An Extremely-Low Cost Ground-Based Whole Sky Imager

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Introduction

Ground-based Whole Sky Imagers (WSIs) provide sky/cloud images at:

- low cost,
- high temporal resolution, and
- high spatial resolution

as compared to their satellite counterparts

- Especially useful in applications where short-term and highly localized analysis of cloud images is required (e.g. solar irradiance forecasting)
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Motivation

- Although WSIs have many advantages, captured images are prone to noise from:
  - sun glare,
  - bird flocks,
  - dust particles,
  - condensed water vapours near camera lens
- Post-processing is an important pre-requisite
- Multiple imagers for the same locality might help reduce noise further
- Hence, reducing the cost of such imagers will help in overall reducing overall information retrieval cost
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Mechanical Design

Mechanical design of the WSI. A: glass dome; B: camera assembly & LDR; C: camera holder and pedestal; D: insulating polystyrene ice box; E, F: PVC Plyboard; G, H: bricks to keep apparatus in place; I: small wedges; J: slit to release hot air from the internal electronic systems; K: raised pedestal with bricks
The WSI is completely operational and is capturing images since September 2020.
Salient Features

- High-resolution images (4056 × 3040)
- Automatically adjusting shutter speeds based on LDR sensor values to capture images in low light conditions
- Local backup facility with easy handling of hard drive to avoid dependence on internet
- Online backup using ethernet cable if internet is available
- Deploys RTC to keep track of time during power outage
- Durable and low-cost chassis which is well-protected from outside heat and other weather conditions
- Extremely low-cost model (< $300) constructed with mostly off-the-shelf and readily available components
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Sample images that were captured by the designed WSI. *Starting from top left corner in a clockwise manner* - clear sky during day; thick white clouds during day; patterned clouds during day; thick dark clouds during day; almost clear sky at dusk; patterned clouds during night; thick white clouds during night; and clear sky during night.
Future Work

- Improve WSI design further by:
  - adding a cooling device for the camera sensor module separately to protect against excessively high temperatures, and
  - adding an IR-filter in front of the camera lens to diminish the effect of sun-glare and color correction
- Work on post-processing methods for the captured images to get rid of the noise elements like
  - sun glare,
  - blur due to dust particles or water droplets which might get deposited on the lens (protective dome), and
  - bird flocks
Thank you for your attention!