Remote Control Laser Pointer

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Team 12

Project Update 1

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1.0 Introduction

1.1 Overview

Mr. Edwin Anderson, the Support Systems Analyst for the NAU Physics department has requested a device to aid him in safely directing the attention of groups of people toward individual stars and constellations. He currently points out stellar bodies by hand with a 5 mW laser which is not powerful enough for people to see that are not in his immediate vicinity. He wants to use a 20 mW laser so that larger groups of people can see what he is pointing out, however it is too powerful to be operated by hand. If the beam were to make contact with someone's eye, instant blindness could occur.

Our team was tasked with designing and building a system to safely focus the attention of large groups to stars while eliminating the possibility of the laser shining into someone's eyes. The design must be stable and comfortably operable in relevant weather conditions, i.e. typical Flagstaff winter night conditions. The laser has a specific operating temperature range and will not operate if it becomes too cold. The main location of use will be the NAU observatory grounds, and other locations in and around Flagstaff such as Buffalo Park, Heritage Square and various elementary schools. A primary concern with various locations are differing minimum angles for the laser. For example, if the system was to be used near buildings, the system must not allow the laser to be shined into windows.

The system must point out stellar objects within a reasonable time while retaining a resolution of 0.5°. A reasonable time was determined by considering the case in which the laser moves a maximum amount, generally 120°, in five seconds. This equates to an angular velocity of 24° per second or 0.4189 radians per second. The system must be able to fit into a small car and able to be transported by a single adult. This means the final inclusive design must have fully collapsed dimensions no larger than 48" X 12" X 12" so that it can fit into the cargo compartment of Mr. Andersons Subaru Outback. The design and all components must weigh no more than 100 lbs.

1.2 Current Project Standing

The PT5 camera turret has been received and functions as expected however, there was a misunderstanding with the manufacturer in that a portable power supply was not included. This issue and its solution are discussed in the Design Modifications section below (2.1). Another issue with the turret is the power cable from the base of the turret to the motor that drives the tilt head (Figure 1.1 below) will wind up around the turret if it is rotated more than 270° in the same direction. The proposed solution to this issue is discussed in detail in section (2.2) below. All other parts are either awaiting order, from our client Mr. Anderson, or purchase, from local shops.

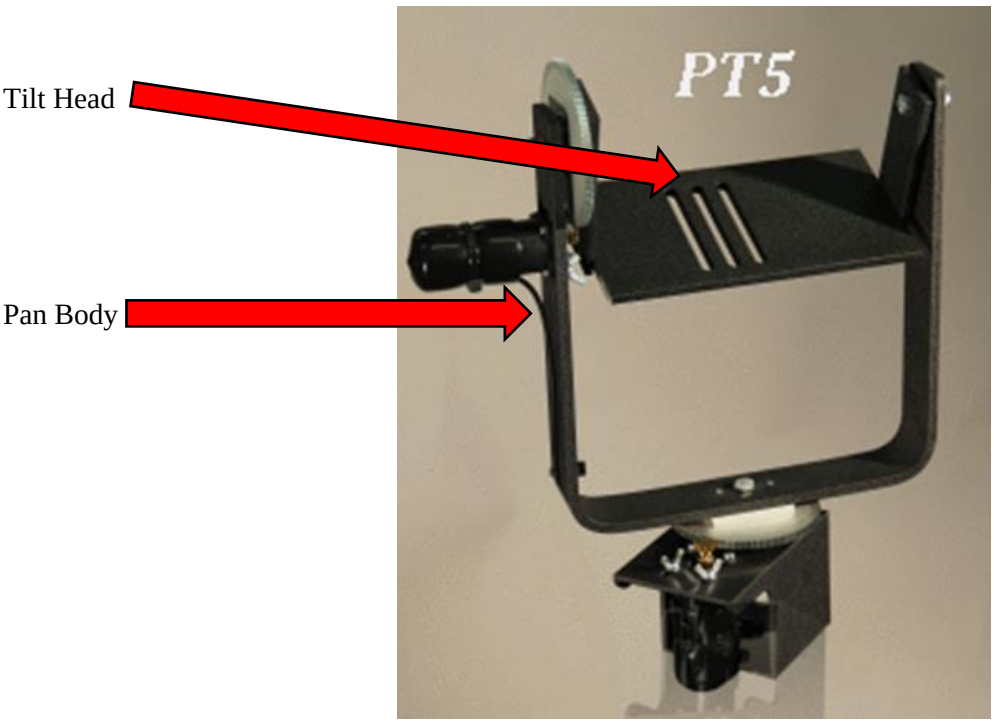

Figure 1.1 – Camera Turret Detail

2.0 Design Modification

2.1 Power Supply

The camera turret was expected to come with a portable power supply, this was a misunderstanding with the manufacturer and no such feature was included. Thus a power supply in the form on a 12V battery, shown below in Figure 2.1, will be purchased and implemented into the design along with a power level indicator. The battery and power level indicator will be removable and attached to the tripod stand underneath the mounting bracket. When the tripod is fully expanded the battery will hang directly in the middle of the tripods legs.

Figure 2.1 – 12V Power Supply for Turret and Laser

2.2 Laser Blind/Electrical contacts

The cable that supplies power to the tilt head of the camera turret limits the rotation of the pan body to 270° in one direction as it winds around the turret. It is desired that the turret have the ability to rotate continuously around in either direction freely. For this purpose electrical contacts will be implemented at the base of the pan body so that power may be supplied to the tilt head without a cable that spans the rotary portion of the pan body. This will eliminate the binding of the power cable and allow for free continuous pan rotation.

The laser beam blind that was designed to act as a physical shield, blocking the beam from shining below a minimum angle of 20° from the horizon, will be replaced with to inclusion of semicircular electrical contacts. The contacts will be mounted to tilt head's swinging axis, so that when the laser is pointed below this critical angle of 20° it will be cut off from power. This will eliminate the possibility of shining the beam into someone's eye while reducing the bulkiness of the design.

Both sets of contacts will be built by the team due to the high costs and limited availability and access to information via manufacturers. The following paragraphs describe the anticipated construction.

2.2.1 Tilt Head Contact System

Solenoid Contact

The tilt head contact system will be composed of two components. The first component is the Solenoid Contact Disk, which is a 3/16 thick PVC disc with 99.99% copper contact rings inserted into machined grooves, see Figure 2.2 below. The grooves will be 1/8" deep such that the copper contacts will be flush with the surface of the PVC disc.

Figure 2.2 – Solenoid Contact Disk

The PVC disc component will be machined from an 8” by 8” by ¼” thick sheet of PVC stock. The copper contacts will be machined from an 8” by 8” by 1/8” thick sheet of copper. The three components will be assembled using JB Weld with roughed surfaces inside the grooves in the disc and on the exterior of the copper contacts.

Solenoid Contactor Head

The Solenoid Contactor Head is the component which houses one set of brushes which will translate electricity from the Pan Body to the Tilt Head, see Figure 2.3 below. The figure is rotated so that the contact brushes are visible. It will be machined from 1” PVC stock in the NAU machine shop.

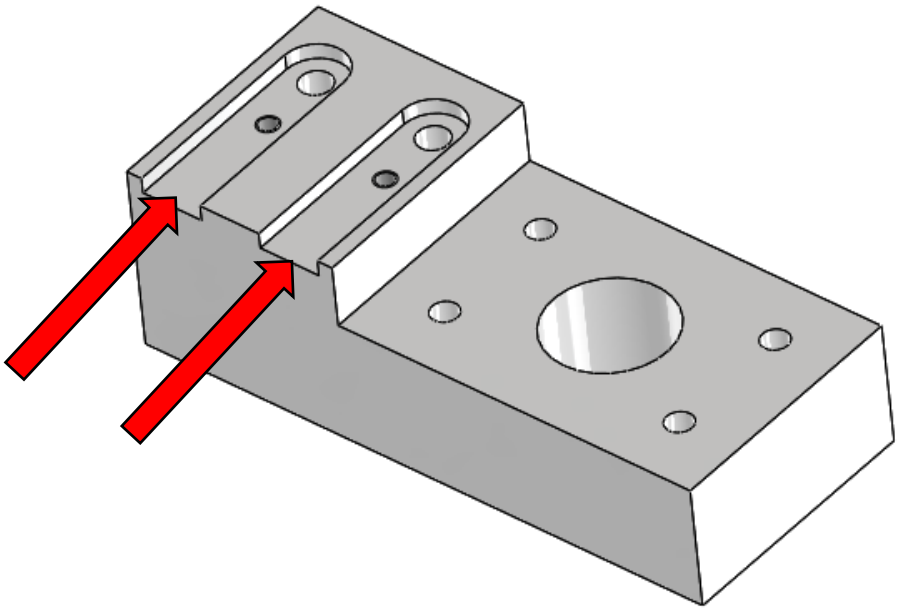

Figure 2.3 – Solenoid Contactor Head

The two grooves, indicated by the arrows above, will house the custom made contact brushes.

2.2.2 Pan Body Contact System

Motor Contact

The Pan Body contact system will be composed of two components. The first component is the Motor Contact disk, which is a 3/16 thick PVC disc with 99.99% copper contact rings inserted into machined grooves, see Figure 2.4 below. The grooves will be 1/8” deep such that the copper contacts will be flush with the surface of the PVC disc.

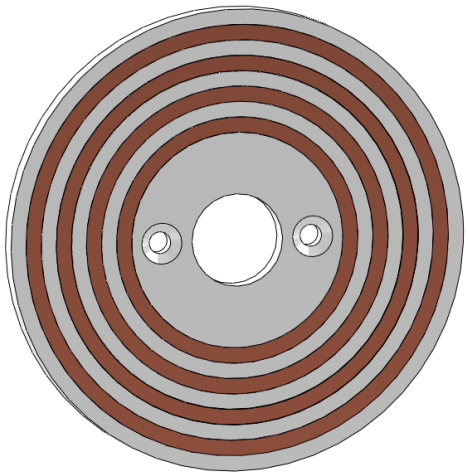

Figure 2.4 – Motor Contact

The PVC disc component will be machined from an 8” by 8” by ¼” thick sheet of PVC stock. The copper contacts will be machined from an 8” by 8” by 1/8” thick sheet of copper. The three components will be assembled using JB Weld with roughed surfaces inside the grooves in the disc and on the exterior of the copper contacts.

Motor Contact Housing

The Motor Contact Housing is the component which houses one set of brushes which will translate electricity from the turret base to the Pan Body and the Tilt Head, see Figure 2.5 below. The figure is rotated so that the contact brushes are visible. It will be machined from 1” PVC stock in the NAU machine shop.

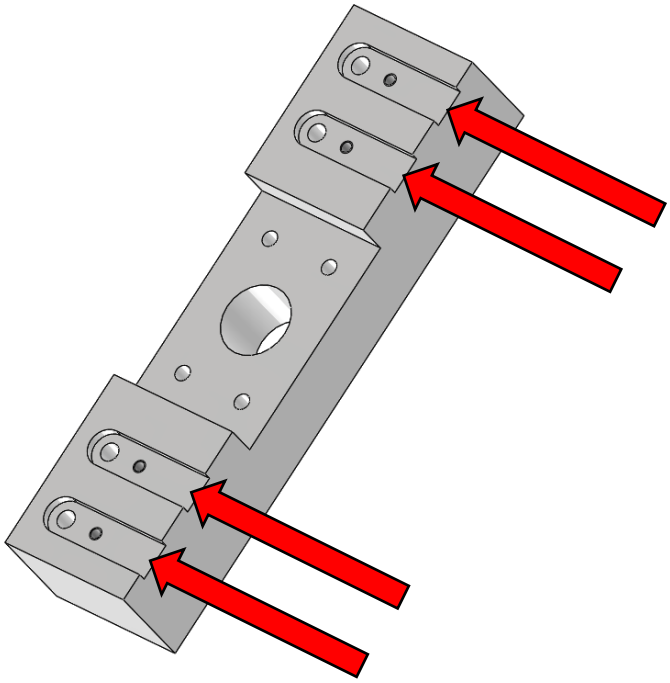

Figure 2.5 – Motor Contact Housing

2.3 Laser Housing

The housing of the laser has a few small modifications. Set screws will be used to secure the cap of the housing instead of threading. The holes on the bottom of the housing will be tapped and studs will be screwed in. These studs will be used to secure the housing to the tilt head by means of two wing nuts. Set screws will be used to secure the laser within the electrical conduit to prevent motion or slippage and allow for different sized lasers. The location of these modifications are shown in Figure 2.6 Below.

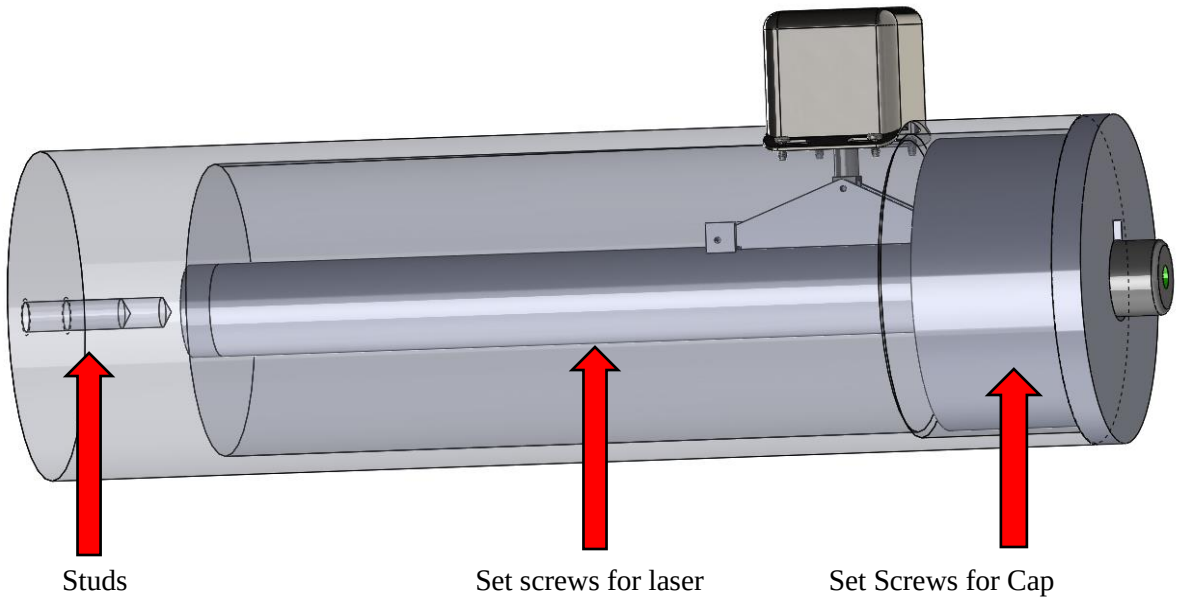

Figure 2.6 –Laser Housing Modifications

3.0 Project Plan

3.1 Task Breakdown

The remaining tasks needed to complete our project have been identified and allocated to each member of the team. Such tasks include machining the following components: laser pointer casing, the switch trigger, custom slip ring assembly and contacts. Additional task include wiring the power supply, assembling the system, writing a user manual, testing the system, and reporting the results of testing. Table 1 shows how these tasks were delegated to each team member.

Table 3.1 – Task Breakdown

Task	Team Member
Machine Laser Casing	Cole Middlebrook
Machine Switch Trigger	Cole Middlebrook
Design/Machine Battery Box	Cole Middlebrook
Machine Slip Rings	Jeb Duncan
Machine Copper Contacts	Jeb Duncan
System Assembly	Jeb Duncan
Wire Power Supply	Michael Orrill
System Testing	Michael Orrill
Safety Analysis	Eddie Hoopingarner
User Manual	Eddie Hoopingarner

3.2 Parts Received/Ordered/To be ordered

The custom PT5 Camera Turret was ordered and delivered in December 2013. This component includes a wired joystick control, two wired motors, and the mechanical system for three axis movement.

Table 2, seen below, shows the parts that have been sent to the client for ordering. Once these parts arrive the team can start machining and building the majority of the design.

Table 3.2 – Parts Ordered

Component	Supplier	Part
Davis and Sanford 78" Tripod	Amazon.com	N/A
Delrin Rod Stock 1'	McMaster Carr	8572K32
Aluminum Stock 1 1/4" X 1' X 3/4"	McMaster Carr	8975K487
Threaded Stud 1/4-20 1" Length (x2)	McMaster Carr	98750A011
12V Power Wheels Battery	Amazon.com	00801-0638
Battery Level Indicator	Amazon.com	V56G
Pipe Insulation	McMaster Carr	4463K163
Solenoid	Deltrol - Controls	53759-81
Copper Sheet	McMaster Carr	89675K14
PVC Sheet	McMaster Carr	n/a

The last components that need to be ordered for the completion of the design are the plastic stock and copper stock required to create the custom slip rings. These parts are needed as

part of the solution to the turrets rotational constraint caused by the motor wire. These components are the final parts to be ordered for a full assembly of the design.

3.3 Schedule

The tasks required to complete the project are separated based on dependencies and tracked using a Gantt chart shown in Figure 1 below (i.e. ordering stock before machining a part). The remainder of the project plan includes deadlines for testing, user manual, and UGRADS presentation.

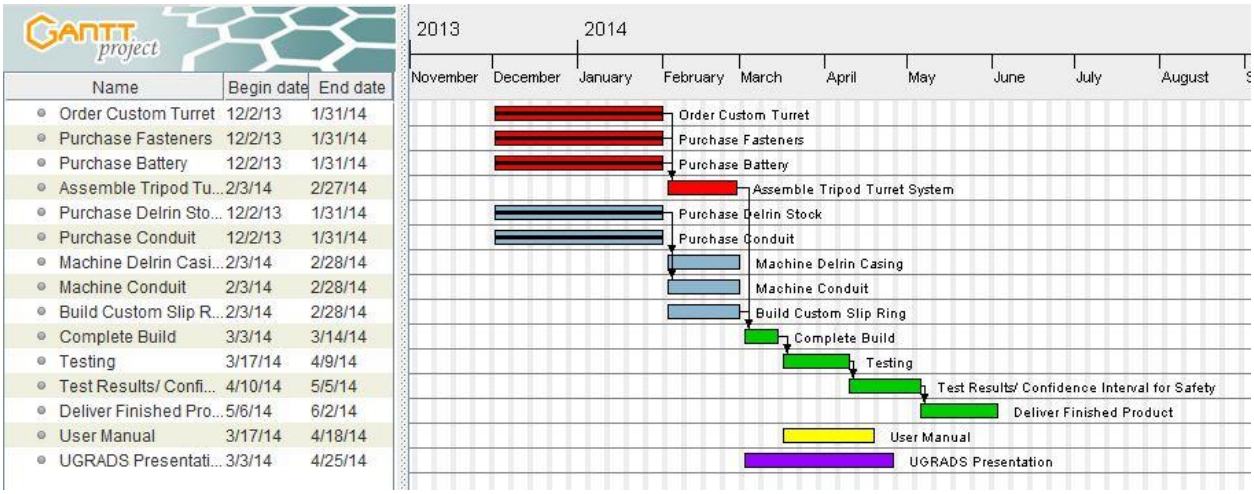

Figure 3.1 - Project Plan – Gantt Chart

Before March 14th, the design should be built and ready for testing. Components may or may not be prototyped using FDM machine in order to produce a prototype of the design sooner. Testing should be completed by April 9th and compile the results of testing about a month afterwards. The user manual is not dependent on other tasks but needs to be completed by April 18th. The UGRADS presentation is also independent of other tasks but needs to be finished by April 25th when the presentation is scheduled. The schedule is subject to minor changes, but will be utilized to manage the project plan to ensure completion and delivery of the product to our client Mr. Anderson.

4.0 Conclusion

Upon receiving the camera turret, the need for several design modifications became apparent. The main problems were the lack of a portable power source, and the cable supplying power to the tilt head winds around the turret which constricts pan body rotation. In our solution for dealing with the latter issue, we decided to implement a system of electrical contacts to limit the angle of tilt that the laser can receive power, eliminating the need for a physical shield. This will reduce the bulk of the design as well as increase visibility of the system to the user while in operation. All parts that must be ordered have been submitted to Mr. Anderson for ordering. All other parts will be purchased locally once all major components are received.

References

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