Paper #242

UNIVERSITY OF LAS PALMAS DE GRAN CANARIA
SIGNALS AND COMMUNICATIONS DEPARTMENT
INSTITUTE FOR TECHNOLOGICAL DEVELOPMENT AND INNOVATION IN COMUNICATIONS (IDeTIC)

CONTINUOS SKY DIGITALIZATION USING IMAGES FROM AN ALL-SKY CAMERA

Carlos M. Travieso-González[1,2], Yeremi del C. Santana-Suárez[2], Alejandro Piñán-Roescher[2], Fabián Déniz[3], Jesús B. Alonso-Hernandez[1,2], José M. Canino-Rodríguez[1], Fidel Cabrera-Quintero[1], Jose F. Medina-Padrón[3], Antonio Ravelo-García [1,2]

[1]Signals and communications Department, University of Las Palmas de Gran Canaria (ULPGC), 35017 Las Palmas de G.C., Spain
[2]Institute for Technological Development and Innovation in Communications (IDETIC), University of Las Palmas de Gran Canaria (ULPGC), 35017 Las Palmas de G.C., Spain
[3]*University Institute of Intelligent Systems and Numerical Applications in Engineering (SIANI), University of Las Palmas de Gran Canaria (ULPGC), 35017 Las Palmas de G.C., Spain*

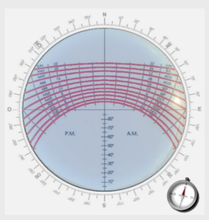
carlos.travieso@ulpgc.es

20th International Conference on Renewable Energy and Power Quality (ICREPQ'22)
Vigo, SPAIN - July 27-29, 2022

ABSTRACT

The designed networked system captures and stores high and medium resolution sky images every 2 seconds. The IP camera employed is low-cost, omnidirectional, and its images are accessible from any point with Internet connection, both in real time and to a database, thanks to the configuration of a VPN network. The images obtained by the camera can be utilised for a variety of purposes but are of particular interest for those applications where a large volume of separate images is required for the characteristics of the sky, as the system also provides an innovative method of measuring solar energy, which provides an unambiguous view of the cloud state on any given day.

DESIGN OF THE CAPTATION SYSTEM



Vivotek FE9381-EHV

- Omnidirectional IP camera designed for outdoor video security applications.
- Low-cost in comparison to specialized all-sky cameras.
- Does not include its own power supply.
- Dome must be cleaned periodically.
- Location should avoid shadows or obstructing objects.
- Camera must be attached to a horizontally level surface and oriented to the north.

Single Board Computer Raspberry Pi 3

- Provides accessibility to the camera through VPN.
- A 16GB SD card is included to support its operating system.

Wireless Access point

- Allows data connection with the images captured by the Raspberry Pi
- Does not need a data cable.

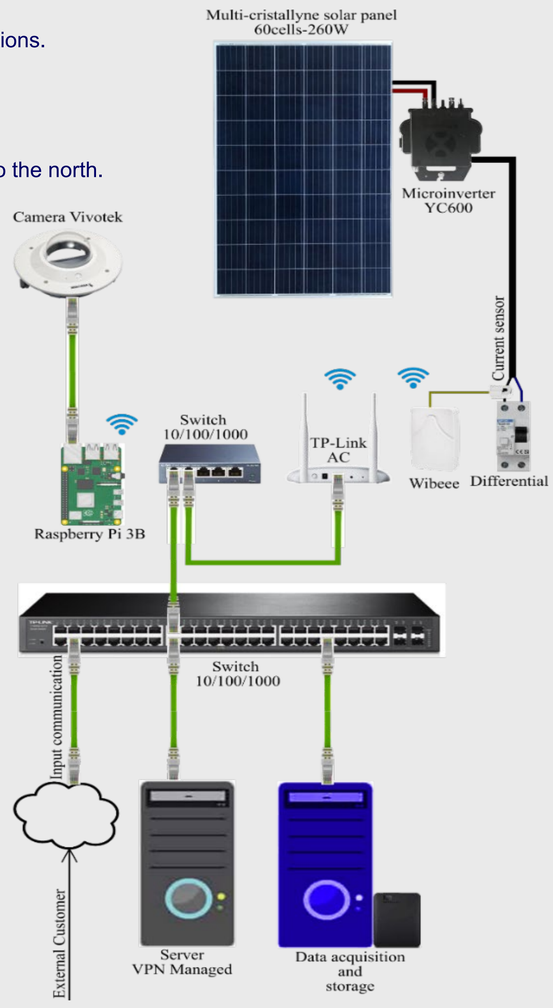
Storage Hard Drive

- Will depend on the number of images to be saved.
- Must support high speed so it doesn't act as a bottleneck.
- In our demonstration we added a 4 GB disk.

Server

- Manages communications withing the VPN network.
- Allows the user access to the different devices (web interface of the camera or the images saved in this case).
- Main specifications shown below.

Item	Description
Processor	Intel ® Xeon ®
CPU(s)	2
Memory	2 GB
Hard Disk	SSD 512 MB
Operating system	Linux (Debian)
Architecture	X86 64



Indirect solar irradiance measurement sensor

- High value in a lot of different applications.
- Can help separate the database base on the visualisation of the power curve generated from a photovoltaic panel.
- The installation of a clamp ammeter.

Technical specifications of the SunMax PV panel:

Item (PV Panel)	Description
Model	SM-SP-260W-DC-EU
Number of cells	60
Cell type	Multi-Crystalline
Nominal Power	260 W

Technical specifications of the AP system microinverter:

Item (Microinversor)	Description
Model	YC600
PV Module Power	200Wp-365Wp
Number of cells supported	60-72
Maximum output power	300 W
Standard Test Condition Irradiance (STC)	1000 W/m² (25º)
Cell Temperature	25º

Image acquisition and storage equipment

- Includes all the equipment necessary to create and store a medium and high resolution version of the images.
- Main specifications shown below

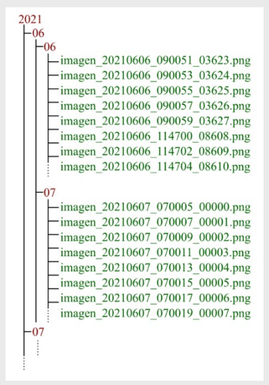
Item	Description
Processor	AMD Phenom ™ II X4 955
CPU(s)	4
Memory	8 GB
Hard Disk	SSD 256 MB
External Hard Disk	SSD 4 TB
Operating system	Linux (Debian)
Architecture	X86 64

DIGITALIZATION: STORING ALL-SKY IMAGES

- Two scripts are utilised to capture the images and classify them in an organised and intuitive manner.
- Details about the software setup are especified below.

Item	Details
Base system	Linux
Development software	C, scripting Bash and Python
Graphical user interface	Console
Secure networking	Scurity Shell (SSH)
Timekeeping	Network Time Protocol (NTP)
ASC control	All-sky camera software

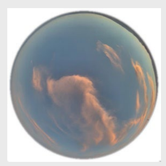
- First script carries out proper image acquisition.
- Second script stores the images in chronological order with a directory in year/month/Day sequence as shown in the image.
- A second directory is also created to store image resized to 400x400 pixels.



RESULTS

- Chosen camera location.

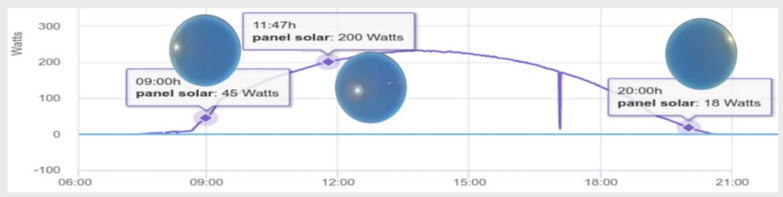
- Files can be visualized from the hard disk or through the web interface provided by Vivote.



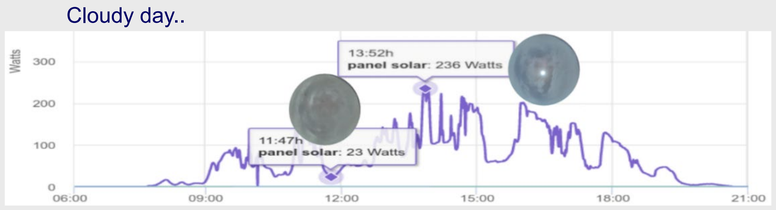
Prototype stores 1800 per hour in two different resolutions.
- 1900x1900 pixels.
- 400x400 pixels

Results of the installation omitting the devices below the switch.

- Different power curves acquired through the prototype:
- Clear day.



Cloudy day..



Clear day with high aerosol concentration