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ELECTRIC DRIVE FOR PHOTOVOLTAIC MODULES DUAL AXIS TRACKING SYSTEM

Svilen Rachev[*]*, Lyubomir Dimitrov*
Technical University Gabrovo, Faculty of Electrotechnics and Electronics,
4, Hadgi Dimitar str., 5300 Gabrovo, Bulgaria

Abstract: The paper deals with the implementation of dual axis tracking system for photovoltaic modules in order to demonstrate the advantages of these systems in education. According to the main components – the system includes electronic module for control and two DC motors for each of the axes, respectively.
Keywords: renewable energy, PV modules, tracking system.

1. INTRODUCTION

One of the main tasks in the implementation of photovoltaic systems (PV) is their effective operation for producing electrical energy from renewable energy sources (RES).

One of the PV system features is their constructional variety which leads to a large number of criteria for classification. According to the type of PV cells used there are the cells built on mono-crystalline silicon, poly-crystalline silicon, cadmium tellurite, as well as thin film structure. In addition, there are other types of new PV cells which are currently in the development stage. [2].

The method of electric loads connection is also one of the main criteria for classification of PV systems. In relation to this, PV systems can be subdivided into stand-alone, hybrid and grid-connected systems.

2. EXPLANATION

For effectiveness of PV systems the position toward the sun is very important. Usually PV modules are set at an angle toward the horizon which is equal to the angle of latitude [1].

The position will be more efficient if the inclination angle is changeable during the seasons. The so-called tracking systems allow a change of module inclination angle toward the sun azimuth at every moment. These systems have a movement along one or two axes. The best operation of these systems is in the areas with temperate climate.

In case of a single axis system the module follows the sun movement from the East to the West only. The angle between the module and the horizon is not changeable. During the day the PV module is orientated mostly to the sun but not always exactly toward the sun.

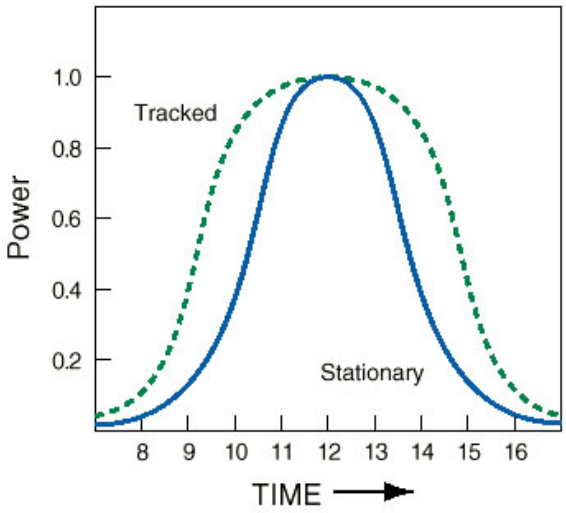

Figure 1. Output power of PV systems

This disadvantage is overcome by means of a dual axis tracking system where the module follows the sun from East to the West but at the same time the inclination angle toward the earth (horizon) changes. There are two methods here: by means of sensors for solar irradiation or by preliminary assigned coordinates for movement of every tracker in accordance with the sun position for corresponding geographical location, date and hour. In this way, the

[*] Corresponding author: sratchev@scientist.com

module is always orientated perpendicularly toward the solar radiation; thus conditions are met for full acceptance and transformation of solar radiation. A dual axis tracking system is by far more complicated but more efficient compared to a single axis, so these systems are characterized by the most expensive constructions and electrical installations.

Tracking systems are more applicable for large PV parks built. A big number of components means reducing of additional expenditures and labor in respect to the price of one module for building of tracking systems compared to small scale projects. In this case either whole strings of modules turn around common axes or multitude of modules are mounted on poles and move as a common row around a single or two axes. In case of strong wind with a speed of 25 m/s and more all tracking systems automatically come into a position which has the lowest wind resistance and can remain intact even under a hurricane.

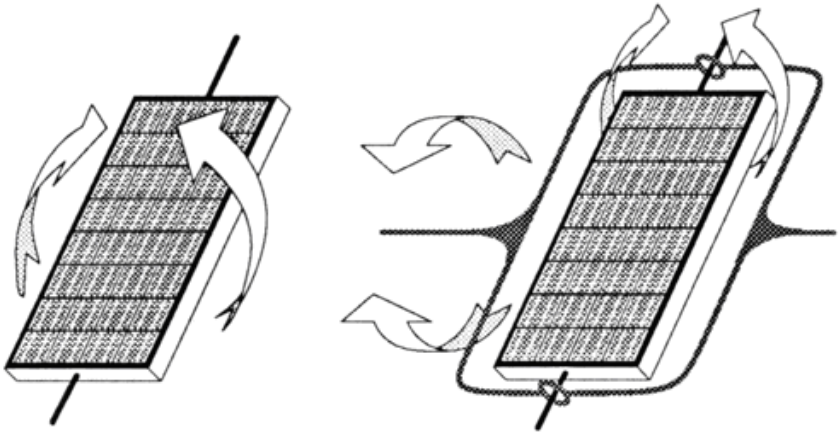

Figure 2. Single axis and dual axes systems

3. IMPLEMENTATION OF TRACKING SYSTEM

The electronic module developed always regulates the position of PV modules toward the brightest point in the sky along two axes – horizontal and vertical.

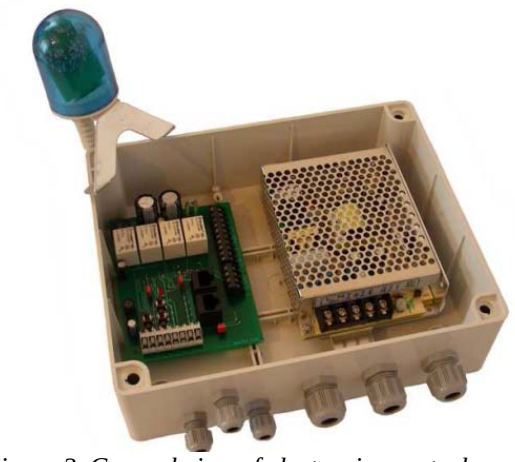

Figure 3. General view of electronics control module

One set consists of: lighting sensor, controller for the motors, assembling box, cable between sensor and controller.

According to the motors – two DC motors for two axes HARL-3612+ DC 36V 12 inch IP56 have been used. They are connected to the controller by means of a 0,75 mm copper multi-wire conductor. The operating voltage of two motors is 12V to 36V.

For motion regulation of each motor there are two limit switches which are manually adjusted. Also, every motor is equipped with a pulse counter for pulse regulation.

In order to reduce the angular speed each of the motors is equipped with a reducer which allows smoother control. The rod for transforming the rotational motion into rectilinear progressive one is designed as screw and nut. The screw is on the bearings and steadily connected to the reducer, the nut freely moves up and down and transmits its motion to the hollow shaft where it is steadily connected. The rod is equipped with joint end piece which allows disparity between support clamp and the end piece. The support clamp is also equipped with joint end piece.

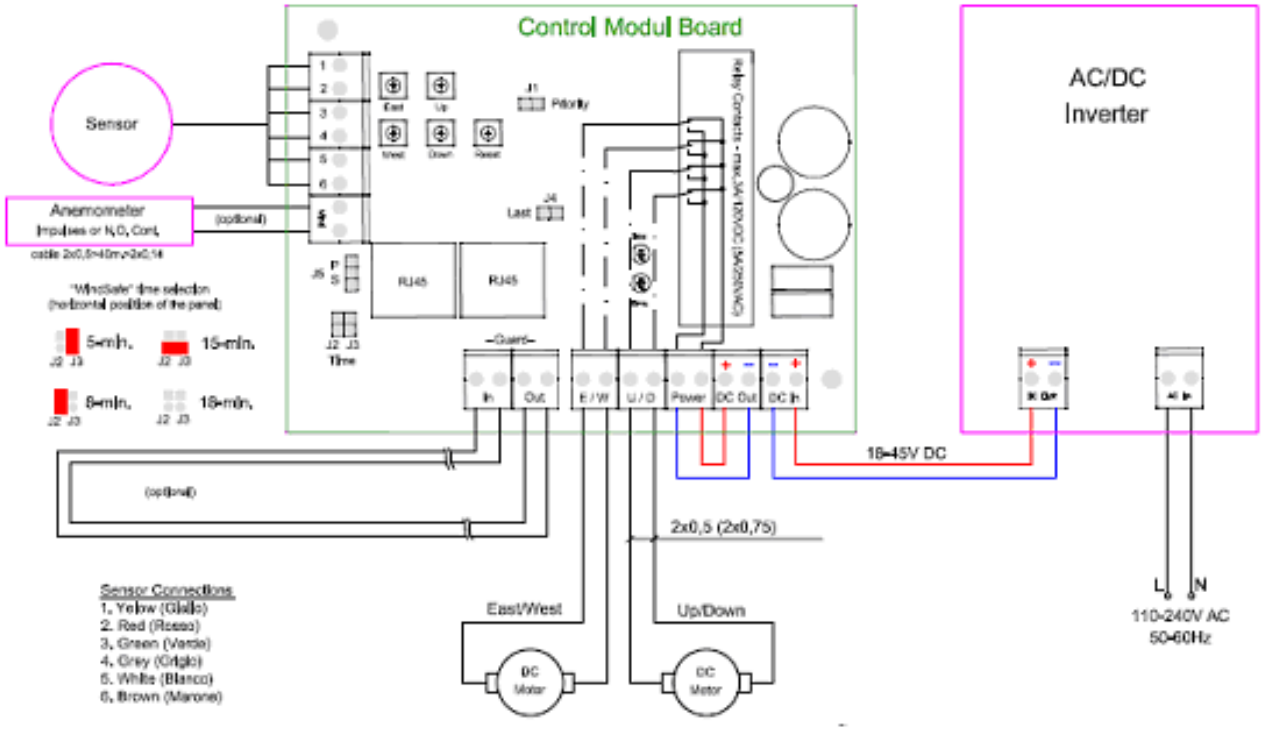

Figure 4. Connection diagram of solar tracking module

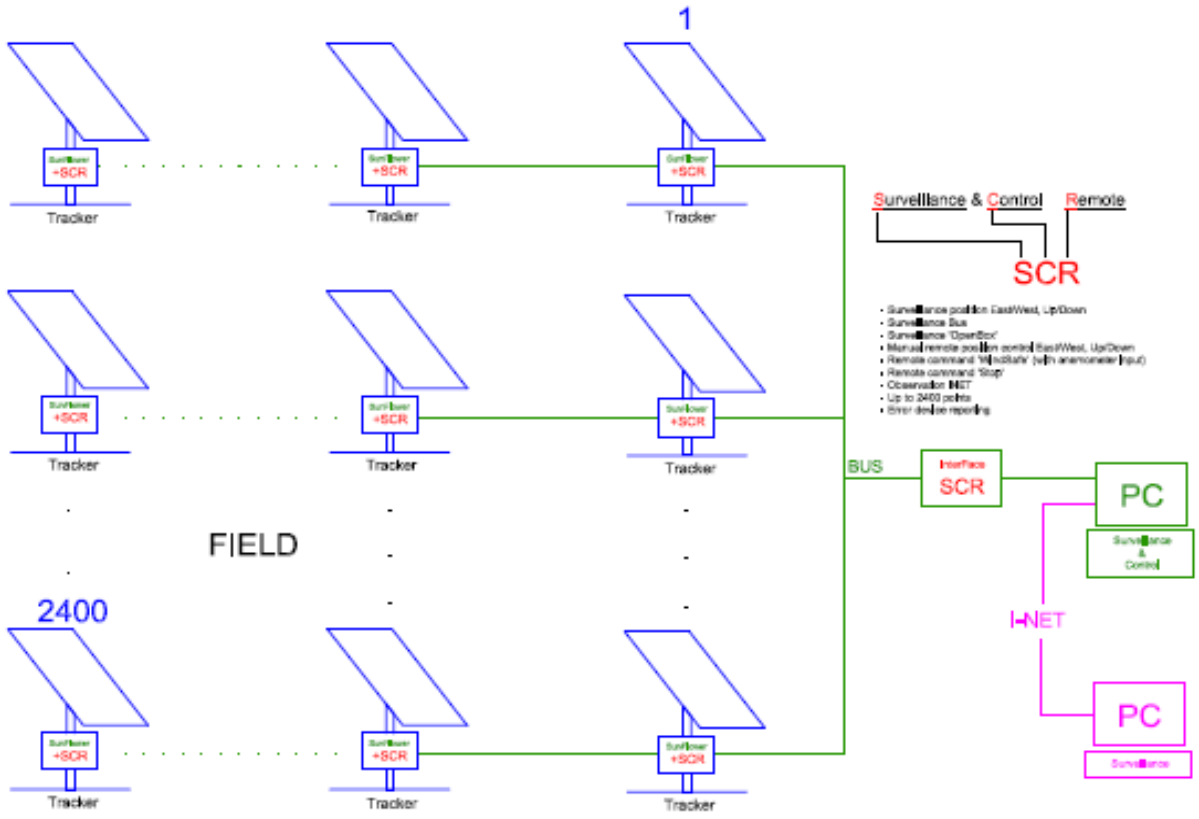

Figure 5. Multi-module tracking control system – block diagram

4. CONCLUSION

The implemented dual axis tracking system for PV modules has been presented. This system is preferable since it produces up to 20% more electric energy than energy produced by fixed PV systems. The disadvantage is a comparatively high price of such a tracking device. Nevertheless, its application in a number of projects is rational, especially in education.

Figure 6. General view of the system implemented

5. REFERENCES

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ЕЛЕКТРОПОГОН ЗА ФОТОНАПОНСКЕ МОДУЛЕ
ДВООСНИ СИСТЕМ ЗА ПРАЋЕЊЕ

Сажетак: Рад се бави примјеном двоосног система за праћење за фотонапонске модуле у сврху показивања предности ових система у образовању. Према главним компонентама – систем укључује електронски модул за управљање и два DC мотора за сваку појединачну осовину.

Кључне ријечи: обновљива енергија, ФН модули, систем за праћење.