Optimized Open Source Python Code for Raspberry Pi-Controlled Eclipse MegaMovie Photography Automatization

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Background

- The total solar eclipse of August 21, 2017 crossing the United States is a unique scientific and educational opportunity to study the solar corona by solar physicists and citizen scientists.
- The Raspberry Pi computer camera setup doubles as an affordable solution for eclipse photography and educational tool for amateur astronomers. This research involves developing the Megamovies software for the Raspberry Pi Computer setup with the following objectives:
  - Optimizing frames per second captured in bracketing and burst modes.
  - Writing image data to a USB drive.
  - Calculating eclipse contact times based on GPS location.
  - Optimizing a user friendly GUI that integrates the code.

Methods & Design

- Imaging with Raspberry Pi Camera and DSLR cameras to create an artificial eclipse. They are then able to take images with a larger view of the Sun’s Corona.
- Spacecraft, like SOHO and STEREO, place a disk in front of their cameras to create an artificial eclipse. They are then able to take images with a larger view of the Sun’s Corona.
- Only during a total solar eclipse can we observe the inner-most region of the Corona in visible (white) light.

Objectives

- Spacecraft, like SOHO and STEREO, place a disk in front of their cameras to create an artificial eclipse. They are then able to take images with a larger view of the Sun’s Corona.
- The Raspberry Pi computer camera setup doubles as an affordable solution for eclipse photography and educational tool for amateur astronomers.
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Challenges

- Interfacing pre-existing code with GUI
- Performing long operations while keeping GUI responsive
- Implementing parallel processing
- Real time text updates to GUI

Implementation

- Camera preview (toggle button) displays a 4-minute preview to assist the volunteer in focusing the telephoto lens.
- Take GPS acquires signals generated from a serial port for one minute then averages last 20 recorded coordinates to complete calibration.
- Time Precision (toggle button) implements network time protocol to synchronize the satellite’s atomic clock with the raspberry pi’s internal clock for optimized photography.
- Take eclipse uses contact times to focus burst and bracket mode photography automation.

GUI Event Timing Flowchart

- The GUI event timing flowchart displays the process sequence for taking photos and setting parameters.
- The flowchart includes the steps for taking photos, setting contact times, camera precision, and the sequence of events.

Raspberry Pi Setup: Electronics and Hardware

- Raspberry Pi boxes include two 85.60 mm × 56.5 mm planks of raft wood, four bolts, GPS hat, a Raspberry Pi, and PiCamera module. These boxes are attachable to a camera tripod (see Fig 7).
- Raspberry Pi is a small, simple computer features include: USB ports, ethernet port, HDMI input, GPU, CPU, and an SD card slot.
- User will need to load pre-configured system image.
- Requires power source, touchscreen or keyboard, monitor, and mouse to operate.

Acknowledgements

- Much thanks to the ASSURE program for making this opportunity possible, and to Dr. Laura Peti c o la s 2,3 for collaboration on this project. This project was funded by grant AGS14612277.
- Future Research
  - Future research includes continued optimization for the upcoming solar total eclipses.
  - Additional optimizations include increasing FPS during burst and bracket mode and reducing GUI lag
  - Upcoming total solar eclipses include 2019 in Argentina and Chile, 2020 in Southern Chile and Argentina in 2021, in Antarctica, and 2024 in Mexico, Central United States, and East Canada.

References

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