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Localization Position Control Based On Video Segmentation Using MATLAB

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Abstract

In this work we propose an innovative system for tracking the sun which is based on the use of a web cam as the sensor element. A practical electro-mechanism was designed and developed to evaluate its accuracy and centroid angle in tracking the sun under different sun position conditions. The impact on the system performance caused by intermittent cloud cover and temperature changes were also analyzed. The system showed a centroid of the sun and high immunity to temperature variations. It established to be able to track the sun, as well as extrapolate its location in day time sun. The aim of this paper is to make a prototype of a counting sun frames tracking system video based by using the MATLAB-Simulink programming tool. And then try to measure its accuracy. And finally, conclude in which situations this system is more reliable and therefore find its advantages and drawbacks.

Keywords

Solar tracking system, sun tracker, webcam as a sensor

Introduction

Solar collector systems require high-precision solar trackers to increase their photovoltaic efficiency [1]. The trackers is use apply discrete elements such as light dependent resistors or photodiodes to establish the approximate location of the sun [2]-[4]. One of the main drawbacks of using this type of sensor is its high sensitivity to environment conditions such as temperature and evaporation [5]. To overcome this drawback, solar tracking systems which currently present a better performance and accuracy depend on sophisticated control systems [6], [7] and complex electronic circuitry. Moreover, their installation and maintenance costs are usually very high [8]. Very few alternative solutions have been proposed [9]-[11]. The use of low cost webcams as sensing elements in solar tracking systems has not been explored previously.

Webcams provide a highly developed technological platform that can be easily adapted to any type of solar tracking mechanism. Worth mentioning that in most of the solar concentrators, computers are frequently used to monitor and registering information regarding the amount of energy obtained, so that in most cases a computer is available and it does not imply any additional inversion [12].

Materials and Methods

A commercial plug and play webcam was used (Genius 312S), it offers an image resolution of 640 x 480 pixels. A polarized filter of welding mask was fitted to the webcam to prevent saturation of the charge-coupled device when solar radiation is very intense. The filter was also found useful to develop a real time pre -binarization of the image, see Fig.1. This pre-binarization speeds up the process of locating the sun.

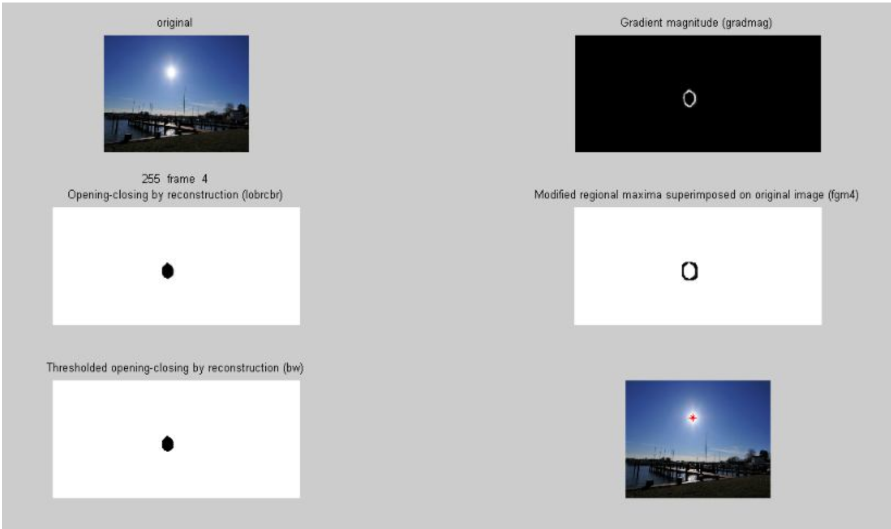

Fig.1 processing of fourth frame

a) Result of real time Pre- Binarization

b) Calculus of the coordinates of the centroid. The webcam was connected to a personal computer through USB port. We used MATLAB to implement a simple image processing algorithm on the incoming frames. Finally, the electronic control signal was output via the printer port of the computer Fig.2.

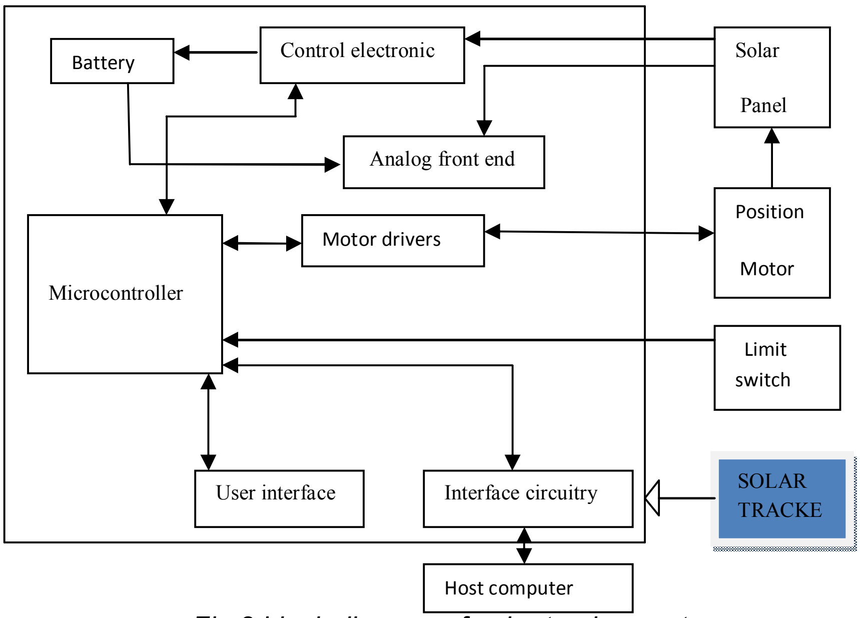

Fig.2 block diagram of solar tracker system

The system evaluate the centroid of the sun and its coordinates, then they are forced to match with the coordinates of the center of the image or the coordinates defined by the user, this is achieved by sending the necessary control commands through the printer port to an dc motors controller. The control program can be advised to set the coordinates of the sun at different location on the screen. When the location of the sun changes and either of the two coordinates varies the system sends a digital signal via the printer port to the motor associated with the corresponding coordinate. The signal achieved is corresponding to the error into the value of the coordinates. The tracker was completed on a purpose-built electromechanical system with two degrees of freedom, Fig.3. A direct current motors controller previously designed was used to convert the control commands provided by the computer into electrical pulses for the motors. Pulse-width modulation was used with a frequency of 10 kHz.

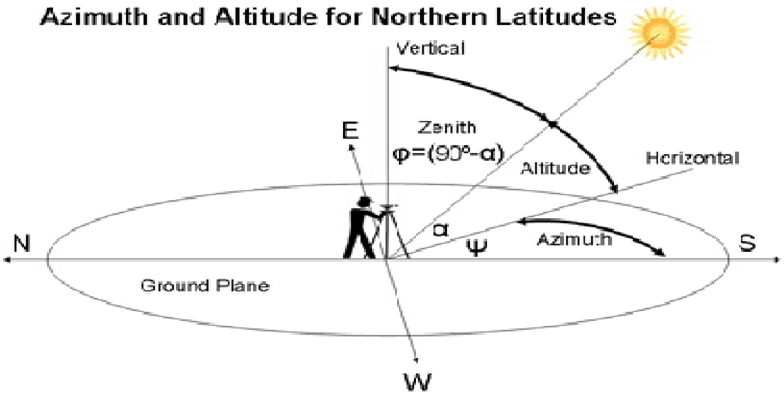

Fig.3 centroid angle

The software MATLAB allows the user to see the image of the sun in all frames of video and to adjust the coordinates in which the centroid of the sun must be fixed. The system was adjusted in the direction of sun, with moving dc motor. The motors were manually activated from the computer keyboard and the charge-coupled device was moved until the image of the sun appeared highest value on the screen. The tracking program starts running. The system was tested working under different environment conditions and also different north-south and east-west orientations were used. To calculate its accuracy a graduated scale was adapted exactly at the focal length of a concave glass.

Results

Once the solar tracking program is running, the image of the sun does not move on the screen, since the control fixes the S(x, y) coordinates. When a passing cloud prevents the sensor from “seeing” the sun, the tracking system holds at the last known location of the sun. When the sun reappears within the charge-coupled device limits, the original location of the sun on the screen is automatically re-established by the motors. The movement of the motors is soft enough to avoid affecting the quality of the image of the sun on the screen. If the sun is partially detected by the sensor, the location is located at the centroid of the partial luminous object. The overall accuracy obtained was higher than 0.24º. Environment conditions such as temperature and evaporation did not affect the accuracy of the tracker. Tracking results were the same in all north-south and east-west orientations. This characteristic allows for data to be collected from web cam connected as sensor to the solar collectors.

I1(no of frames)	Φ (angle between sun deflection)	angle Φ + sun deflection
1	63.7647	63.7647
2	1.2920	65.0567
3	1.0467	66.1032
4	1.0672	67.1704
5	0.9139	68.0843
6	0.7942	68.8785
7	0.8583	69.7368
8	1.0090	70.7457
9	0.6347	71.3804
10	0.4911	71.8716
11	0.6202	72.4917
12	0.7400	73.2317
13	0.2405	73.4722
14	0	0
15	0	0
16	0	0
17	0	0
18	0	0
19	0	0
20	0	0

Fig 4: Centroid angle

Conclusion

The use of a commercial webcam as the sensor element allowed us to avoid most of the common problems usually presented on the solar trackers currently in usage. One of them is the high sensitivity of the discrete elements such as photodiodes or phototransistor to environment conditions, especially to temperature and evaporation. Another important aspect to consider is the rapid deterioration that may occur in discrete elements under extreme environment conditions and the cost of the constant maintenance that this implies. Installation procedures of discrete elements are also more complex and critical to achieve the desired level of accuracy. The system that we propose does not present most of these drawbacks. The electronics needed to activate the motors are simple and the system can be applied to any electromechanical com location. With minor arrangement it can be used with various types of collectors including parabolic trough, Fresnel lens, parabolic dish flat-plate, compound parabolic, evacuated tube, and heliostat field collectors.

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