Remote Control Laser Pointer

By
Jeb Duncan, Michael Orrill, Bryon Middlebrook, Eddie Hoopingarner

Team 12

Project Formulation and Plan

Submitted towards partial fulfillment of the requirements for
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Department of Mechanical Engineering
Northern Arizona University
Flagstaff, AZ 86011

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NEED

Our client, Mr. Edwin Anderson the support systems analyst for the NAU Physics department, demonstrates the locations of various astrological points of interest with a 5mW laser pointer. Mr. Anderson is unable to give star gazing talks to large groups of people because the laser isn't powerful enough. More powerful lasers are too dangerous to be handheld. Therefore, our goal is to design and construct a mechanism to safely focus the attention of an audience towards individual stars or constellations while observing the night sky.

CURRENT STATE

Mr. Anderson would like to use a 20mW laser because 5mW laser pointers are not powerful enough for larger groups to see. An image of a 20mW green laser similar to the laser Mr. Anderson would like to use is shown in Figure 1 below.

Figure 1 – 20mW laser [1]

The use of lasers above 5mW is regulated and requires appropriate control, labeling, and training in order to comply with Environmental Health and Safety regulations. The reason for regulation is because these classes of lasers can interfere with aircraft and direct eye contact with the beam can cause immediate retinal damage and even blindness. During a demonstration, Mr. Anderson points the laser into the sky and focuses the attention of an audience to a star or constellation of interest.

OBJECTIVE

The goal of this project is to provide our client with a means to identify the location of individual stars and constellations, with a resolution of 0.5°, to an audience in a safe and controlled manner. The term safe meaning eliminating the possibility of the laser shining into someone's eye. The design should hold the laser at a height of at least 6'5". It must be collapsible such that it can fit into the cargo compartment of a small car. Currently Mr. Anderson uses a Subaru Outback to transport his equipment to and from stargazing events. The device must remain manageable by one adult. The design must be stable from high winds and people bumping into it or tripping over the legs. Electronics need to be operable in normal Flagstaff winter weather conditions. System response must be rapid such moving objects like satellites can be pointed out.

OPERATING ENVIRONMENT AND CONDITIONS

The primary location of the system will be on the NAU observatory grounds. The system will also be used in various other outdoor locations in and around Flagstaff, Arizona. Operating conditions range from cool summer night temperatures to below freezing winter night conditions including high winds. The system will not be operated in rain, snow, sleet, or hail and thus it need not be designed for such conditions

PROJECT PLAN

The plan for the project is separated by the capstone deliverables (i.e. presentation deadlines). These presentation deliverables are listed as milestones in a Gantt chart, seen in Figure 2, which is used to track the progress of our project. The project plan is partially shown in the Gantt chart image below which includes two milestones: Needs/Specs/Plan and Concepts and Design. The remainder of the project plan has yet to be determined due to unknown requirements for program coding, material, and component selection.

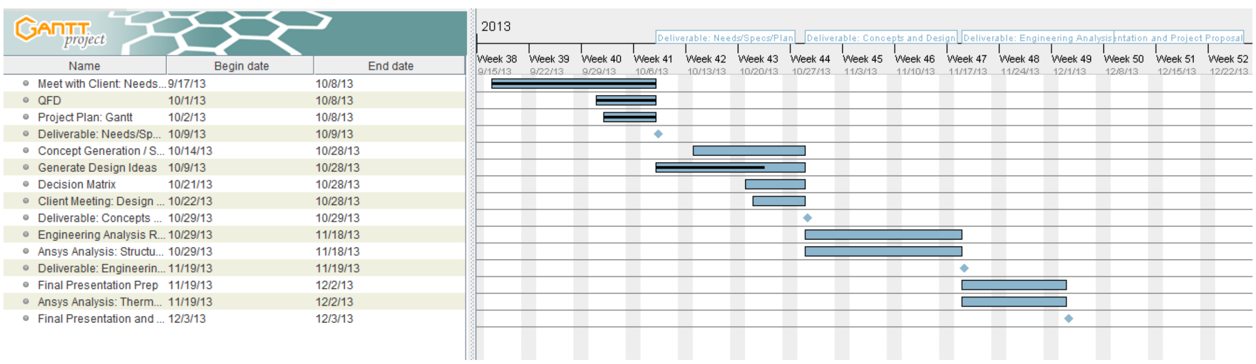

Figure 2 Project Plan – Gantt Chart

By October 8th, we should have met with our client to identify the project need and constraints, created a QFD, seen in Figure 3 below, and generated a project plan using a Gantt chart. These items have been completed and are indicated using the black progress bar within each item. The next deliverable will be the Concepts and Design Selection of our project. We will have generated and selected from several designs, created a decision matrix, and prepared a report and presentation of our design progress by October 27th. We also plan to met with our client and discuss design options. One of our project goals is to provide an acceptable solution to our client's need. Therefore, receiving our client's input and suggestions will prove beneficial to meeting or exceeding his expectations.

Quality Function Deployment								
		Engineering Requirments						
		Insulation / Isolation	Moment of Inertia	Weight	Cost	Height	Angle of Departure	Motor/Servo
Customer Requirements	Asthetics				X			
	Stability		X			X		
	Controlablity				X			X
	Safety (no eye contact)					X	X	
	Inexpensive				X			X
	Long Lasting							X
	Operable in all temperatures	X						X
	Colapsable					X		
	Rapid Response							X
	One Person Mobility			X				
	High Resolution							X
	Units	R	m^4	kg	$	m	°	rad/sec
		10		W < 45.35	3000	1.9812	30	
		Engineering Targets						

Figure 3 – Quality Function Deployment

CONSTRAINTS

The primary constraint of the project is to maintain safety. This means eliminating any possibility of the laser beam making contact with someone's eyes. The designed system and control must abide by all local, state, and federal regulations. Arizona Radiation Regulatory Agency or AZRRA will need to conduct biannual inspections of the device to ensure that it is compliant with regulatory standards [2][3][4]. These standards include proper training, labeling, and storage of any laser rated for over 5mV. The user requires the ability to move the laser beam to a desired location and toggle it on and off by means of remote control. The laser must be removable from the system for maintenance or storage. The project must also be completed within the allowable budget of $3000.00.

CONCLUSION

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. The overall goal of the project is to design and build an apparatus capable of controlling a 20mW laser by remote control. The design must eliminate any possibility of the laser beam making contact with someone's eyes. It must be stable and comfortably operable in relevant weather conditions. The system must point out stellar objects within a reasonable time while retaining a resolution of 0.5°. It must fit into a small car when fully collapsed, and its weight must be manageable by one adult. We plan to utilize a six axis rotational turret, mounted to a tripod with a standing height of at least 6’5”. We also plan to develop a remote control system to relay input from a remote user to the laser.

REFERENCES

[1] http://a.tgcdn.net/images/products/zoom/green-laser-pointer2.jpg

[2] Arizona Administrative Code – Radiation Regulator Agency. (2012, September 30). Obtained from www.azsos.gov/public_services/Title_12/12-01.pdf.
AZRRA Rules/Licensing. (n.d.). Retrieved from http://www.azrra.gov/rules/index.html.

[3] Illuminating the Hazards of Powerful Laser Products. (2009, June 23). Obtained from www.fda.gov/ForConsumers/ConsumerUpdates/ucm166649.htm.
Patrick Murphy. (2013, August 9). Federal Rules For Those Owning Or Using Lasers In The U.S. Obtained from www.LaserPointerSafety.com/rules-general/rules-US-consumers/rules-US-consumers.html

[4] Patrick Murphy. (2013, August 9). Federal Rules For Outdoor Laser Use In The U.S. (FAA Authority Over Airspace). Obtained from www.LaserPointerSafety.com/rules-general/rules-outdoor/rules-outdoor.html