Arduino Satellite Tracker Rotor

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Problem Definition and Background

- Antenna and satellite communication relies on clear access to the Electromagnetic Waves that are transmitted and received.
- On-ground antennas require adjusting orientation towards objects orbiting within Low Earth Orbit.

Requirements and Specifications

Antenna Rotor

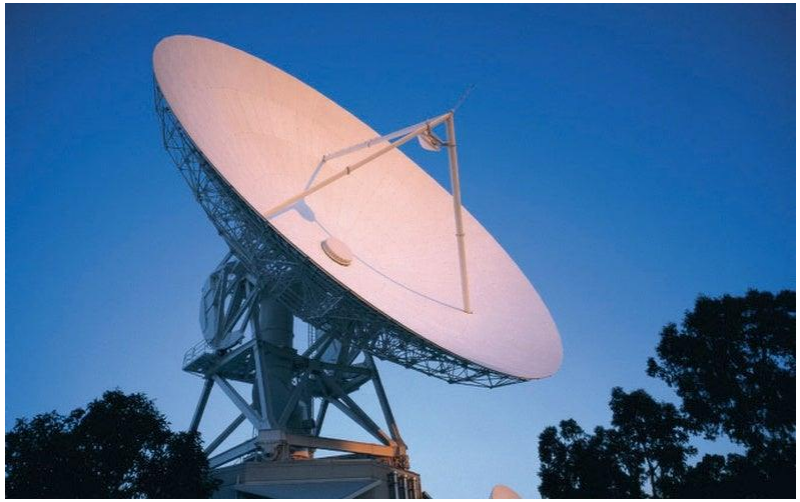
- Design an antenna rotor device that utilizes an Arduino Uno paired with Satellite Tracking software.

Portable Use

- Use plastic box to house components to enable compact, portable usage.

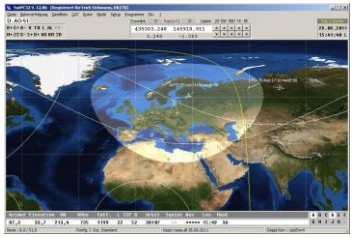
Communicate Information

- Display important information on an LCD:
  - Azimuth and Elevation Positions
  - Desired Tracked Satellite
  - Current Time

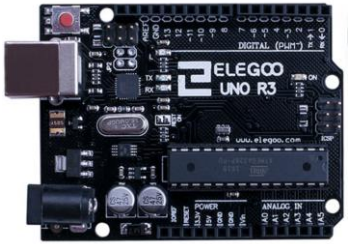


Technical Approach

Communication



SatPC32



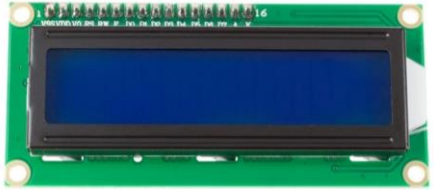
Arduino Uno Microcontroller

Orientation Control

Servo Motor

Stepper Motor + ULN2003 Motor Driver

Display Information



Liquid Crystal Display + 10K Ohm Potentiometer

Additional Pieces

Compass

Plastic Container

Power Supply Module

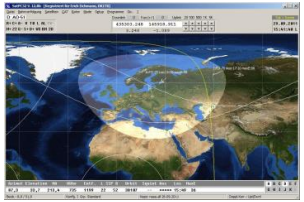
Design Decision Identification

1. Satellite Tracking:

SatPC32 utilizes orbital perturbation models to track satellites.

Calculates elevation and azimuth orientation based off user's coordinates.

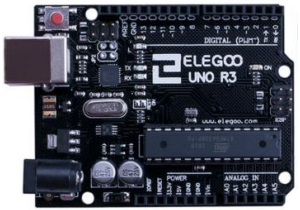
Outputs commands through serial COM port.



2. Data Manipulation:

Arduino sketch's general operation:

1. Interpret serial port and store Az./El. as variables.
2. Control stepper motor (Azimuth)
3. Control servo motor (Elevation)
4. Display information such as current SAT and time.

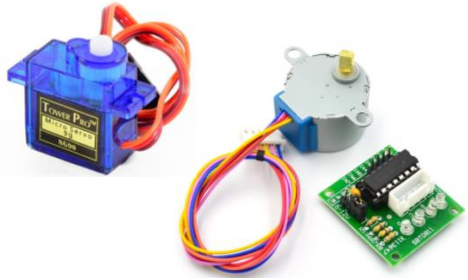


3. Orientation Control:

Rotor must orient along two axes: azimuth and elevation.

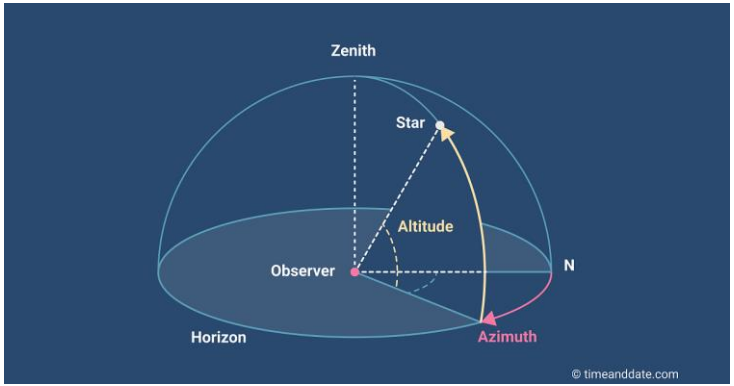
3 possible axes controls:

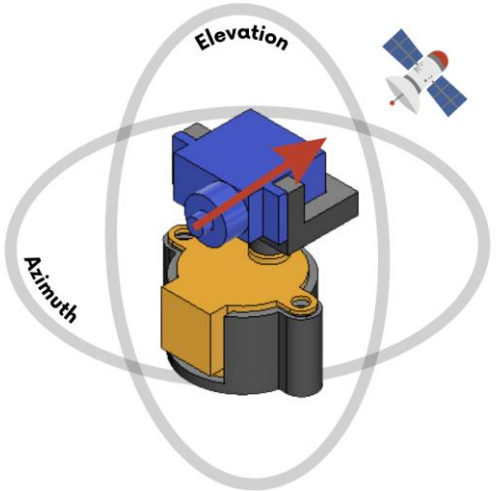
1. Servo + Servo
2. **Stepper + Servo**
3. Stepper + Stepper (Ideal)



Orientation Control

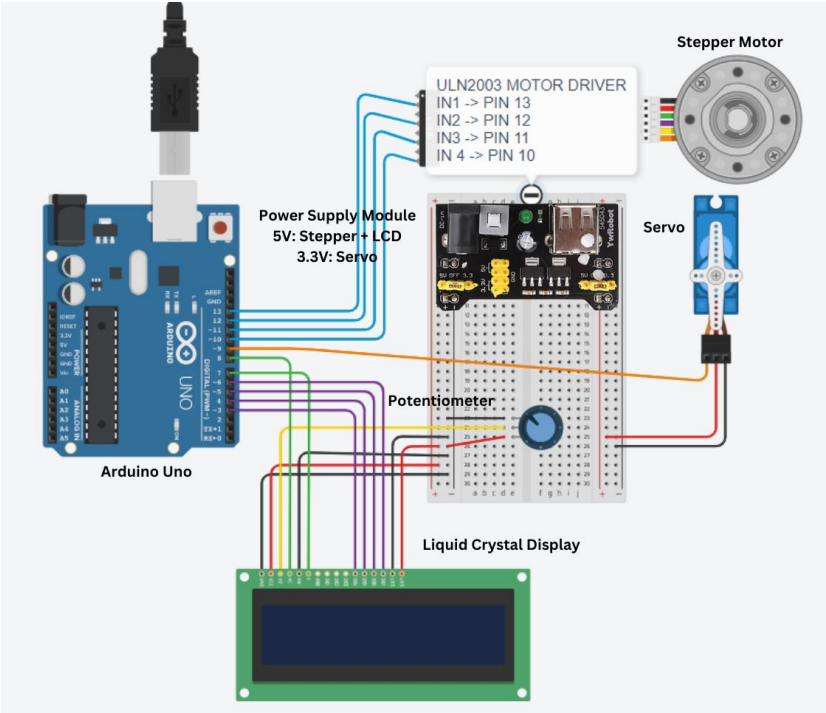
- Azimuth: Stepper Motor has 2048 steps which prevents angle error at large distances. 360 degrees is now mapped to 2048.
- Elevation: Servo motor has 0-to-180-degree control over antenna orientation.





Fusion360 Rotor Mockup

Circuit Diagram



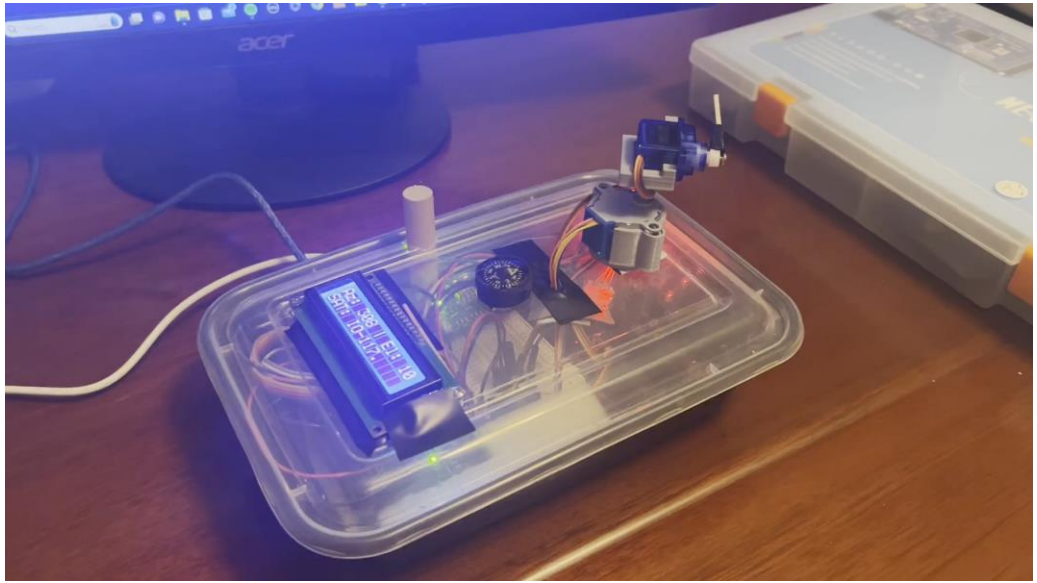
Unit can be powered one of two ways:

1. Elegoo 9V AC Adapter (outlet required)
2. Battery Pack with 9V Connector (for mobile use)

AC Adaptor

AA Battery Pack

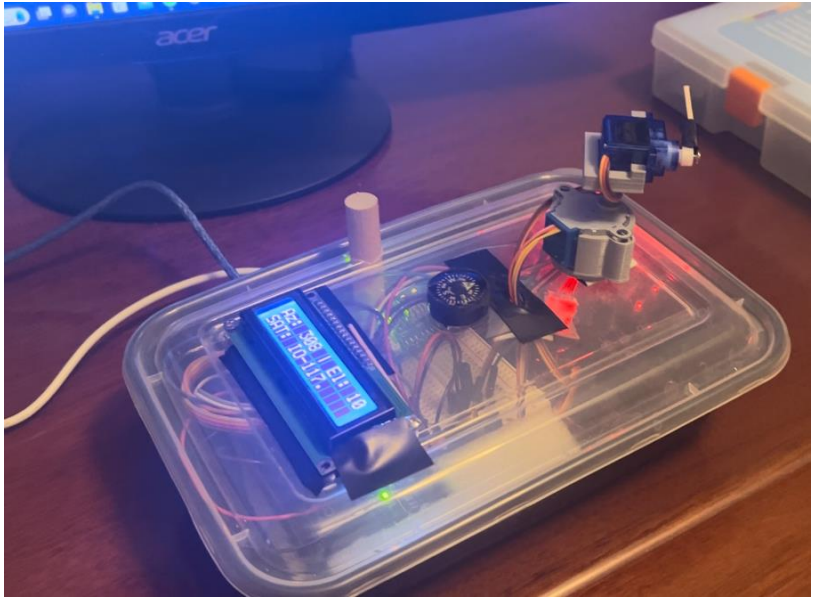
Assembled Project



https://www.youtube.com/watch?v=jSG6fBYsqfE&ab_channel=ChristianPack

Project Evaluation

- Project was a success in determining location of satellite passing by.
- Antenna rotor was tested with multiple satellites for relative accuracy.



Future Improvements

- Modified with battery pack for mobile use.
- Improve enclosure appeal and cohesiveness.
- Model antenna that encapsulates rotor for appropriate look.
- Display current time; if N/A, display next pass time.

Conclusion

Arduino Satellite Tracker can successfully provide corrected access to satellite’s passing overhead.

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