Celestial Identification System

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Overview

- Client Background
- Need / Goal
- Objective
- Operating Conditions
- Constraints
- System Design
- System Testing
- Purchased Equipment & Supplies
- Conclusion

Client Background

Client: Mr. Edwin Anderson

- Support Systems Analyst for NAU Physics and Astronomy Department
- Hosts astronomy talks to large groups using laser to point out stellar bodies

Need Statement

Mr. Anderson is unable to give presentations of the night sky to large groups of people because the current laser is not powerful enough to be visible. More powerful lasers are too dangerous to be handheld due to risk of blindness.

Project Goal

The goal of this project was to design and construct a system to safely focus the attention of an audience towards individual stars or constellations while observing the night sky.

Objectives

- Controllable laser pointer system
- Laser pointer mounted at elevation above ground greater than 6’ 5”
- Pointer resolution at ½°
- Collapsible to fit in cargo compartment of a small car 48”x12”x12”
- Weight less than 100 lbs
- Rapid response time 24° per second

Operating Conditions

Weather Conditions:

- Typical Flagstaff year round night conditions
- Low temperatures, above -5 °F
- Medium-high wind speeds, Maximum of 30 mph

Locations:

- NAU Observatory grounds
- Buffalo Park
- Heritage Square
- Various outdoor locations

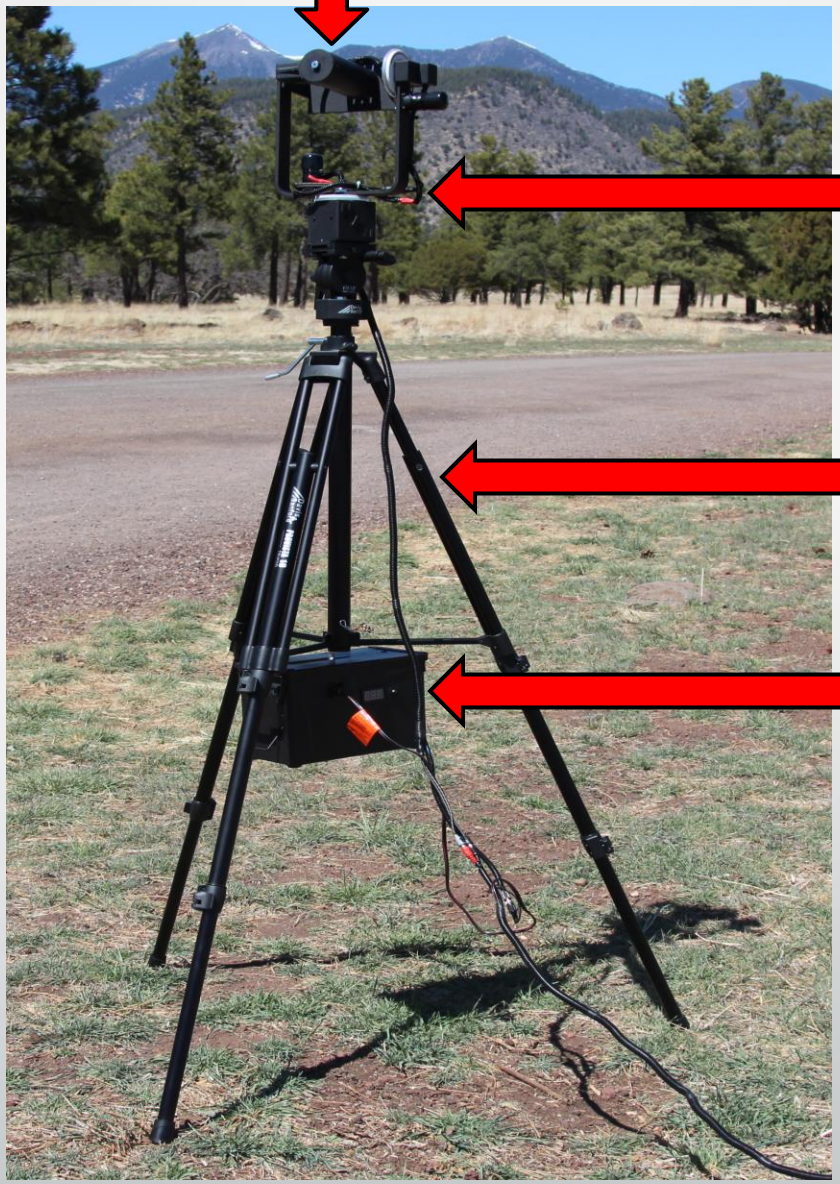
Constraints

- Must operate in safe manner i.e. no possibility of laser beam pointing into a person's eyes
- Laser must toggle on and off upon user command
- Laser unit must be removable from device
- Must remain within allowable budget of $3000
- Must comply with all local, state, and federal regulations

System Design

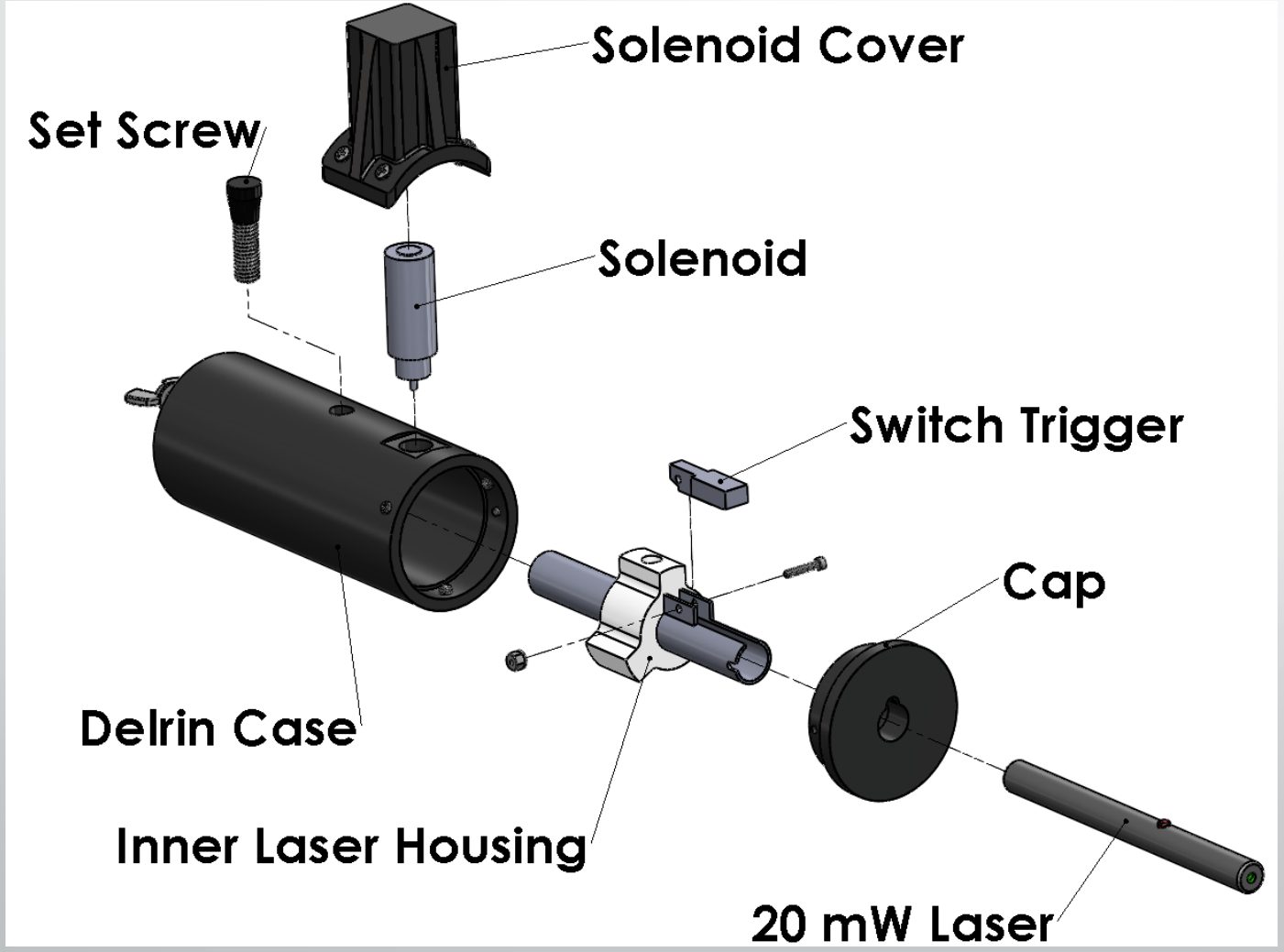
Joystick Camera Turret

- 12 Volt power supply
- Tripod
- Multi-axis camera turret
- Laser housing



System Design

Laser Housing Assembly



System Design

Camera Turret

- Laser housing mounts directly to turret
- Allows for 360° Pan and 360° Tilt
- Quick attach mounting to tripod
- Integrated switch mechanism built into variable speed joystick control

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System Design

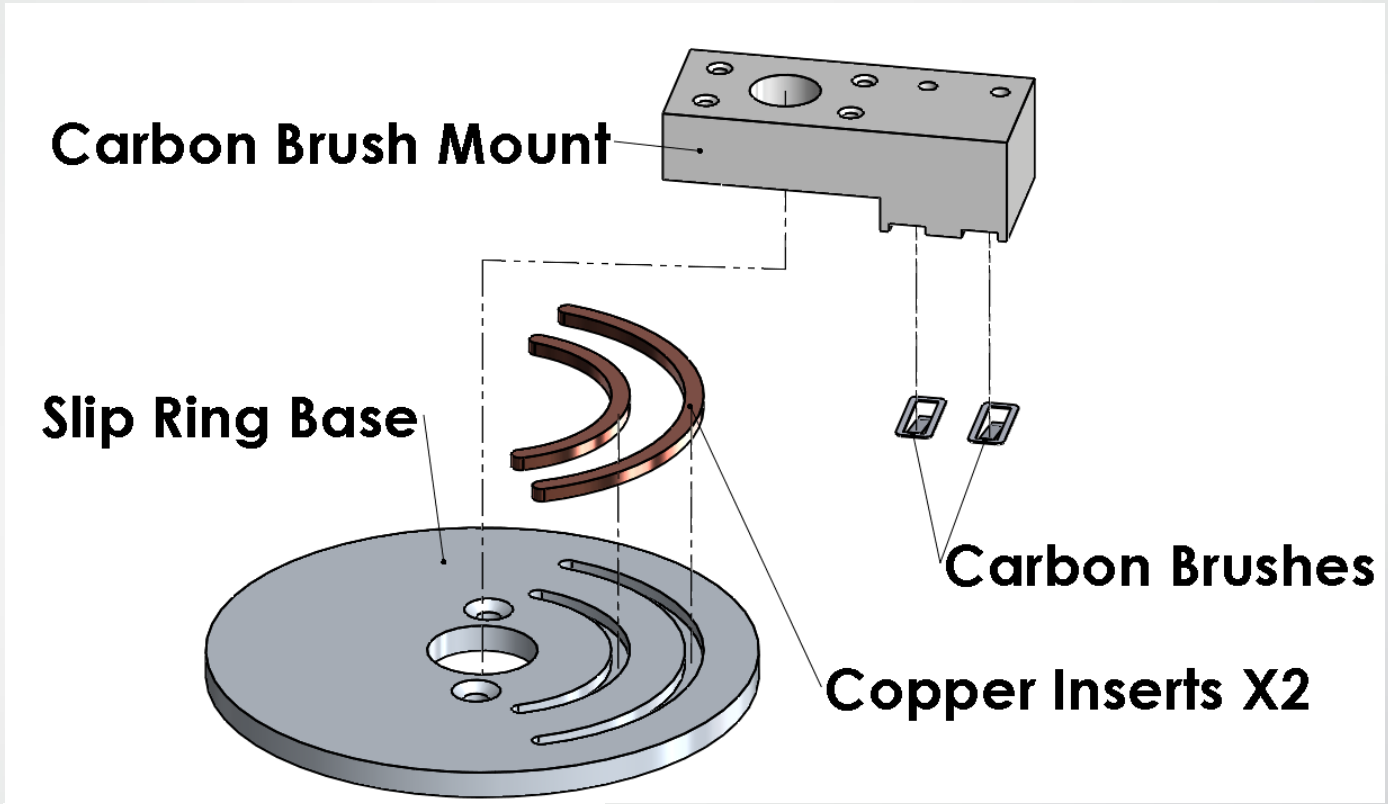
Camera Turret Modifications

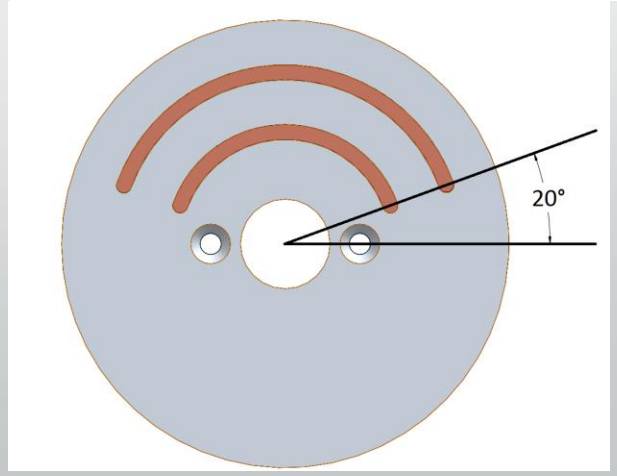
- 6 contact slip ring installed for 360°+ rotation
- Completely rewired
- Laser limiting slip rings installed

System Design

Laser Limiting Slip Rings

- PVC plate with Copper Contact limit laser operation to 20° above horizon
- PVC contact block with Carbon brushes

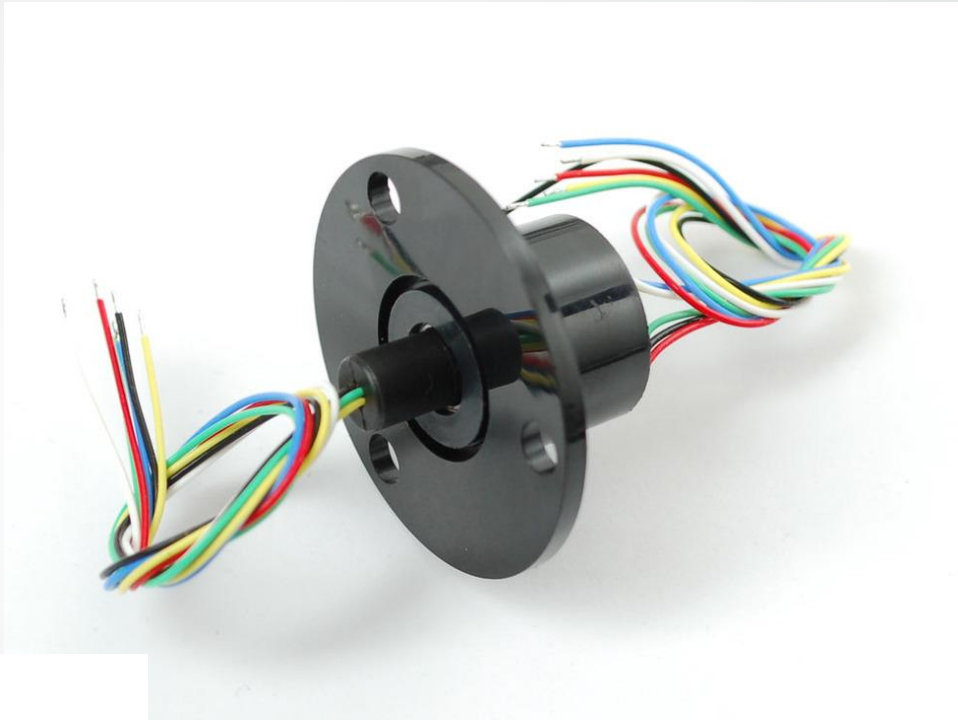




System Design

System Slip Rings

- 6 wire slip ring for 360°+ operation
- Aluminum mounting plate



System Design

78 Inch Tripod

- Quick attach mounting
- Level adjustment in head

System Design

Power Supply

- Securely houses battery
- 12 Volt meter displays current voltage
- Easy access charging and hookup port
- Flip up pin for fast and easy mounting to tripod

System Design

Turret & Laser Assembly Case

- Safely Houses
  - Turret assembly
  - Remote control
  - Laser assembly
  - Electrical cables

System Testing & Results

- 4 hours continuous use with no observable power loss

Component	Function	Details
Turret	Degrees of Rotation	Pan = 360 degrees Tilt = 360 degrees
Turret	Max Rotational Speed	6.5 rev/min 36°/sec
Power Supply	Charging Time	~ 8 hrs
Power Supply	Battery Life	~ 8 hrs

Purchased Equipment & Supplies

Component Category	**Cost [$]**
Camera Turret	861.00
Davis & Sanford 78" Tripod	163.00
Construction Materials	43.46
Electrical Supplies	494.04
Hardware	128.96
Casing	75.06
Grand Total	1765.52

Conclusion

- Mr. Anderson needed a safe way to operate a 20 mW laser for guided talks about the night sky
- Joystick controlled turret was designed and constructed
- Thermal analysis was conducted and the results showed no heating element was needed to maintain operating temperature
- Final system cost is $1765.52, well below the allotted $3000 budget
- Testing showed the system to perform to, or exceed expectations

Acknowledgments

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References

[1] lordwhimsey, . "People pointing vector." *VectorStock.com*. N.p.. Web. 9 Dec 2013. <http://www.vectorstock.com/royalty-free-vector/people-pointing-vector-6316>.

[2] "Picture of the Day." *www.Mikesjournal.com*. N.p.. Web. 9 Dec 2013. <http://www.mikesjournal.com/July 2010/iPad Eclipse Star Walk App.htm>.

[3] "Nintendo Wii Remote Jackets Free Sample | Gadgets & Apps - Sample.net." Nintendo Wii Remote Jackets Free Sample | Gadgets & Apps - Sample.net. N.p., n.d. Web. 10 Dec. 2013. <http://www.sample.net/prod/gadgets-apps/nintendo-wii-remote-jackets-free-sample-453.html>.

[4] "CAMERA TURRET TECHNOLOGIES, INC.." *PT5 Motorized Pan and Tilt System*. N.p.. Web. 9 Dec 2013. <http://cameraturret.com/pt5.htm>.

[5] "Playstation Move Controller - Black (PS3)." : Amazon.co.uk: PC & Video Games. N.p., n.d. Web. 10 Dec. 2013. <http://www.amazon.co.uk/Playstation-Move-Controller-Black-PS3/dp/B003R7KV16>.

[6] "Davis &Sanford ProVista F12." *http://www.tiffen.com/*. Tiffen Company. Web. 9 Dec 2013. <http://www.tiffen.com/userimages/D&S Product Sheets/D&S_ProVistaF12_ss.pdf>.

[7] "Delrin, acetal resin." . Dupont. Web. 9 Dec 2013. <http://plastics.dupont.com/plastics/pdflit/americas/delrin/230323c.pdf>.

[8] Incropera, Frank P. *Fundamentals of Heat and Mass Transfer*. New York [etc.: John Wiley & Sons, 2006. Print.

[9] R.C. Hibbeler, “Kinetics of a Particle: Force and Acceleration,” in *Dynamics,* 12th ed. Upper Saddle River, New Jersey, Pearson Prentice Hall, 2010, ch. 13

Questions?