation of the motor as well as of brackets to allow for rotational motion at each end of the jack.

**Future Work**

In the coming week I hope to finalize our decision on the DC motor. At the moment we have three motors which seem ideal for our selection. Also, I hope to complete plans and begin construction of the bed back frame, as well as the connections between the jack and the bed. With these designed and build, we will begin construction of the majority of the structure one the bed frame comes in. With these together, we will be better equipped to finalize placement, and begin testing of the electrical systems.

**Project Review**

At the moment, we have tackled many small problems which have hindered us in progressing forward with more complex and time consuming problems, such as the motor control. We are at the point in which the project can begin to take shape, and we will see tangible results. As of now we have spent $275 of our $2000 budget. With three potential motors ranging from $149 - $349 and the bed frame, this number may increase to around $700, bringing our remaining budget to about $1300 after the majority of our components have been bought.

**Hours Worked**

12 hours