Python Telescope Automation for the Modern Eddington Experiment of 2024

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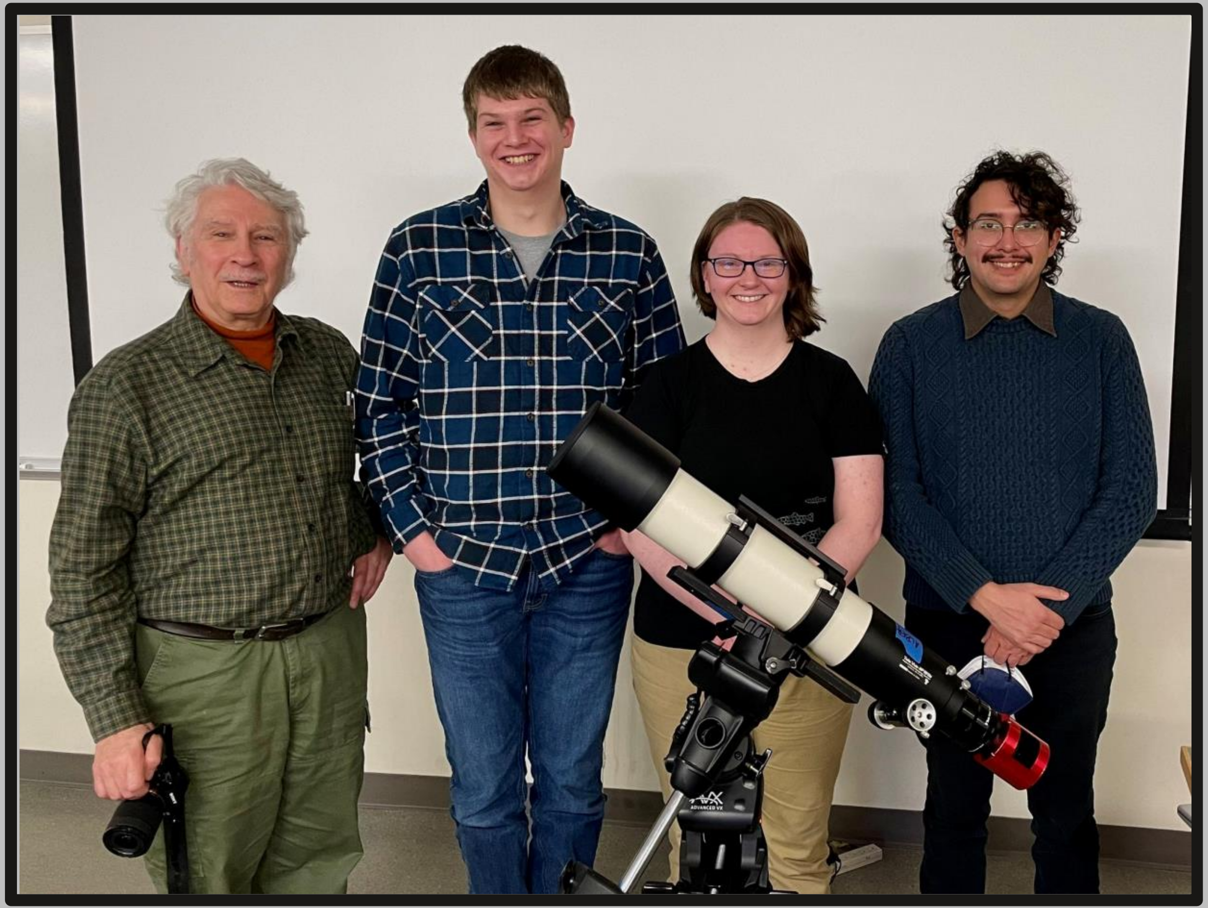
Our Team

Mentor: Richard Berry

Researcher: Kyle Gourlie

Faculty Advisor: Heather Hill

Researcher: Austyn Moon



Purpose

Create:

- Python-Based
- Astronomical Hardware Control Software
- Image Processing Software
- Educational
- Accessible
- Open Source

For:

- The Modern Eddington Experiment

Research Process

Technical Challenges:

- Scattered Information
- Fragmented or outdated tutorials
- Steep learning Curve
- Lots of trial and error

How we overcame those challenges:

- Collaboration
- Creative Solutions
- Experimentation
- Iterative development

Software Framework

- Python
  - Programming Language
- ASCOM ALPACA
  - API Server
  - All in one firmware control
- Alpyca
  - Python based ASCOM library for hardware control
- Python GUI Framework
  - PySide6

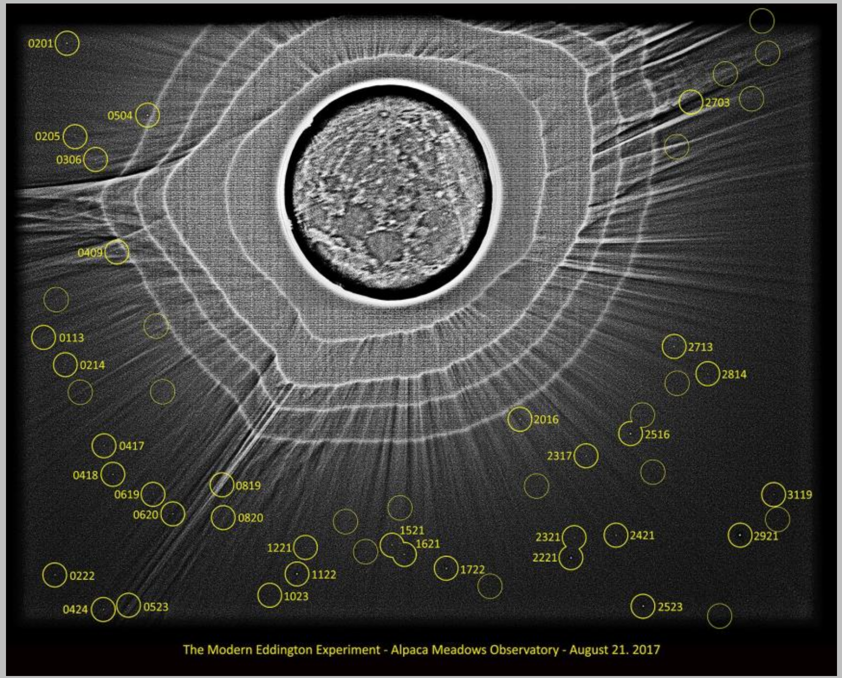
Equipment

Section (A) shows the refractive telescope, including the CCD camera and lens piece.

Section (B) includes wiring connections for all the equipment.

Section (C) is the telescope mount and tripod.

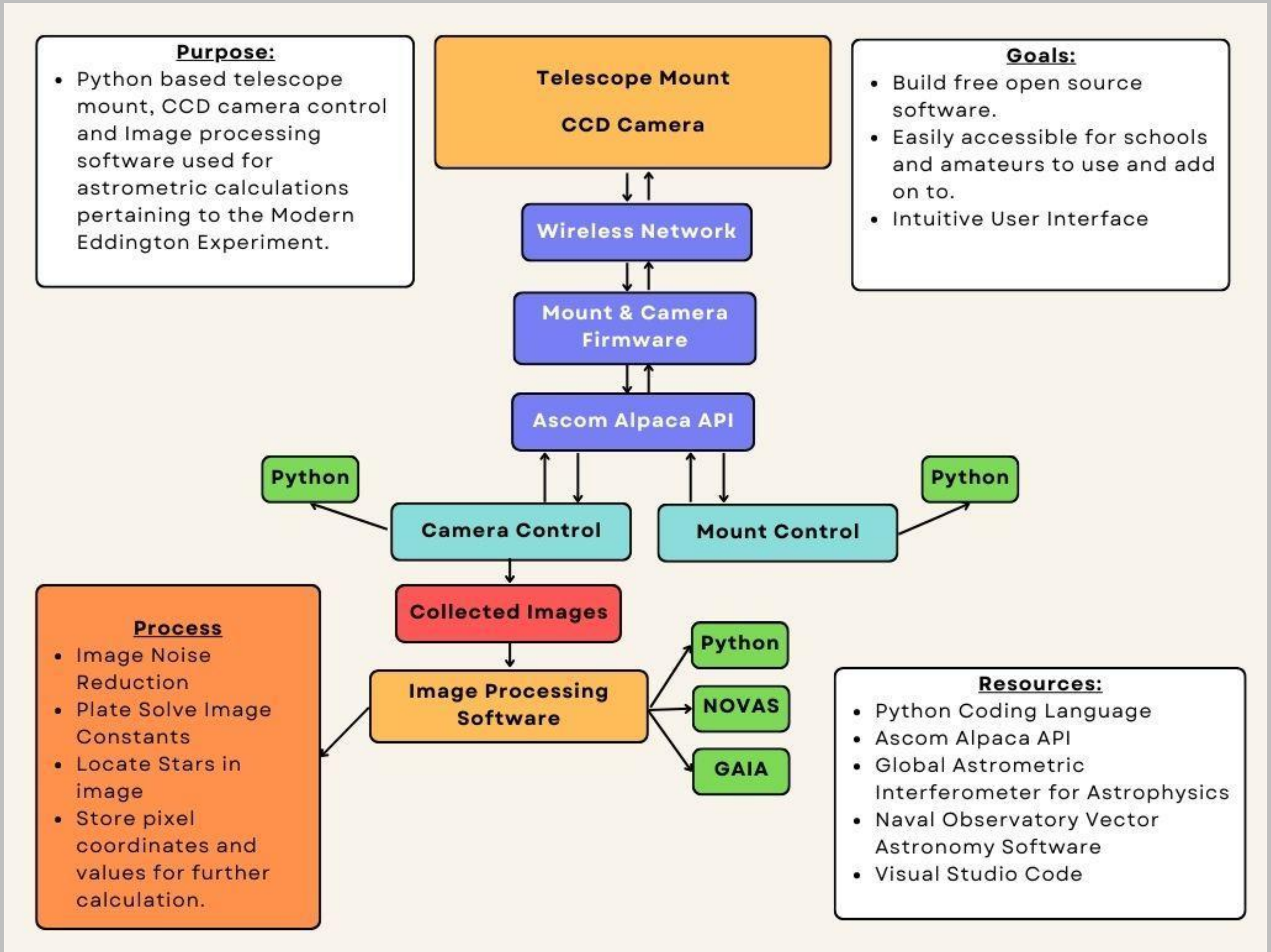
Field Work



The first test-run of the Python program in Dallas, OR. Image includes Kyle Gourlie (left) and Austyn Moon (right) analyzing how the program is running and viewing the FITS files taken of the night sky.

An image of star finding that we are trying to recreate using Python. This processed image of the Sun was taken and analyzed by Richard Berry of Dallas, OR at Alpaca Meadows Observatory following the 2017 total solar eclipse (Berry, n.d.).

Methodology



Project Timeline

Week 1: Dumpster fire (BCG)

- Discovered ASCOM Alpaca
- Discovered Alpyca

Weeks 2-4: Version 1.0

- First “operating” version
- Strictly text-based

Weeks 4-6: Version 2.0

- Became class-based with a Graphical User Interface

Project Timeline

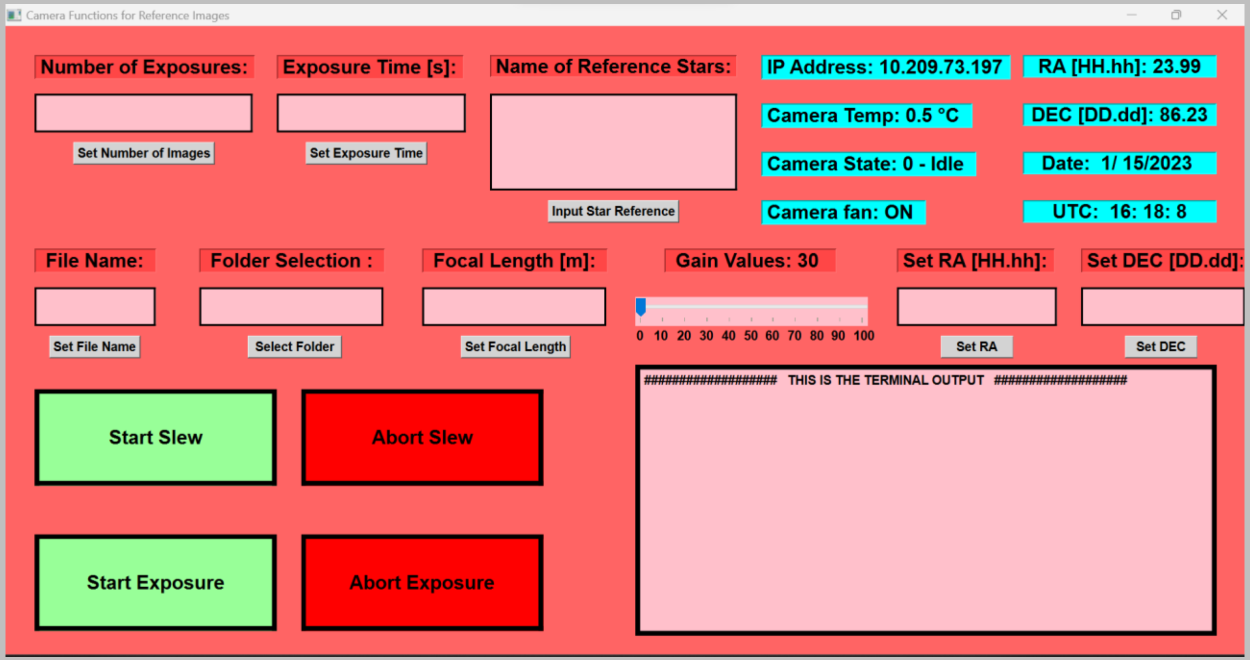
Weeks 6-8: Creation of User Manual

- Test run of the installation process
- Begin rough draft of User Manual

Weeks 8-10: Image Processing

- Plate Solver
- Centroid Finder
- GAIA/NOVAS

Results


Camera Functions for Reference Images
Number of Exposures:
Set Number of Images
Exposure Time [s]:
Set Exposure Time
Name of Reference Stars:
Input Star Reference
IP Address: 10.209.73.197
Camera Temp: 0.5 °C
Camera State: 0 - Idle
Camera fan: ON
RA [HH.hh]: 23.99
DEC [DD.dd]: 86.23
Date: 1/ 15/2023
UTC: 16: 18: 8
File Name:
Set File Name
Folder Selection :
Select Folder
Focal Length [m]:
Set Focal Length
Gain Values: 30
0 10 20 30 40 50 60 70 80 90 100
Set RA [HH.hh]:
Set RA
Set DEC [DD.dd]:
Set DEC
################## THIS IS THE TERMINAL OUTPUT ##################
Start Slew
Abort Slew
Start Exposure
Abort Exposure

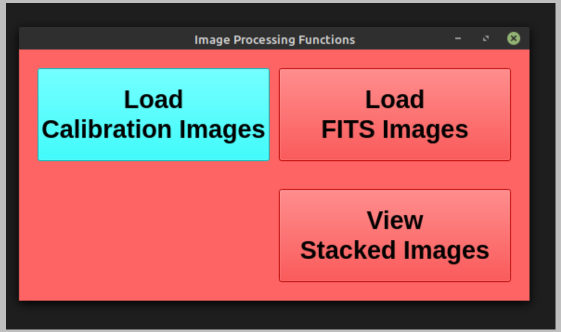
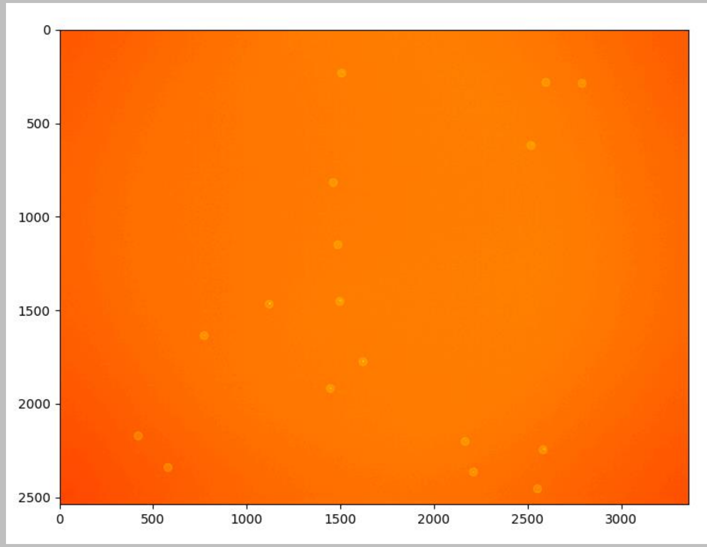


Image Processing Functions
Load
Calibration Images
Load
FITS Images
View
Stacked Images


0
500
1000
1500
2000
2500
0
500
1000
1500
2000
2500
3000

Conclusion

What we were able to do

- User-friendly Python program successfully controls telescope hardware and CCD camera.
- Telescope mount programming enables full movement and tracking of celestial objects.
- Python program captures multiple FITS images with specified exposure duration and saves data in a single file.

Future work

- Installation resources available in the form of a User Manual on GitHub (https://github.com/MEE-2024/MEE).
- Future work involves integrating image processing methods and comprehensive automation for solar eclipse imaging.
- Further exploration needed for accurate and efficient data analysis models.

Acknowledgements

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- Brionna Poppitz

Works Cited

Designer, I. Python, Logo Icon - free download on Iconfinder. Iconfinder. https://www.iconfinder.com/icons/282803/python_logo_icon

PySide6.QtWidgets#. PySide6.QtWidgets - Qt for Python. (n.d.). https://doc.qt.io/qtforpython-6/PySide6/QtWidgets/index.html

ASCOM - Standards for Astronomy. https://ascom-standards.org/index.htm

MEE. *GitHub - MEE-2024/MEE*. GitHub. https://github.com/MEE-2024/MEE

Berry, R., & Burnell, J. (2000). *The Handbook of Astronomical Image Processing*. Willmann-Bell, Inc.

Berry, R. *Richard Berry’s World-Wide-Web Site.* http://www.wvi.com/~rberry/index.html