Release Lanyard Design

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Progress Report

Document

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Table of Contents

Introduction

Many weapons constructed by Raytheon use a lanyard to activate after the weapon has been released. Unfortunately on a few occasions the lanyard has failed to activate the weapon due to icing, poor installation, and contaminates such as sand and dust. Raytheon has proposed this project to our team to find a new design that is more reliable and less susceptible to these modes of failure.

Background Research

Raytheon was established on July 7, 1922 in Cambridge Massachusetts as the American Appliance Company. Raytheon became a major national defense company during World War II where they supplied 80% of the magnetron tubes used in radars. With these strong foundations Raytheon now specializes in defense and homeland security in the United States as well as government markets throughout the world.

Needs Identification

This project will consist of developing a new design for an arming system lanyard and a functional prototype. The current lanyard design does not address issues relating to extreme temperatures and environmental effects, which leads to system malfunction.

Project Goal

The current release lanyard design does not address issues relating to extreme temperatures and environmental effects, which leads to system malfunction. Our goal is to design a reliable, low cost system that can withstand extreme temperatures and environmental effects. This system will also be constrained due to size and specific material requirements.

After a meeting on January 10, 2013 with Raytheon's release lanyard design supervisors, the emphasis of our design analysis has changed to focus primarily on the internal activation mechanism, instead of the external components. This changed the original design problem from redesigning an entire lanyard system to redesigning the slider switch area, which disregards the cable, cable guide components, and activation arm.

Objectives

With the information provided to us by our client, we have constructed the following table based on the most important criterion.

Table 1: Objectives

Objectives	Basis for Measurement	Units
Inexpensive	Manufacturing Cost Based on Current Design	$300
Maintain Current Location of Devices	Location Based on Current Design	Meters
Installation and Assembly	Timed Trial	Seconds
Successful Activation of Devices	Minimum Force Required	Newtons
Low Susceptibility to Contamination	Amount of Contamination Required to Induce Failure	Kilograms
High Performance Reliability	Number of Successful Attempts vs. Failed	%

Constraints

i. The device has to fit the within the dimensions of the environmental testing chamber which can simulate the conditions that the currently used designs are failing under.
ii. The placements of the lanyard mounts and associated devices such as the battery have already been predetermined.
iii. Internal components must fit in allowable housing space.
iv. Internal activation switches cannot be modified.
v. The allowable cost must not exceed that of the current design of $300 in material cost.
vi. Must be easily assembled within 30 minutes.

Top Designs

After visiting our client's facilities our team has been refocused to address the complexity of the internal battery slider assembly. The team is currently working on designs for the slider switch and the arrangement of associated components. Two of the designs being considered can be found in Figures 2 and 3.

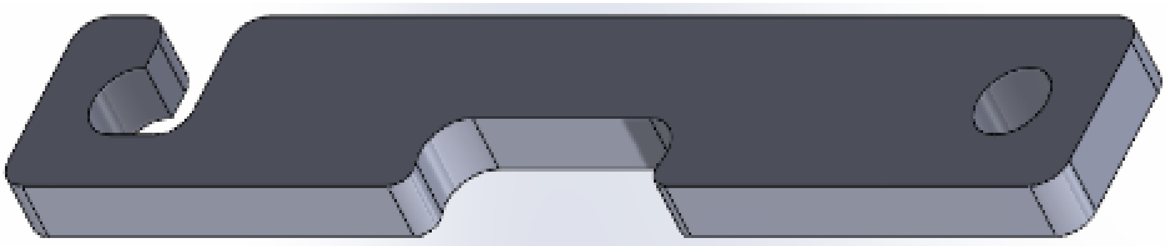

Figure 2: Slider Design 1

The primary difference between these designs and the current slider is the surface area. With a smaller, more compact slider the internal complexity should decrease as a result.

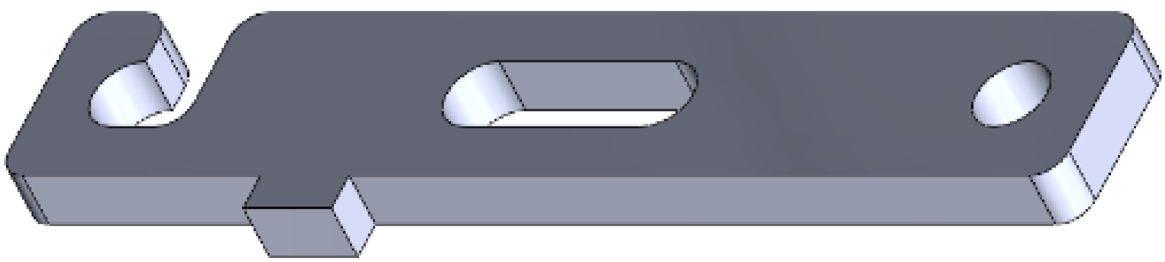

Figure 3: Slider Design 2

Each of the concepts produced need to address the environmental conditions experienced while the weapon is attached to the vehicle (vibration, contaminants and icing). When considering future designs, we need to look at materials that will not corrode under the extreme environmental conditions and materials that can withstand these conditions for long periods of time.

Future Tasks

Our future tasks include the following: design analysis, rapid prototyping, scaled designs, testing of materials and prototype testing. For the design analysis we plan on using concepts from mechanics of materials, vibrations, finite element analysis, statics, and fluids mechanics to aid in choosing a functional design. Once a functional design has been determined the drawings can be submitted for approval. Once approved, an iterative process will begin with prototyping and experimental testing to ensure the feasibility of the design.

To rapid prototype the team will be using Fused-Deposition Modeling (FDM) and CNC Milling for the final design. Before coming up with our final design that will be presented at the end of the year the rapid prototypes that the team plans to produce will be scale down to decrease the amount of material used and wasted during the testing process.

To test different materials for our final design the team will use corrosion, strength, and yield testing.

First we will test the battery slider at room temperature to verify that it will be able to perform the necessary. Then the battery slider will be tested at varying temperatures between -50° C to 150° C to examine its response to extreme temperatures. We will also test the material of the battery slider to determine how it reacts to the exhaust fumes of the vehicle. To test this we will first weigh the raw material and then expose it to the fuel used by the vehicle. After exposing the material we will allow it to air dry, then reweigh and calculate any change in the weight. The testing method for the final design will be composed of building layers of ice on the prototype till a predetermined thickness is achieved. Once the ice reaches this thickness we will pull the lanyard to test the battery slider mechanism. This testing method will be repeated until the design meets Raytheon's required specifications.

Project Plan

The Gantt Chart in Figure 4 shows how the team plans to use this semesters time, which is represented by the solid green bars. The black diamond represent the dates our presentations and reports are due. Prototyping and testing needs to be completed by the end of April at which point we must present to our client.

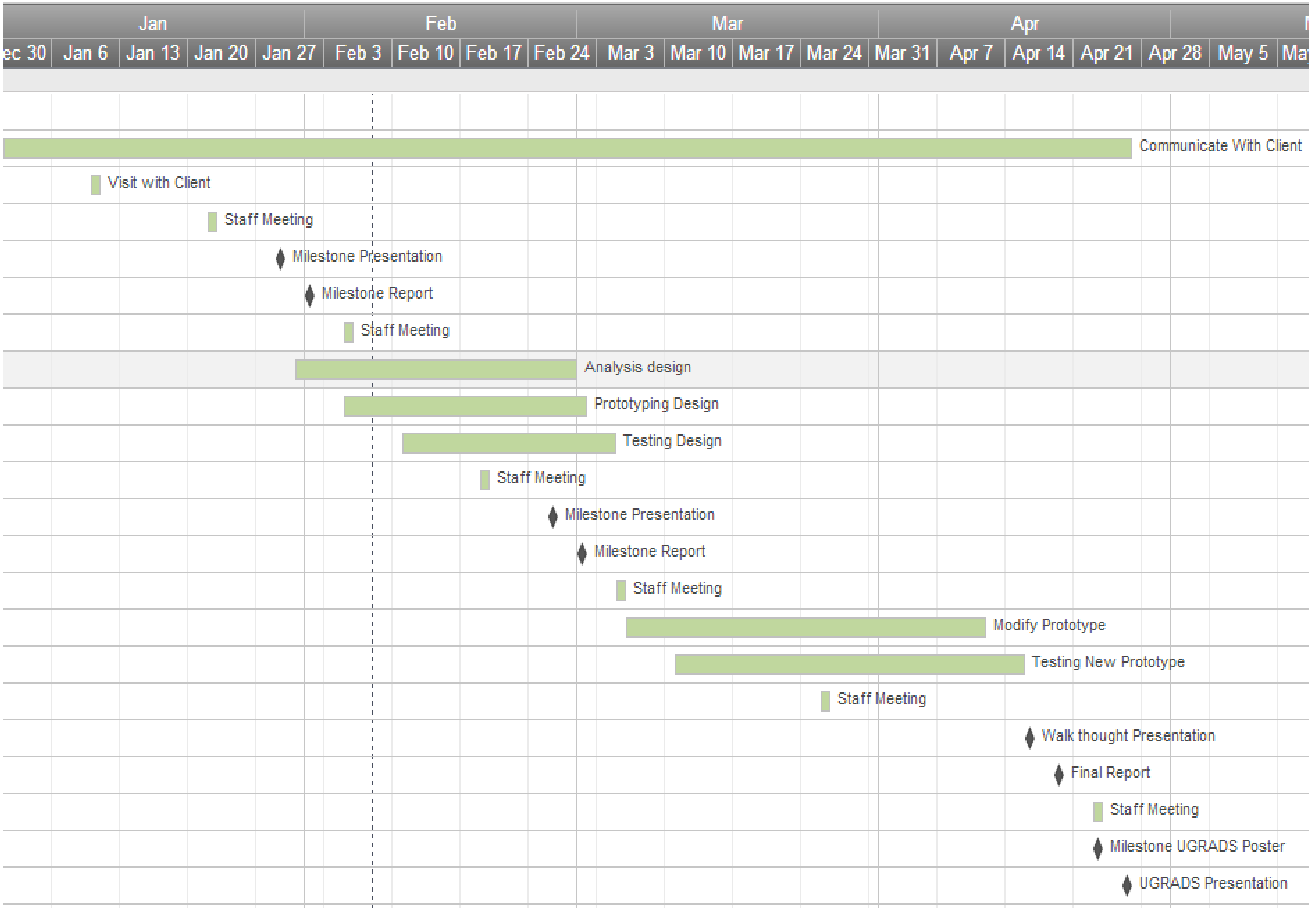

Figure 4: Gantt Chart for Spring 2013

Conclusion

Raytheon is currently experiencing activation failures due to icing and other debris contaminating the activation area. Raytheon has tasked us with creating a more efficient design which will alleviate these issues and attempt to correct any problems of poor installation and lengthy installation time. To alleviate and address these concerns we are focusing on building a new activation slider. In constructing a new activation slider the failure percentage, time to assemble, and cost of manufacturing will decrease by meeting our client's requirements. To meet these requirements our designs will undergo thorough analysis and testing in an iterative process. The next steps will be to:

- Finalize the current design
- Material testing and analysis
- Prototyping/ Manufacturing
- Testing

References:

1. Chang, Tien, and Richard A. Wysk. *Computer-aided manufacturing*. 3rd ed. Upper Saddle River, NJ: Pearson Prentice Hall, 2006. Print.

2. "Raytheon Company: History." *Raytheon Company: Customer Success Is Our Mission*. N.p., n.d. Web. 7 Dec. 2012. http://www.raytheon.com/ourcompany/history/