

***IPRO 324 – Design of a Simulator for Mechanical Loading of
Garage Door Operator Systems over a Wide Temperature Range
Fall 2003
Mid-Term Progress Report***

Project Goal

The goal of this project is to develop algorithms to be used in a virtual simulation of a garage door's operation and to construct a working prototype that functions in the thermal test chamber in The Chamberlain Group, Inc. in order to collect data under various temperatures and different operating conditions. The simulator that is in progress of construction will be made as small as possible in attempt to fit as many of them inside the thermal test chamber in The Chamberlain Group. The final cost of the simulator should be kept around one thousand dollars.

Summary of Actual Progress

On September 3rd, 2003, the IPRO team, accompanied by Professor Mostovoy and Professor Ferguson, visited The Chamberlain Group, Inc. in order to obtain a better understanding of the operation of a garage door operator, as well as the conditions and temperature range it would be tested in, to discuss the problems the IPRO team is expected to solve, and to collect data such as the load profile and the dimensions of the thermal test chamber.

We were provided a ½ horsepower garage door operator, and the assembly of the simulator started from designing the support frame for the simulator. The AutoCAD team continuously worked on AutoCAD drawings of the support frame. The support frame was originally constructed with slotted angles, but it was discovered that the slotted angles are not stiff enough to hold the weight of the operator and other mechanical and electrical systems we plan to use to create the simulator. As a result, the construction material changed to unistrut. Currently, the assembly of the support frame is still in progress. The

garage door operator is hung but mechanical systems such as brakes and pulleys are still to be mounted.

The team is also constantly developing ideas to simulate the load profile of the garage door in motion. The initial load profile data were given to us by one of the engineers in Chamberlain in graphs, which we digitalized and reduced in EXCEL such that we could better understand them. We also plan to make another visit to Chamberlain, in which our data collection team will record more of this type of data for a better analysis. This data will be used in a Labview program we'll create for the simulator. We will use brakes to control the load the operator will be experiencing, and a rail mounted a few inches on top of the garage door operator rail will have two arms hanging from it. Those arms will be attached to a single small door panel to control the load.

At the same time, the web team is updating our website every week. Pictures and movie clips of our progress on the assembly are posted, as well as the data we have collected. The meeting agendas and meeting minutes are posted every week as well.

Future Progress

- The team is still in the process of obtaining all the materials and tools we need to complete the construction of the assembly, and we are expecting to have all the materials we need within a few days, such that we could complete the assembly in one to two weeks.

- The AutoCAD team will have drawings of the assembly with dimensions and will be working with a software called Working Model to simulate the movement of the garage door virtually.

- The data collection team will make a trip to The Chamberlain Group, Inc. to collect more data on load profile.

- Data collected will be used in the Labview program we're going to use for the simulator.

- Actual testing of our simulator and make corrections as necessary.

Team Organization Issues

The project is divided into various areas and responsibilities:

- 1.) Data digitization and reduction: Tom, Jimoh
- 2.) Web: Yoshikazu, Jimoh
- 3.) Working Model/ AutoCAD: Guillermo, Matt, DongHoon, Tonny
- 4.) Servo motor and brake research: Peter S., Viola
- 5.) Data collection: Tom, Peter M., Alex
- 6.) Strain gage calibration: Peter M.
- 7.) Scribe: Viola
- 8.) Labview: Tom, Yoshikazu, Jimoh, Tonny
- 9.) Circuit design with operational amplifier: Peter S., Viola
- 10.) Assembly: All

Technical and Non-Technical Barriers and Challenges

Technical Barriers:

- 1.- Finding the right devices to use for the simulator due to lack of knowledge and lack of resources
- 2.- Having detailed AutoCAD drawings because the design of the simulator changes
- 3.- Delays in assembly because of lack of materials or tools at the moment

Non-Technical Barriers:

- 1.- Dividing the work load equally among team members because some are less willing to work than others
- 2.- Communications between team members because team members do not read E-mails sent out by others regarding the project

3.- Having members of the same subgroup work together due to the lack of communication

Challenges:

1.- Designing a resistance arm in the simplest way

2.- Writing a Labview program because no team members are familiar with Labview

3.- Designing a circuit with an operational amplifier or other electrical components

Solutions to Barriers and Challenges:

Initially, a lot of research was done on servo motors and other electrical or mechanical devices the team is not very familiar about, but Chamberlain later gave us a brake to use for the simulator, which is a lot cheaper and simpler than our original ideas. At the same time, as we decided what device we would use for the simulator, the design of the support frame as well as the simulator changes less. The support frame is now completed and the AutoCAD team took dimensions of it to make a detailed drawing.

In terms of the assembly, the team tried to do as much as possible, even when the appropriate parts or tools are not there. We make active efforts to buy the parts or tools that we need, and we communicate with our sponsor such that they could get the parts for us in a short amount of time and a team member could pick it up from their company.

Regarding the uneven distribution of work load and communication between team members, each member is required to report what they've done regarding the project each week such that the progress of each member is monitored. A mid-term student evaluation might be used in hoping that team members would participate more in the project and communicate with other team members such that the project's efficiency will go up.

At first, the team was trying to design a "dog leg arm" that avoids contact with the garage door operator rail and provides the load profile. This design requires a very stiff material and it needs to be fabricated. Currently, a new design is made such that two arms

will be used, one on each side of the garage door operator rail, in order to provide the load profile. These two arms can be easily provided by our sponsor because they are the same ones used for the garage door opener itself.

Since no team members are familiar with Labview, but we need this software to carry on with our project, we've asked help from Mr. Joseph Papp from the Fluids Center for his help to get us started. The Labview subgroup has met with him to go over the basic functions of Labview. They were also given a Labview software (Version 6.0) for practice.

We also need a circuit that outputs the difference between two inputs. The idea is to use an operational amplifier. However, the design of the entire circuit is not completed, and we might encounter difficulties if we need to use electrical components, such as different programmable chips, that we're not familiar with. The team will look for help in the Electrical and Computer Engineering Department of IIT. Professor Felber has helped in the research for servo motors, and the team will look for his help again in order to design a suitable circuit for our project.