Development of Dobsonian Telescope Positioning Device

Mr.Warunyoo Nijjarungul ; teenyzeed@gmail.com
Suratthani School 88 Donnok Road, Makhamtia, Mueang, Surat Thani, Thailand, 84000
Adviser : Ms.Chadaporn Chuaichu ; kookkoi@hotmail.com

Abstract

This project focused on building a device attached to Dobsonian telescope that help locating sky objects using Arduino and Stellarium software, together with the coordinate conversion equation. The result turns out to be accomplished and solved the poor altazimuth coordinate system problem effectively with some room left for further improvement.

Introduction

Entry level telescopes are mostly equipped with a very easy to use Dobsonian (altazimuth) mount. Facts shows that altazimuth has a poor coordinate system in terms of astronomy due to how the sky is expanding continuously and it also depends on time and location. To prevent dealing with the changing coordinates, astronomers invented a smarter way to determine the sky object location, The Equatorial Coordinate System. The problem is telescopes with equatorial mounts are so unaffordable, especially for young students who can't make money by themselves. This project is an affordable solution to get rid of the poor altazimuth coordinate system, inspired by the GoTo Telescope downgraded to PushTo by just using cheap components people can easily find in local electronic stores alongside with some fundamental coding skills without needing any modification to the telescope itself.

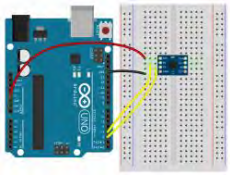

Fig 1 : Wiring Difagram

Tools, Materials and Method

Required Tools: Soldering Iron with some Soldering Material, Duct Tape
Required Materials: Arduino UNO x1, GY-25 IMU Module x1,
Terminal Strips x2, Jump Wires x4
Breadboard x1, USB Cable x1, *Arduino UNO Acrylic Case x1

Optional.

1) Solder the terminal strips to GY-25 module and install it to the breadboard. Connect the following wires to Arduino UNO; 1) VCC -> 5V, 2) RX -> D3, 3) TX -> D2, 4) GND -> GND.
2) Code the following commands; 1) Get the altazimuth coordinates out of the GY-25 module. 2) Convert altazimuth coordinates to equatorial coordinates, time and location informations are also necessary for conversion. 3) Communicate with Stellarium using LX200 protocol.
3) Compile and upload the code to Arduino UNO. Config Stellarium to recognise the device in the Telescope Control section.
4) Attach the device to the telescope using duct tape and perform a movement test.

CAUTION! Pointing the telescope directly to the sun without solar filter installed may cause irreversible blindness.

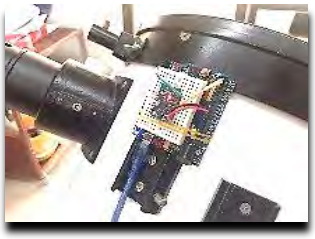

Fig 2 : The Final Prototype.

Result and Conclusions

The accuracy of this device is acceptable but not as good as expected, probably because of the high noise from the low quality inertial measurement unit module combined with errors from gyroscope drift and the highly sensitive accelerometer, also because of the decimal digits that get chopped off during the coordinate conversion process. Atmospheric refraction also affect the accuracy of this device, but it could be corrected later using sets of equation. This study suggests making one despite the advantages mentioned about the device. This is an Arduino-based project, it's known for being very flexible and ready for future development.

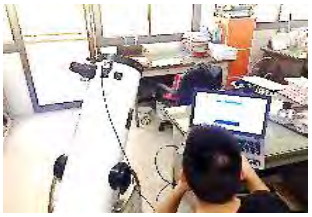

Fig 3 : Testing and Troubleshooting.

Acknowledgment

I would like to express my special thanks to Ms. Chadaporn Chuaichu who helped me a lot in finalising this project as well as Mr.Thressapong Siriboon, Mr. Matipon Tangmatitham and National Astronomical Research Institute of Thailand (Public Organisation).

Fig 4 : How the device is shown in Stellarium.

Reference

Fiona Vincent (2003), Conversion between horizontal and equatorial systems,
URL: http://star-www.st-and.ac.uk/~fv/webnotes/chapter7.htm
Nelson Ferraz (2016), Control Your Telescope Using Stellarium & Arduino,
URL:http://www.instructables.com/id/Control-Your-Telescope-Using-Stellarium-Arduino/
Meade Instruments Corporation (2010), Meade Telescope Serial Command Protocol,
URL: https://www.meade.com/support/TelescopeProtocol_2010-10.pdf
Arduino User : JohnChi, Krodal (2016), MPU-6050 Accelerometer + Gyro, Arduino Playground,
URL: https://playground.arduino.cc/Main/MPU-6050