.decimal Proton Therapy Device Manager

Team Number:	14
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1 Product Specification Deliverable

1.1 Need Statement

The sponsor for this project is .decimal. .decimal is a medical device manufacturing company in North Orlando. They manufacture patient specific devices for various types of cancer treatments including proton, photon, and electron beam treatment. The need that they have expressed to the senior design team has been that the apertures, or patient specific devices, take too long to load into a Mevion S250 Proton Therapy System. For the technician to come into the room, the machine must be off and then they have to navigate through a long hallway before getting to the treatment room. Also the apertures can be up to 25 pounds and the technicians have complained about having to lift the heavy apertures repeatedly throughout the therapy session.

It takes too long and too much effort for a technician to load and unload apertures during a patient's treatment.

1.2 Goal Statement & Objectives

Goal Statement: Provide proof of concept by developing a functioning scaled model of an automation device that will load and unload .decimal's apertures and range compensator relative to the nozzle of the Mevion S250.

Objectives:

- Decrease the time a patient is in the treatment room
- Eliminate manual process for technician

1.3 Constraints

- Automation device must lift up to 25 lbs.
- Automation device must not interfere with proton beam or the patient couch
- Automation device must scan apertures to identify patient specific aperture
- Automation device must be installed in the same room as the Mevion S250
- Automation device must load apertures and range compensator
- Automation device must unload apertures and range compensator

1.4 Methodology

The team plans on spending a week or two brainstorming and narrowing down possibilities. Then, the team will create a few rough prototypes made out of cardboard or foam to create a general proof of concept before finalizing designs and ordering parts. By December, the goal is to have an initial prototype. From there, further improvements and refinement can be made during the spring semester as the group prepares for the final deliverable.

1.5 Schedule and Work Breakdown

We plan to have one, very basic prototype built in mid- October and then our first major prototype built by the beginning of December. This will allow the team to utilize the spring semester to refine the design and take the necessary measures to correct the design to make it the best it can be. Our schedule can be seen in the Gantt Chart in Figure 1. The work breakdown structure is in Table 2. The team will be referring to our defined roles when delegating who will do the tasks. Since the team is so small, most aspects will be completed together.

Table 1 Work Breakdown Structure for Spring 2016

22			Order and gather parts for linear rail system	11 days	Mon 1/11/16	Mon 1/25/16
23			Conduct background research on actuators	10 days	Mon 1/11/16	Fri 1/22/16
24			Finalize Mechanical Design	10 days	Mon 1/25/16	Fri 2/5/16
25			Develop program to automate the system	15 days	Mon 1/25/16	Fri 2/12/16
26			Assemble Prototype 2	6 days	Fri 2/5/16	Fri 2/12/16
27			Validate and troubleshoot prototype 2	12 days	Fri 2/12/16	Mon 2/29/16
28			Schedule and conduct meeting with sponsor	5 days	Mon 2/29/16	Fri 3/4/16

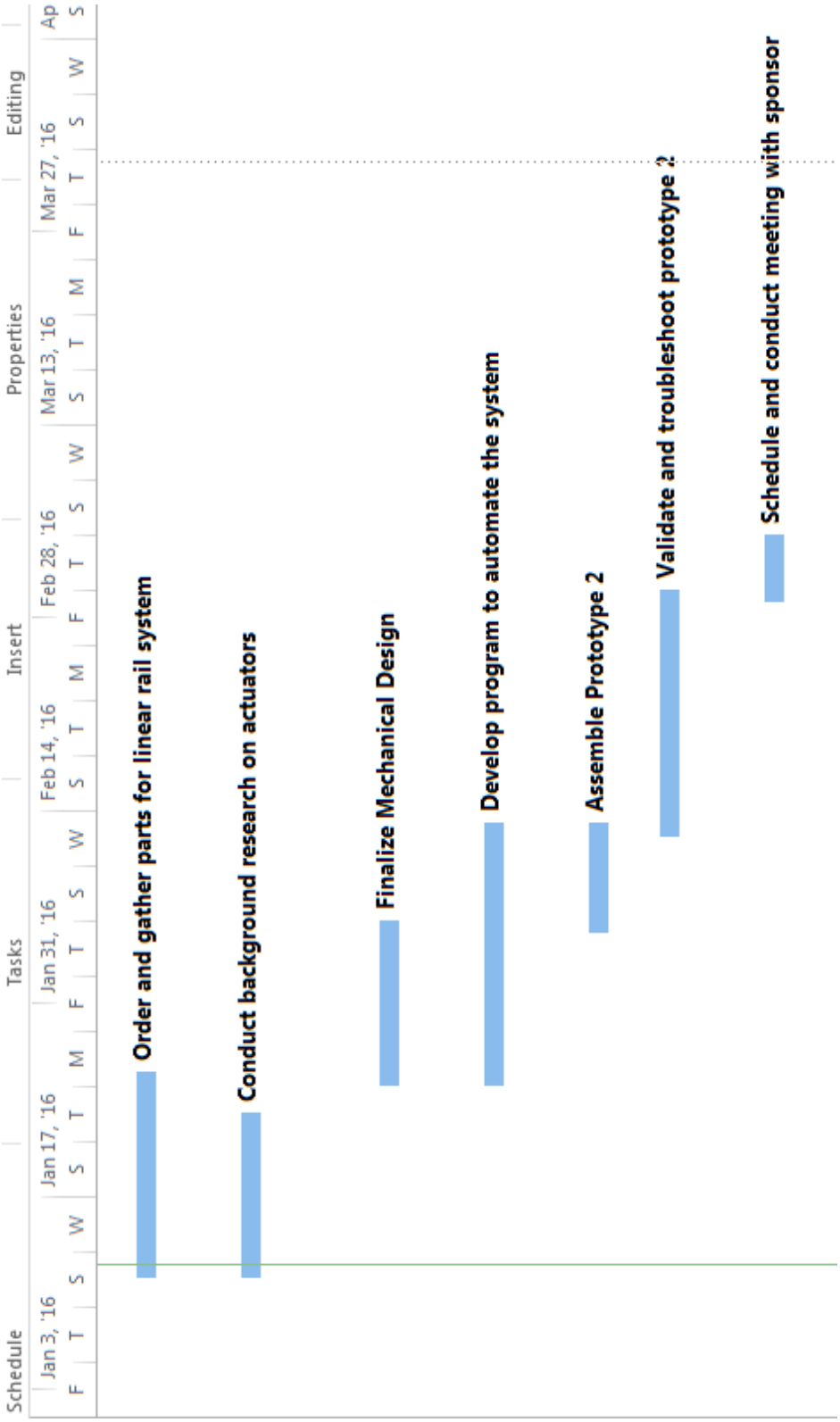

Figure 1 Gantt Chart for Spring 2016

1.6 Product Specifications

1.6.1 Design Specifications

The design must be fully automated and fit inside the proton therapy room. It must not interfere with the 6 degree of freedom robotic couch, which positions the patient for treatment. The automation device must not interfere with the movement of the electron therapy system's nozzle. The device must repeatedly and reliably be able to identify, pick up, and load an aperture. The design must incorporate a device that releases a spring-loaded safety latch. The purpose of this is to enable the aperture to be unloaded from the nozzle of the Mevion S250. Preliminary discussion with Dot Decimal has established that a secondary device can be designed to perform this operation. An integrated safety system for identifying the order of each aperture should be created. The system must return to its original position after a full cycle of loading and unloading has occurred. After unloading, the cycle must repeat. . A life cycle will need to be developed to ensure a re-design is in line with the latest market requirements of the Mevion S250. Design for manufacturability must be considered. One Mevion S250 Proton Therapy System is clinically active and 6 are under installation and architectural planning in the United States.

1.6.2 Performance Specifications

The system must perform the loading and unloading process faster than a human technician. The goal for operation time of one complete cycle (unloading and loading) is under one minute. Patient safety is of utmost importance. The apertures must be rigidly secured to the automation device during loading and unloading. The system should be able to lift up to 25 lbs. The device's deflection under load must be minimized and accounted for to ensure the aperture is able to be secured in the nozzle. Failure mode analysis must be performed on all components of the system in order to identify any safety concerns. Safety factors should be considered to ensure failure does not occur during operation. Additionally, the automation device must be manufactured from materials that are anticorrosive. Additionally, the cycle progress and state will be continuously monitored and outputted to the technician. Data transmission will be wired and should not affect the room.