Fully Autonomous All- Sky Camera

Background

Since the invention of digital cameras, electronic units of cameras have been used as surveillance equipment with a variety of optical devices. With the development of wide-field optics, use of the digital cameras for obtaining data from a large field of view has grown rapidly. These types of wide-field cameras are being used in monitoring the sky for various scientific research and known as hemispherical, whole sky or all-sky cameras. These cameras have a field of view 180º which is a unique advantage, thus any activity in the sky can be recorded optically. Ground based all-sky cameras are frequently used in meteor detection, extrasolar planet detection and gamma ray bursts detection in the astronomy field. In atmospheric physics the all-sky cameras are being used in monitoring cloud formation, measuring solar irradiance levels and for confirming satellite weather data. These cameras are used in security and defense for monitoring, locating intruding aircrafts and drones.

Technical Problem

All-sky camera units are expected to function continuously with minimum human supervision. The already available camera units fulfill this requirement by allocating a human user who is dedicated to maintain the unit. When maintaining a large network of cameras comprising of all-sky cameras it is difficult to sustain unless each camera unit can function independent of human supervision. The camera units will be located in remote places to avoid the light pollution wherein, in case of a malfunction maintenance will be laborious. Therefore, this type of unit should either comprise of intelligent electronics to assess the problem or allow a user to fix the problem by remotely logging to the device. As the device is exposed to intense heat from sun and dust the exterior casing of the device should be insulated and proper ventilation must be allowed. At the same time the enclosure should be able to protect the electronics from rain and humidity wherein the enclosure should be specially designed with selected materials. Another main technical problem of the available devices is lack of security. During the daytime direct sunlight can saturate the camera sensors and in a cloudy situation the light level of the camera will not be enough to form detailed images. Moreover, changing of splintered light streams coming from the gaps of the clouds may put strain on the camera's ability to obtain a detailed image. Thus, the camera should have a shading mechanism to shade the excessive light.

Technical Solution

The all-sky camera unit fabricated here comprises of a single board computer and sub variant electronics thus, the unit acts as a peripheral of network which can communicate

with a remote computer. This eliminates the requirement of human supervision or external computer allowing the camera unit to execute the software written by us which controls the data acquisition, storing, transmission and other utility actions. When maintaining a large network of camera units each device can be connected as a node using the Internet of things technology (IoT). A user can remotely log in to the device for troubleshooting and the in situ single board computer is programmed to create a log report of all the error reports. The camera unit is Bluetooth and Wi-fi device is flexible to available facilities. Inside the dome a small strip with arc shape is connected to the servo motor where the strip is pivoted from. When maintaining a large network of camera units each device can be connected as a node using the Internet of things technology (IoT). A user can remotely log in to the device for troubleshooting and the in situ single board computer is programmed to create a log report of all the error reports.

Advantageous Effects

The functional parameters of the camera unit allow the user to change the functionality of the processing unit and other sub variant electronics according to the user's preference. This includes controlling data transmission such as selecting network connectivity of the unit, data transmission rate, end receiver of the data and encryption. Further the unit's functionality such as enabling and disabling of the ventilation fan, sun shading mechanism, synchronization of the clock with other units can be controlled remotely. This type of broad remote controlling features is not available in the counterparts of the camera unit. The autonomous camera unit makes reasoned decisions based on the software instruction in functions such as obtaining images, controlling the sunshade, establishment of communication with the server, acquiring time and synchronizing with other camera units.

Industrial Applicability

The camera unit can be actively used in many industries which require wide field monitoring of the sky. Similar units are being used in the meteorology field for acquiring ground-based data regarding cloud cover. A network of these camera units combined with machine learning algorithms is capable of measuring direction of the cloud movement, altitude of the formation and specially the movement of night time clouds. In the solar panel industry before laying an array of solar panels in a particular place a prior research must be done to analyze the level of solar irradiation level. This irradiation level is measured throughout the year to understand obstruction of sunlight due to cloud cover. As this invention contains a programmable SBC the unit can be programmed to measure irradiation level of a large area by launching multiple units. Aerospace technology is another industry which benefits largely from wide-field sky monitoring for tracking airplanes, satellites and low orbital objects. The camera unit's ability of measuring the trajectory of any visible objects plays a large role wherein two or more camera units are capable of detecting altitude of the object.

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