The SCGO AllskyPi Camera System 2020 March 08
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Background:

An allsky camera system monitors the sky throughout the night. It can be used to see what the skies look like for cloud cover and incoming weather from a remote location (even if just inside your house), keep a historic record of weather and cloud conditions, provide a gorgeous animation of the entire night and more. Many people also use it for more specific reasons, such as fireball detection or aurora imaging.

Our 1st allskycamera in 2003 was replaced with a donated system that ran from 2006 until 2018. Commercial allsky systems that used to be available trended around $1000USD +, but are discontinued as welll (Moonglow, Mallincam, Orion). So we started to look at another homemade system, with low cost, reuse of existing parts and a smaller footprint computer for the data collection. Computer electrical cost was also a consideration so instead of a desktop system we were looking at a smaller laptop, or netbook.

Figure 1

The new design:

Then along came this project: http://www.instructables.com/id/Wireless-All-Sky-Camera/ and we started along the process of developing The SCGO Allsky Camera Version 3.
It uses a ZWO ASI120MC camera (we had one from 2014)) with 1280x960 pixels colour USB2.0, and came with an ASI ° Lens Adapter 1/3" 2.1mm lens and a Raspberry Pi 3b (about $40Can).

Figure 2

It took a couple of days to assemble the hardware, a few hours to get the software installed and up and running. The system went live in December but after a few weeks, a check revealed water in the housing, along with 110vac and condensation on the dome.
A redesign led to a larger housing (12" long rather an 9"), removal of 110vac to inside the observatory, and the introduction of a 5vdc powerline for the pi and a 12vdc powerline for a heating element in the dome.

Figure 3

The dome heater is a 10 ohm 10 watt resistor running at 3vdc (=0.9watts). The dome no longer condenses, fogs or holds snow and ice. On the opposite side, the camera sensor temperature gets pretty warm (20+C) on a sunny day, so we introduced a mechanical 110vac power timer on the 3-12vdc power adapter for the heater, running only from 6pm to 6am.

As of today (2020 March 08), we have a system that covers appro 130-150 degrees of the sky (limited by the 2.1mm lens that came with the camera), biased northward to capture aurora primarily but to also avoid as much sunlight (and heat) and moonlight from the south. The software runs automatically from dusk to dawn in astronomical mode but also runs through the day an occasional image basis. Nice for weather and cloud images.

It autoexposes during the night, up to 60 seconds, archives all of the night images (317 from last night), generates a video from the images, generates a startrail (still working on that), and a keogram (cool visualization of the nights cloudcover), and then uploads them from the pi to the house file server, and ftps them up to our website. All automatically and pretty darn robust.

Our last upgrade to the system is to add dark frame processing to the imagery to remove the camera hot pixels (the camera is not cooled and has a *lot* of hot pixels).

Each nights storage of up to 540 images (at about 250KB each), .mp4 file etc takes about 150MB. Six days of data on the pi will use up approx 1GB of space. One year will be approx 60GB.

Sample Image.
The image is 1280x960 pixels covering 100 x 132 degrees. The date and timestamp is annotated on the image along with the camera sensor temperature, the exposure time and gain.
We are attempting to add on location and other information as well.

Figure 4

Figure 1 - The assembled and installed SCGO Allskypi camera system.
Figure 2 - The dome heater with a silicon bead between the dome and the lid with vent holes in the lid to the housing.
Figure 3 - The parts from the first 110vac to the housing iteration. 110vac later removed.
Figure 4 - a system image from 2020 March 01 at 03:06:15 EST showing the text annotation, a local cell tower, cloud bank and stars in a 60 second exposure with no moon, north is up, east is left, west is right.

Appendix 1 -List of materials (most of which we had on hand)
ASI120MC camera from ZWO (ASI224MC or MM works too) (approx $240 Can today)
2.1mm wide angle lens (comes with the camera)
Raspberry Pi 3 (with builtin wifi) (approx $40Can)
64 GB micro SD card (we use an 8GB) (approx $10)
Short right angle USB cable for the camera inside the housing. ($5 Can)
4" ABS pipe with two end caps ($20 Can)
4" Acrylic dome ($20 Can)
misc: small piece of wood to mount the camera, silicon to seal the dome onto the top end cap.
Total approx cost: $340 (much less if you already have spare parts).

Software:
The Raspberry pi was configured with an 8GB microsd card with the Raspbian Buster Lite distribution, using Balena Etcher on windows to put the operating system onto the card.
Then the allsky.zip software package was downloaded from the Instructables page and unpacked on the pi. We used a remote SSH terminal program (putty) from windows to do this.

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