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Article · March 2022

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Volume: 63 Issue: 6
Publication Year: 2020

A Smart Control Based On Microcontroller For Solar Tracking System

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Abstract:- In recent decades, researchers have focused on renewable energy sources to reduce the use of fossil fuels, Solar energy is an important source of energy production at lower cost and clean potential because solar cells depend on the intensity of light and the angle of radiation emitted by the sun's rays due to the Earth's rotation. Therefore, ensuring the best sunlight perpendicular on the solar cells is the focus of the research. In this proposal, a smart self-movement system is designed to track the sun's rays and keep them falling on solar panels perpendicullary at all times of the day. The microcontroller AT-MAGA328P is used to control the motion of two-axis solar panels through the use of alternating servo motors. The microcontroller adopts reading a signal from the sensors that detect the maximum light intensity. The main purpose of this proposal research is to create a smart, low-cost and efficient system by compared to research data in previous works.

***Keywords*:** smart control, solar track, microcontroller, LDR, servomotor.

1. Introduction:

Renewable energy is one of the alternative sources of energy that researchers have been interested with the increasing demand in the development of smart cities as well as the rapid progress in modern technology [1, 2].

In other word, reducing the pollution of various toxic gases in the atmosphere has encouraged interest in the use of alternative energy compared to conventional power plants such as petroleum, natural gas, the coal, etc. Which is gradually being used less in developed countries [3].

It is worth mentioning that increasing the interconnection between renewable energy and architecture in the form of intelligent solutions to generate equipment and architectural facilities thus the trend in urban design towards reliance on renewable energies, which has a positive environmental impact in reducing pollution, exclusively in the new urban areas of thought and application [4].

One of the renewable energy sources is the solar energy regardless of their types [5] which can get it directly from sunlight. There are three main ways to convert solar energy into usable energy: latent

solar energy, active solar energy and photovoltaic cells [6]. As well Photovoltaic (PV) cells were used to generate electricity in multiple applications,

It should be noted that the research process lead to the development of photovoltaic cells in both level of materials used in the cell industry and the level of using advanced cell manufacturing technology [7].

Generally the encouraging results in reducing costs lead to the manufacture and widespread use of photovoltaic cells at the level of quantitative production. Making the applications of these cells in simple systems only need very simple maintenance work. It also requires the supply of solar radiation during daylight hours [8].

The photovoltaic cell is made up of thin films of pure silicon, with small amounts of other materials added, when sunlight falls on the chips, electrons that produce small amounts of electricity will be emitted. Since the quantities of electricity produced from a single photovoltaic cell are few, a large number of cells must be grouped together to generate usable amounts of electricity [9].

The highest efficiency is to convert solar energy into electric power when the sun is vertical on photovoltaic cells. To obtain this dependence, there are several ways, including using the Light Diode Resistor (LDR) sensor to sense intensity of light [10, 11] or by putting a camcorder to take a picture and then processing it for collection or through using the Global Positioning System (GPS) that based navigation system [12].

In this paper we designed a model to track the intensity of sunlight by controlling the movement of solar panels to get the best orthogonal solar radiation. The microcontroller were used to control the movement of the two servomotors through which the solar panels were moved. this moved depend on four LDRs.A comparison was made between the results in the case of non-controlling work and the state of controlling, and the difference between them was significant. This proposal can be used in practical life.

2. Objective:

The main aim of this project is a Mechanism proposal to control of moving servomotors angel depend on intensity of light throw via comparing the fall light on (LDR) sensors.

3. Suggested Questions:

The central question that this project asks, then, is:

I. How is transform the solar energy to electrical energy with high efficiency and low cost?

Another questions that then are consequently asked are:

II. What is the effect of the controllers on converting the solar energy into electrical energy?
III. What are the best methods used to find the best response to solar radiation on solar panels?

4. Importance, relevance and impact:

The human need for renewable sources of energy in the present and future is important. It is necessary to obtain a high level of clean energy by significantly increasing the dependence on solar energy and reducing dependence on the energy generated by the burning of fossil fuels in order to reduce carbon dioxide (CO2) emissions in the atmosphere that lead to global warming problems and its toxic effects on both the environment and health. Raising the value of solar cells to a super value is desirable in order to raise the yield of solar cells to a higher value. One way to get more radiation, Solar cells should always be in the direction of the sun by using a solar tracking system. This solution is often much more economical instead of buying a larger number of cells in order to obtain higher output. This makes the solar tracking system an urgent research issue for researchers in the field of alternative energies.

5. Methodology:

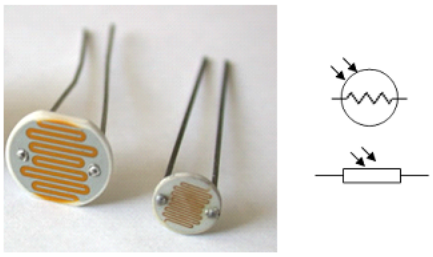
As mention in the summary of section (4) the solar tracker system is divided into three sections. The first one refers to four inputs which represent LDR sensors, the second section refer to a program in embedded software in the microcontroller and lastly the driving circuit that has the two servomotors. Whenever the sun light falls on the solar panel it accumulates the radiation and stores in it. It will send the signal to the microcontroller about differences in the power then stored in it. Microcontroller will receive this information and pass the signal to the servomotors. As the time passes the panel rotates with the help of servomotors in the correct direction.

6. Components (working and specifications)

This section will take the main components to results that possible explain it briefly as follow:

6.1.Light sensor:

The term (LDR) as **Fig**.no1 refer to Light Dependent Resistor and its resistance value changes as a result of exposure to light [13,15]. The resistance value is reduced to a small value when exposed to bright light, but on the dark side, the resistance is of high value. These values depend on the sensitivity to light of the photoresist, its size of the surface for its , the intensity of the light and the amount of light falling on it. The LDR is considered one of the reliable devices with low requirements [14]. the **Fig**.no2 show the relationship between resistance and light intensity. The advantage of this characteristic is that by changing the incident light, the resistance value will change, which will lead to a change in the passing current [16]. Thus, the voltage on the ends of the resistance will change according to the intensity of the light falling on the resistance, according to Ohm's Law. These types of resistors are used in control circuits. The figure no.1 shows the simple of LDR sensor and The figure no.2 relationship between the change in the amount of light and the resistance value of the previous photoresist. It is noted that the greater in intensity of illumination it will lead to reduce the value of resistance and vice versa.



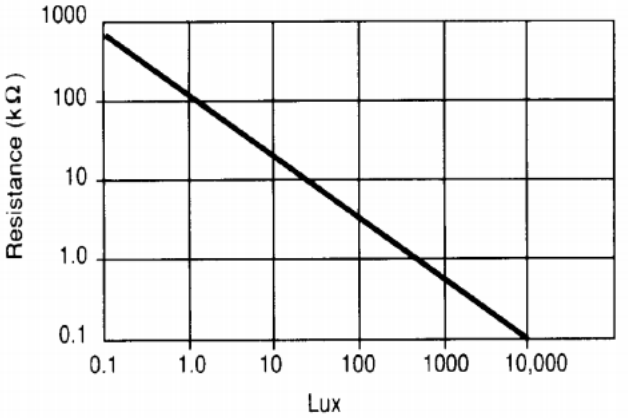


Figure 1: Simple LDR sensor

Figure 2: Relationship between resistance and light intensity.

6.2.Servomotor:

The servomotor it is a DC motor equipped with an electronic circuit to precisely control the direction and position of the motor shaft and its gear box. The main factor in determining the location of the spindle is the potentiometer, which is a variable resistance that leads to a change in the value of the voltage out of them and by the value of the resulting voltage, the electronic circuit determines the position of the spindle accurately [17]. The servo motor system must be stable in motion with limited variables to ensure no dangerous erratic movement at a low speed [18]. There are three wires out of the motor black, red and yellow. Black connects to ground and red under 5 volts and yellow control signal is a set of pulse width modulation (PWM) pulses at a frequency of 50 Hz with different pulse width depending on the direction of rotation required.

6.3.Microcontroller:

The microcontroller is one of the elements of the rapid electronic development [19]. It is an integrated electronic circuit that contains an internal microprocessor and programmable internal memory to store the control program and other memory for data processing. It also contains data entry and output gateways and control commands. It may also contain other tools such as analog digital converters (A/D), voltage comparisons, process amplifiers, counters, timers and more [20].

7. Flowchart a proposed system

The flowchart diagram of the system as shown in figure no.3, The analog signal that detected by LDRs is converted to digital form by (A/D) convertor. The stepper motor rotates is depend on converted signals which is compare value to the ATMEGA328p microcontroller. In principle, the resistance of the LDR that receives dark light increases, which in return results in higher voltage value. On the other hand, lower voltage means the LDR is in a brighter situation. As can be seen from the flowchart in Figure no.2, when the two LDR1 and LDR2 have equal value of intensity, the motor1 is kept idle and in static position. If LDR2 has lower intensity (higher voltage) than the LDR1, it means that the resistance of the LDR2 is bigger. This condition causes the motor1 to rotate the solar panel in clockwise direction. In contrast, when LDR2 has higher intensity than the LDR1, the LDR2

will have lower resistance value causing the motor1 to be rotated in anticlockwise direction toward the brighter light source. In the same way, the motor2 is affected by sensing value of LDR3 and LDR4. When they are equally, the motor1 is locked. But change direction move clockwise and anticlockwise is depend on sensing intensity light from LDR3 and LDR4 respectively. These processes will continue over the day for 19:00 hours, in which with the time set in the microcontroller (MCU), the panel will be rotated back to its initial position for the following day's operation. The C language is a based on written the program code.

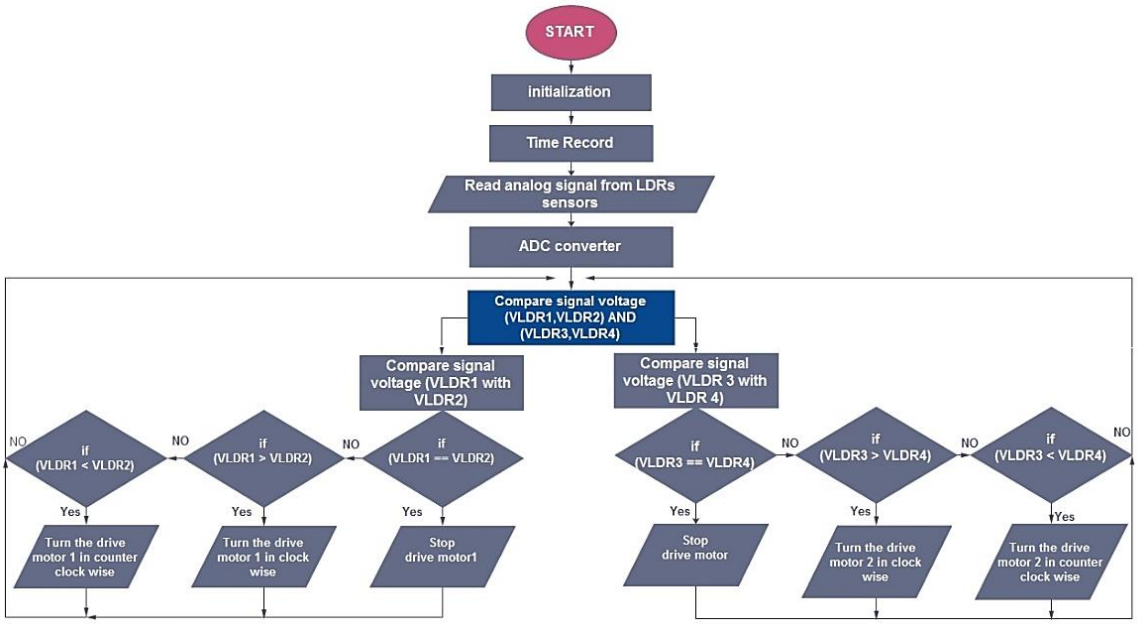


Figure 3: Flowchart diagram.

8. System block diagram and simulation

The system block diagram that is shown in figure no.4, it consists of LDR sensors, Atmega32 microcontroller (with built in ADC), two servomotors and a solar panel. The figure no.5 shows the simulation of the circuit. The Proteus program was used to simulate the running of the circuit and to identify the errors before starting in the real work.

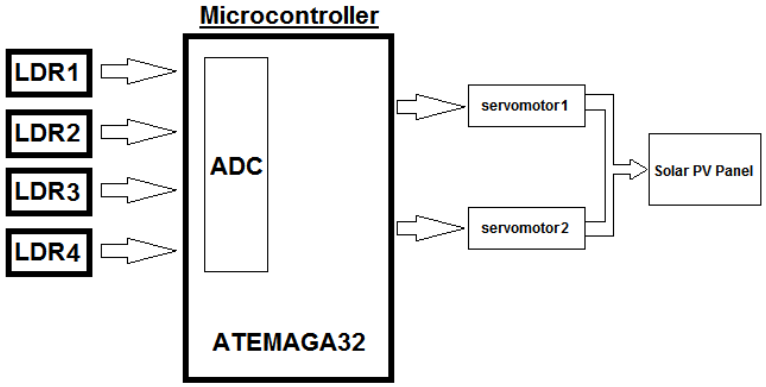


Figure 4: The block diagram of whole

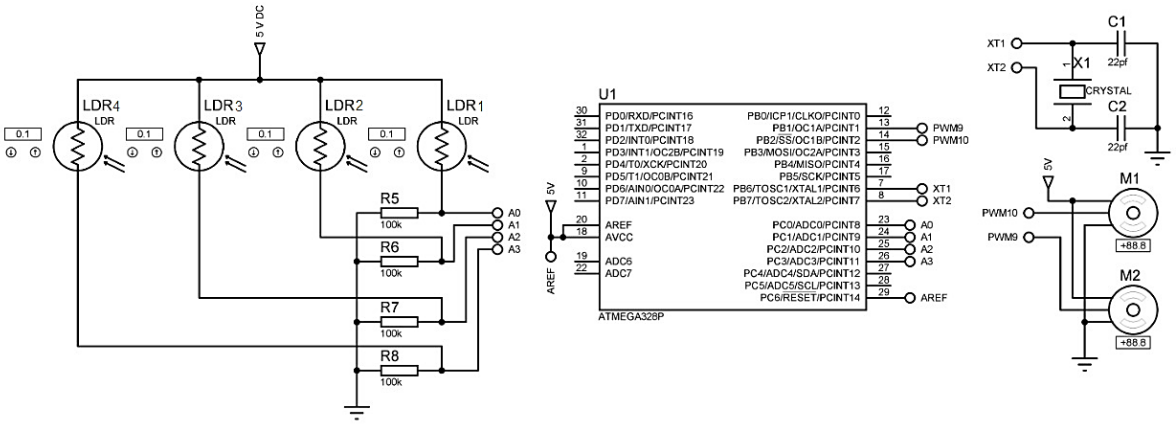


Figure 5: Overall software design circuit.

9. Results:

In the practical part the voltage is measure at certain times by a voltmeter in the stability of the solar panel and the tracking state. Table 1 represents the voltage values have receiving it in both cases at different times of the day. Figure no.6 shows the status curve. As we can see there is a lot of improvement in the traceability condition.

Table 1: Represent voltage value measurement in two cases.

time	0.6:30	07:30	08:30	09:30	10:30	11:30	12:30	13:30	14:30	15:30	16:30	17:30	18:30
Permanent solar panel (**without tracking**) (V)	**0.3**	**0.5**	**0.9**	**1.8**	**4.1**	**6.5**	**7.5**	**7.3**	**6.5**	**5.4**	**4.2**	**1.5**	**0.4**

Dynamic solar panel (**with tracking**) (V)	**0.8**	**1.5**	**5.2**	**6.3**	**7**	**7.5**	**7.7**	**7.6**	**7.3**	**7**	**6.3**	**6**	**1.8**

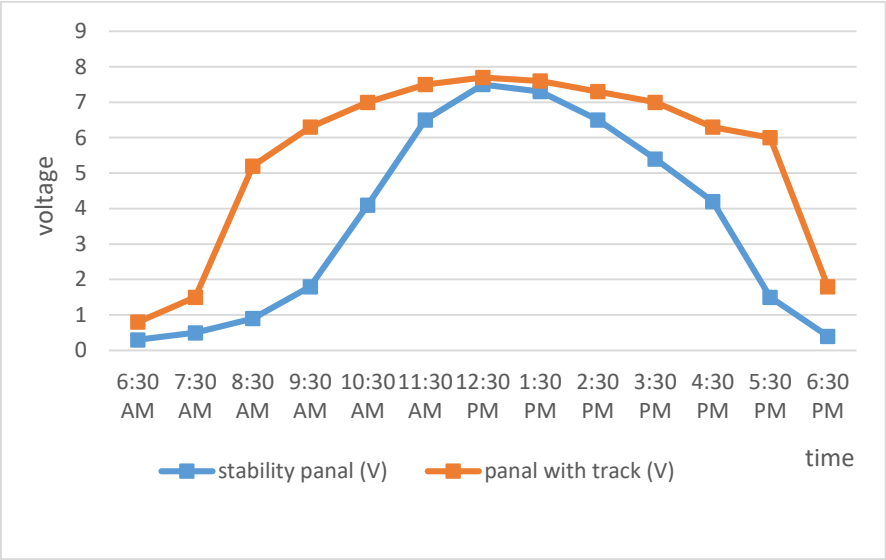


Figure 6: output voltage curve.

10. Future scope

In future it will be more accurate and speed of the process solar tracking based on genetic algorithm (GA) with minimizing the error in the system by using PID controllers should be high efficient powerful tools as an automation system.

11. Conclusion:

As results, the smart of solar tracking system (SOST) has been designed to act as a framework for enhancement the measure and getting the better results.

We conclude that in the early morning hours (sunrise) the response of the system will vary according to the intensity of light and find that the movement of motors it's less if in the hours of day with high light intensity as well as increase the efficiency of electrical power production at a low cost in addition to there are clear improvement of the results with the solar tracking system compared to the old traditional system.

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