Development of celestial object pinpointer equipment : Sky Object Beam (SOB)

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Abstract

Developing devices that can shorten the amount of time to search, pinpoint and track celestial objects accurately makes astronomical activities work efficiently. It starts with searching for the database, writing code, creating the physical part of the device, and testing its efficiency. The test results lead to the development of a more accurate, portable, and easy-to-use celestial object finder.

Research background

The study of Astronomy at the youth level requires astronomical observation activities allowing students to see the beauty of celestial objects. It helps them to understand the changing phenomena that underpin sustainable living. However, if there is a telescope with a device that includes an automatic celestial-boy-tracking-system, it will make observations in light-polluted areas, which it is difficult to observe with the naked-eyes, much more convenient. The objective of this project is design, create, test, and develop devices that can search, pinpoint, and track celestial bodies accurately.

Method and Result

1. As part of our research, we used the “Sky Field Library” as a database system, which has a total of 127 celestial objects; it includes 119 stars, 7 planets, 1 of dwarf planet and 15 deep-sky objects.
2. The device was designed and printed using 3D printers as shown in Figure 1. The code was written to control the motor and calculate the celestial object’s coordinates using Sidereal time [1], hour angle, Right ascension and Declination.
3. The device was used to point at celestial objects to find its accuracy. The results are shown in table 1.

From the data as shown in table 1, it was found that the values of angles calculated by the device were accurate when compared to the Stellarium. However, the motors were still not accurate enough. As a result, when adjusting the telescope at the laser, the desired object couldn’t be seen in the field of view (fov) of the telescope’s eyepiece. In addition, the scale values on the device set did not meet the standard when compared with the scale on the telescope.

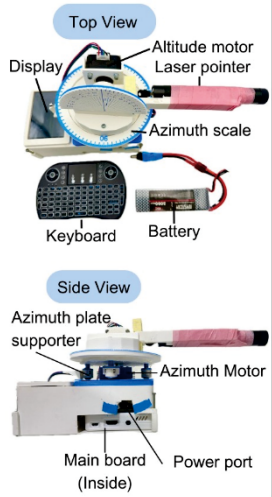

figure 1 Components of the first version

Object Name	Trial No.	Differences of values calculated by the equipment and Stellrium: Azimuth	Result	Accuracy	Altitude	Result	Accuracy	Differences of values read from the scale and calculated by equipment: Azimuth	Result	Accuracy	Altitude	Result	Accuracy	Differences of values from the scale of equipment and of telescope: Azimuth	Result	Accuracy	Altitude	Result	Accuracy
Phecda	1	0.482	✓		0.221	✓		3.449	✗		4.58	✗		2	✗		3	✗	
	2	0.499	✓	100%	0.219	✓	100%	0	✓	33%	7.689	✗	0%	2	✗	0%	2	✗	0%
	3	0.552	✓		0.175	✓		3.346	✗		2.888	✗		3	✗		3	✗	
Spica	1	0.449	✓		0.472	✓		2.996	✗		1.919	✗		3	✗		2	✗	
	2	0.454	✓	100%	0.475	✓	100%	7.115	✗	0%	5.092	✗	0%	6	✗	0%	4	✗	0%
	3	0.46	✓		0.471	✓		3.232	✗		1.269	✗		2	✗		2	✗	
Sirius	1	0.217	✓		0.388	✓		2.155	✗		7.874	✗		3	✗		6	✗	
	2	0.223	✓	100%	0.389	✓	100%	7.936	✗	0%	2.691	✗	0%	2	✗	33%	1	✓	33%
	3	0.271	✓		0.49	✓		12.53	✗		4.545	✗		1	✓		5	✗	
Peiades (M45)	1	0.128	✓		0.902	✓		6.329	✗		2.019	✗		1	✓		3	✗	
	2	0.144	✓	100%	0.577	✓	100%	5.709	✗	0%	2.507	✗	0%	2	✗	33%	0	✓	33%
	3	0.147	✓		0.573	✓		4.788	✗		5.139	✗		2	✗		2	✗	
Mean		0.336		100%	0.446		100%	4.965		8%	4.018		0%	2.417		17%	2.750		17%

✓ the value is under field of view (fov) (< 1.04 deg) - Considered Accurate
✗ the value is over field of view (fov) (> 1.04 deg) - Considered Not Accurate

table 1 show the accuracy of the equipment in first version

Discussion and summary

After testing the first version, it was found that there were accuracy issues, the motor was overheated; there were also power surges due to improper circuit connections. Lastly, the installation was quite difficult. For the second version we induced the following improvements: GPS, rotary encoder, compass sensors; we improved the motor control. circuit, level adjustment system and laser position. The updated version can be used and shown in figure 2.

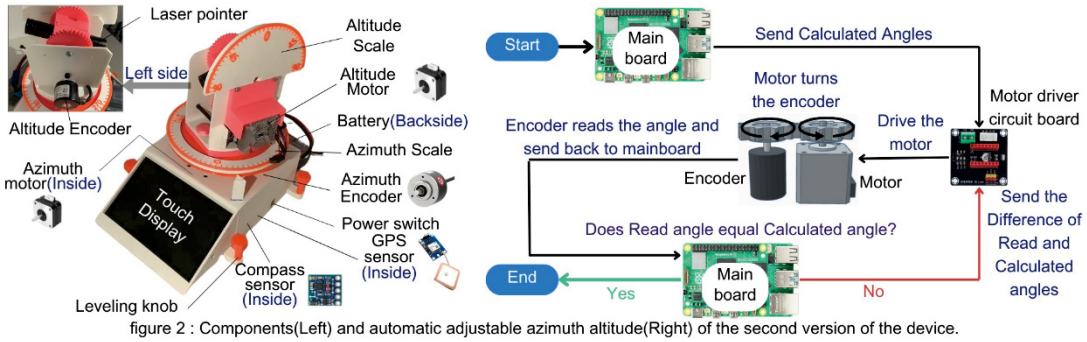

figure 2 : Components(Left) and automatic adjustable azimuth altitude(Right) of the second version of the device.

Reference

[Royal Belgian Institute for Space Aeronomy] [1] https://www.aeronomie.be/index.php/en/encyclopedia/sidereal-day-definition [Sidereal day, a definition] (30/3/2024)