Executive summary

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Project Name:

Self-adjusted Photovoltaic device

Purpose:

Puerto Rico is facing a very serious power shortage. Many houses are dark in the night, which may cause much chaos. Our device can help light Puerto Rico at night, and support some other electrical devices.

Main parts

Raspberry-Pi with GPS module (Used for collecting GPS data and computing the Altitude of Sun and the solar Azimuth), Stepping motors (rotate solar panel around two specific axes), LED light, Rechargeable Battery, Solar panel, the skeleton of the device, and other materials such as electric wires.

Main functions

First, we place the device on a plane. The Raspberry-Pi starts to collect the location data via GPS module and the gesture information via posture sensors. Moreover, it then computes the direction angles, and pitch angles of the solar panel desired. According to those angles, the Raspberry-Pi can rotate the solar panel, so it faces the sun directly. The solar panel is designed to transfer the solar energy to electrical energy stored in the rechargeable battery. Later the battery can support the LED light.

Main problems and solutions

1.How to use the GPS data and other data to work out the altitude of the sun and the solar azimuth.

We applied some geometric knowledge to design an algorithm, which can be used to compute these angles according to the longitude, latitude, time, altitude of a given place.

2.How to adjust the solar panel according to calculated angles so that it can face the sun directly?

We use two stepping motors to control the rotation of the solar panel. One is for the rotation around the vertical axis, while the other is for the rotation around the horizontal axis. So we can make the solar panel face the sun directly by rotating it around different axes.

3.What if the device is placed on a plane that is not horizontal?

First, we establish a coordinates system with the slice of the earth, which pass the given place, and the vertical line of the slice.

Second, we use the spatial vectors to represent the incoming light and the plane in which the device is placed (According to the data from GPS module and posture sensor).

Finally, we do some vector operations to work out the projection of the light in the plane, which is the direction of the device, and the angle between the light and the plane, which is the angle that solar panel should rotate around the horizontal axis.

4.What if we need some special components during the assembly process, such as an un-standard gear?

We can use the 3D printing to make some small special components.

Advantages

Compared to the traditional photovoltaic device, our device can keep on adjusting itself to face the sun directly so that there is more solar energy being transferred to electrical energy per unit area of the solar panel. That means our device can produce more electrical power than the traditional solar cells in the same coverage area.