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ECONOMICAL TRACKER FOR SOLAR POWER PLANTS

The article discusses an energy-efficient sun tracking system using a solar panel as a light-dependent sensor. Changing the properties of the solar panel does not affect the detection algorithm, so it easily avoids the problem of false alarms.

Key words: economic tracker, solar panel, sensor, false positive

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ЭКОНОМИЧНЫЙ ТРЕКЕР ДЛЯ СОЛНЕЧНЫХ ЭНЕРГЕТИЧЕСКИХ УСТАНОВОК

В статье рассмотрена энергоэффективная система слежения за солнцем, использующая в качестве светозависимого датчика солнечной панели. Изменение свойства солнечной панели не влияет на алгоритм обнаружения, поэтому легко избегает проблемы ложного срабатывания.

Ключевые слова: экономический трекер, солнечная панель, датчик, ложное срабатывание

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КҮН ЭНЕРГИЯСЫН ОРНОТУУЛАР ҮЧҮН ЭКОНОМИКАЛЫК ТРЕКЕР

Бул макалада күн тактайчасынын жарыктан көз каранды датчиги катары колдонулган күн үчүн көз салуу энергетикалык системасы каралган. Күн тактайчасынын касиеттеринин өзгөрүшү таасир алгоритмине таасир бере албайт, ошондуктан ал жалган иштөө көйгөйүнөн сактайт.

Ачкыч сөздөр: экономикалык трекер, күн тактайчасы, датчик, жалган штөө

The position of sun varies from time to time and season to season due to earth’s continuous and periodic rotation and revolution. As a result it has become necessary to locate the position of sun for a particular moment. The locations are placed on a special type of chart named Sun Path Diagram. A Sun Path Diagram shows the azimuth angle, elevation angle, sun paths throughout the years, sunrise and sunset time etc. [1]

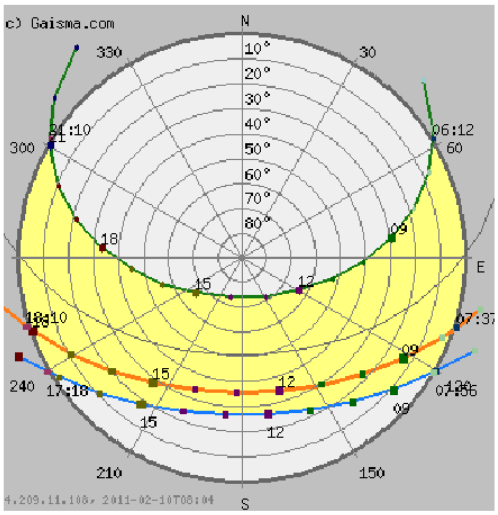

Figure1. Sun path diagram

Photovoltaic (PV) technology is the technology of converting the solar energy into electrical energy. The efficiency of such an energy conversion without tracking is inefficient. Solar system efficiency depends on solar radiation, ambient temperature, wind speed, optimal matching of the system with the load and appropriate spatial placement of the module at optimal inclination angle to the horizontal plane.

Figure2. Solar tracker

Solar trackers are the devices that track the solar path throughout the daytime and orient photovoltaic panels, reflectors, lenses or other optical devices toward the sun. Since the sun's position in the sky changes with time (about 15 degree per hour) and the altitude angle and azimuth angle varies continuously, trackers are used to align the collection system to maximize energy production. Several types of single-axis tracker and dual-axis trackers have been developed in the last decade after the development of light sensitive sensors.

The solar tracker proposed here has one degree of rotation. The solar tracker can track the sun only in horizontal direction (that is, from east to west). The algorithm is based on the difference of solar irradiance at different position. Voltage detected by the solar panel at different position will be compared and the optimum position will be found. The motion of this tracker panel is controlled by a variable reluctance stepper motor. The tracker sensor is a 5 Watts solar panel. For large scale power plant project, an individual tracker, placed on a high tower can be used to detect the position of sun and then the data can be used to rotate a set of solar panels to that specific direction according to signal. The design has three main units-

- Position Sensor Unit
- Motor Unit
- Controller Unit

The sensor unit performs the detection of difference of solar irradiance due to chance in position of sun. The control unit decides on the motion of tracker analyzing the input detected by sensors and sends necessary signals to track the sun. The motor unit performs the tracking operation physically. Hence the control unit is a connection between the other two units.

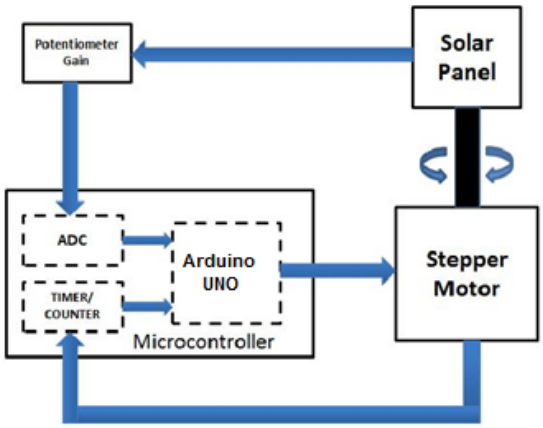

Figure3. Block diagram of the system

Initially the microcontroller reads voltage from the output of panel. The voltage is read through the ADC channel of the microcontroller. The input data is compared with a preset threshold level. Tracking is initiated when input data goes above a preset threshold level. The panel is first rotated clockwise by a step and then counter-clockwise by two steps. Then it returns to its initial position. [2]

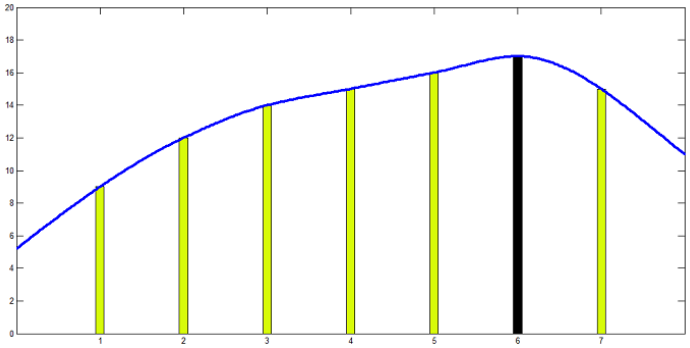

Figure 4. Optimum position detection (Black bar indicates the optimum position)

The position at which the sensed voltage is found higher indicates the direction of path of the sun. This direction is set as default for that search operation. Then the panel is rotated to that direction step by step with specified interval.

Voltage is measured after each step. This data is compared with the previous data stored in memory. The process continues as long as the voltage is increasing. After crossing the maximum value (the optimum position) when the voltage read at the next step is found lower than the previous data, the panel rotates back to immediate previous position. This is the optimum position for maximum power at a certain load.

Once optimum position is found the microcontroller sets on the timer and waits for next loop of operation after a preset time. This process will continue until reset button is pressed. The flow chart of the tracking operation is shown in the following figure. [3]

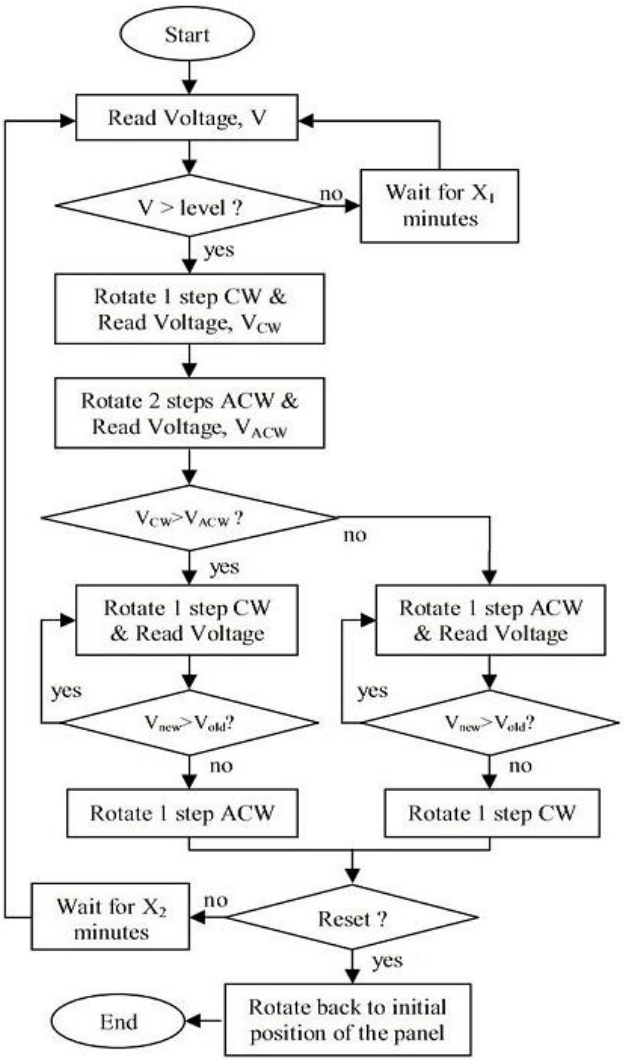

Figure5. Flow chart of the algorithm

Solar energy is an unlimited source of energy. Solar tracker is used to harness this energy with more efficiency. This paper has demonstrated the implementation of solar tracking system in a cost effective way. Generally, direct use of output data from solar panel makes the system independent of light sensor that requires external biasing circuit. The use of stepper motor ensures more accurate tracking with minimum error. Thus, the proposed design offers a better solution to the implementation of solar energy.

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