Design and Implementation of Approach Can Track Sunlight using Arduino-uno

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ABSTRACT:

The aims of this work are how to develop approach can track the light of sun using Arduino type uno to achieve the maximum efficiency. The project is divided into two stages: they are hardware and software maturity. In hardware development there are four sensors work as a light dependent resistor (LDR), which has been used for capturing the deliver maximum intensity of light. Two DC motors have been used (one for vertical motions other for horizontal motions) to move the solar panel at maximum light source location sensing by LDR. The results show that the designed system of tracking light has a low cost with efficient solar energy system. Enlargement the system has been simulated by MATLAB to demonstrate the performance of the system has superior performance compared with static solar panel.

Keywords: sunlight tracking, Arduino-uno, light dependent resistor (LDR), DC motors

تصميم وتنفيذ منظومة تتبع ضوء الشمس باستخداماوردوينو- اونو

م د نصير قاسم حمودي \ كلية الدراسات الانسانية الجامعة

الخلاصة:

ان الهدف الرئيسي لهذا العمل هو كيفية تطوير المنظومة يمكنها أن تتبع ضوء الشمس باستخدام مسيطر رقمي اردوينو نوع (أونو) وذلك للحصول على اقصى قدر من كفاءة. وينقسم المشروع إلى مرحلتين، وهما بناء الأجهزة ثم كتابة برمجيات. المنظومة تشمل أربعة أجهزة استشعارمبدأ عملها عبارة عن مقاومة كهربائية تعتمد قيمتها على شدة ضوء LDR ، وقد تم استخدام هذه (المتحسسات) للاستشعار باتجاه أقصى شدة للضوء. وقد استخدمت المنظومة اثنين من محركات التيار المستمر (الاول للتحكم بالحركات الرأسية والاخر للحركات الأفقية) لتحريك الألواح الشمسية وتوجيهها بالاتجاه الذي تم الاستشعار به من قبل LDR وهو مصدر ضوء. توضح النتائج ان النظام المصمم كان بتكلفة منخفضة في حين ان تتبع شدة الضوء ذو كفاءة كبيرة لاستخدام الطاقة الشمسية. بالاضافة تصميم وتنفيذ المنظومة فقد قمنا بمحاكاة النظام بواسطة MATLAB لبرهنة افضلية أداء المنظومة المتحركة بالمقارنة مع الألواح الشمسية ثابتة.

1. INTRODUCTION

The energy demand and the environmental problems have increased in recent years. The natural energy sources have become very imperative as an alternative to the conventional energy sources [1]. The world population is increasing all the time then the demand for energy still increasingly day by day. While the main source of energy nowadays is Oil and coal but, they expected to end up from the world during the recent century which explores a serious problem in providing the humanity with an affordable and reliable source of energy. Renewable energy is derived from natural processes that are replenished constantly [2]. Renewable energies are inexhaustible and clean. The energy comes from natural resources such as sun, wind, sea waves, tides, and geothermal heat. They are vast potential and the available in any place in the world; rather they are economic, preserved, and efficient and environmentally are very friendly to deliver an electric energy and its power [3]. Solar is a radiant light and heat from the sun harnessed using a range of technologies such as photovoltaic, thermal electricity, parabolic trough solar collector etc. Solar energy is quite simply for energy produced directly from the sunshine. Photovoltaic is a tool converts the energy of light into electric power. A solar panel is a set of photovoltaic devices connected to deliver a large amount of energies. The mainstream of modules of these panel use silicon or cadmium telluride bonded as a thin-film, also some cells made as a wafer of crystalline. Several types of solar cells are available; they are Mono-crystalline Solar Cells, Amorphous Silicon Si Solar Cells, Polycrystalline Solar Cells, and Cadmium Telluride CdTe Solar Cells. A series Electrical connections gives a desired voltage while a parallel connection provides a desired current. [4]. Solar energy plays an important role as a primary source of energy, especially for rural area in Iraq. In a numerous countries the renewable energy sector has a large awareness of their researchers [5]. In [6] S. Abdallah and et al design a system for tracking the sun and enhancing productivity the solar, also a computerized sun tracking device was used for rotating the solar still with the movement of the sun. Mousazadeh and et al studied the diurnal and seasonal movement of earth affects the radiation intensity on the solar systems. Sun-trackers move the solar systems to compensate for these motions, keeping the best orientation relative to the sun. But using sun-tracker is not essential in them studies [7]. In [8] Mohammed S. Al-Soud and et al designed A parabolic solar cooker with automatic two axes sun tracking system, constructed and its operated. The system tested to overcome the need for frequent tracking and standing in the sun, facing all concentrating solar cookers with manual tracking, and a programmable logic controller was used to control the motion of the solar cooker. Koussa, M and et al was inserted with revise the investigation of performed and effect of sun tracking using different mechanisms on the flat plate photovoltaic system performances and studied the main parameters affecting the amount of their electrical energy output as well as those affecting their gains compared to the traditional fixed

photovoltaic systems [9]. Most of these works were just simulation or studies and some of them designed a complicated system [10]. In this paper we design a simples system for tracking the sun moving during the day using this microcontroller. Due to simplicity of arduino – uno, "Uno" was first proposed by one Italian. The Uno is the latest in a series of USB Arduino boards which some time named Arduino version 1.0., and the reference model for the Arduino platform; This paper organized as in section two we present Arduino (UNO) and section three, four and five design of dual axis solar tracking system, solar tracker and methodology respectively, while in section six and seven was a results and conclusions respectively.

2. Arduino (UNO):

A microcontroller named Arduino is a single-board, planned to apply the interactive objects. It's a development to write software for specific entity, also it provide an open- source physical computing board. In this device the inputs have been taken from a sensors or array of switches, the physical outputs are multiplicity of controlled signal for motion based motors or lights and any other applications. The advantages of Arduino over other systems came from its inexpensive. The ATmega328 microcontroller has 14 pins digital input/output which 6 pins are used for PWM output, 6 pins for analog inputs, the frequency of crystal oscillator is 16 MHz, an ICSP header, a USB connection, a reset button and contains all required to hold up the microcontroller as power jack or an AC-to-DC adapter or battery. This board has an easily to connected to a computer by USB cable. The Uno differs from all preceding boards in that it does not use the FTDIUSB-to-serial driver chip. The features of Atmega8U2 programmed using a USB [11].

3. Design of Dual Axis Solar Tracking System:

This project is divided into two stages, which are hardware and software development. In hardware development, four light dependent resistor (LDR) has been used for capturing maximum light source [12].

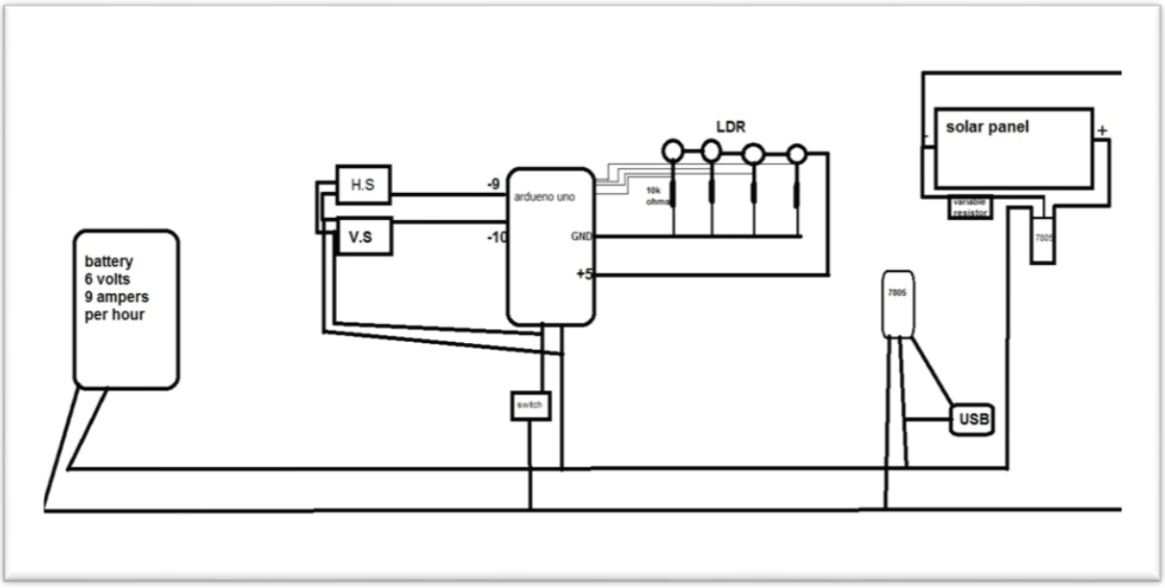

Fig.1 The Electrical Circuit Of The Tracker

Two Servo motors have been used to move the solar panel at maximum light source location sensing by LDR. Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. As shown in Fig. 1. Algorithm had been constructed using Arduino, CC programming. The performance of the system has been tested with a static solar panel.

4. SOLAR TRACKER

Sunlight has two components, the direct beam that carries about 90% of the solar energy, and the diffuse sunlight that carries the remainder. The diffuse portion is the blue sky on a clear day and increases proportionately on cloudy days. As the majority of the energy is in the direct beam, maximizing collection requires the sun to be visible to the panels as long as possible. A typical solar panel converts only 30 to 40 percent of the incident solar irradiation into electrical energy. This paper proposes the use of dual-axis solar tracker. The paper continues with specific design methodologies pertaining to Light Dependent Resistor (LDR),. The dual-axis tracker is a very compatible system to be developed with the usage of implementing the system using Arduino. The software gives the order operating to DC motors according solar panel,. The controller received an analog input from the LDR and converts it into digital signal by Analog-to-Digital converter. The output given to the DC motor will determine the movement of the solar panel.

5. METHODOLOGY

This main participation of this paper is to design a robust solar tracker. The methodology of this work is divided into two parts; software and hardware. It composed three main constituent which are inputs, output and controller as

shown in Fig 2. The Light Dependent Resistors LDR which some time is called photocell or photo resistor. LDRs are functional particularly in light and dark sensor. In general the resistance of an LDR is a variable resistor usually controlled by light, sometimes as high as Mega ohms, but when they are illuminated with light resistance drops**.** LDR has simple structure and low cost

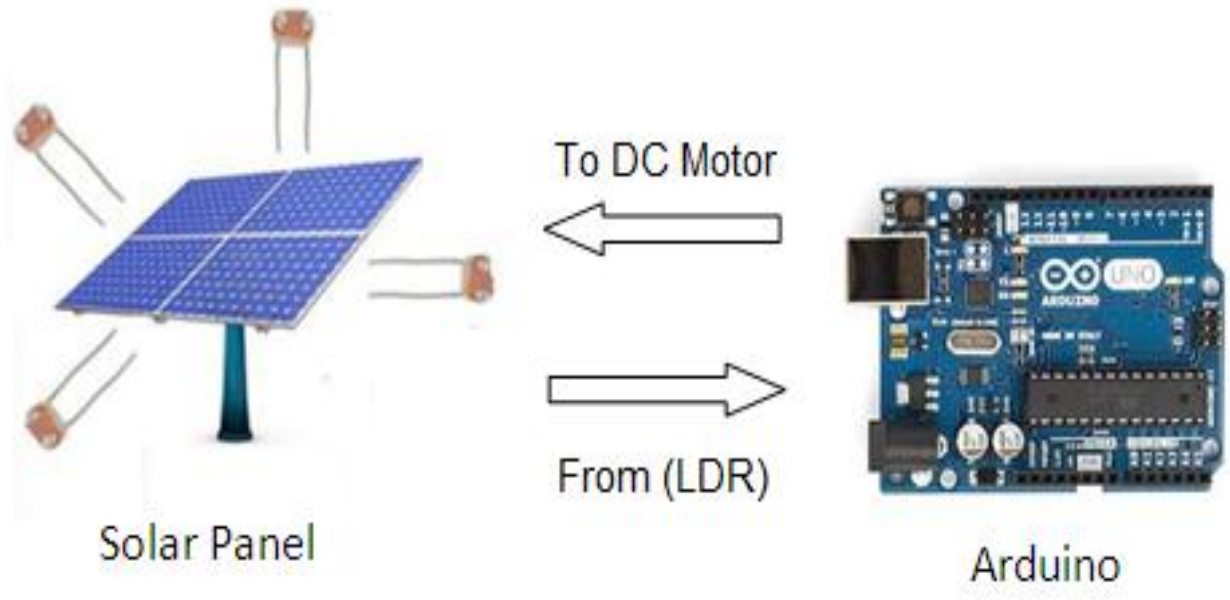

Fig.2. Block diagram of system

A DC motor relies on the fact that like magnet poles repels and unlike magnetic poles attracts each other. DC motors consist of one set of coils, called armature winding, inside another set of coils or a set of permanent magnets, called the stator. Applying a voltage to the coils produces a torque in the armature, resulting in motion. DC motor with gear arrangement have been selected since they are cheaper than servo and stepper motors.L293D IC having two channels has been used to drive the DC motors. DC motors with gear arrangement have been used to achieve the desired speed in moving the solar panel .The most important effect of using DC motor with gear mechanism in dual axis tracking system is getting mechanical stability of solar panel without spending much power for DC motors. The Dc motors can turn either clockwise or anticlockwise direction depending upon the sequence of the logic signals. The sequence of the logic signals depends on the difference of light intensity of the Light Dependant Resistor sensors. The principle of the solar tracking system is done by LDR. Four LDR's (LDR1 and

LDR2, LDR3 and LDR4) are connected to Arduino analog pin AO to A4 that acts as the input for the system. The ADC is to convert the analog value of LDR into digital. The inputs are from analog value of Light Dependant Resistor, Arduino as the controller and the DC motor will be the output. LDR1 and LDR2, LDR3 and LDR4 are taken as pair .If one of the LDR in a pair gets more light intensity than the other, a difference will occur on node voltages sent to the respective Arduino channel to take necessary action. The DC motor will move the solar panel to the position of the high intensity LDR that was in the programming. Fig.3. Fig 4 shows the completed system.

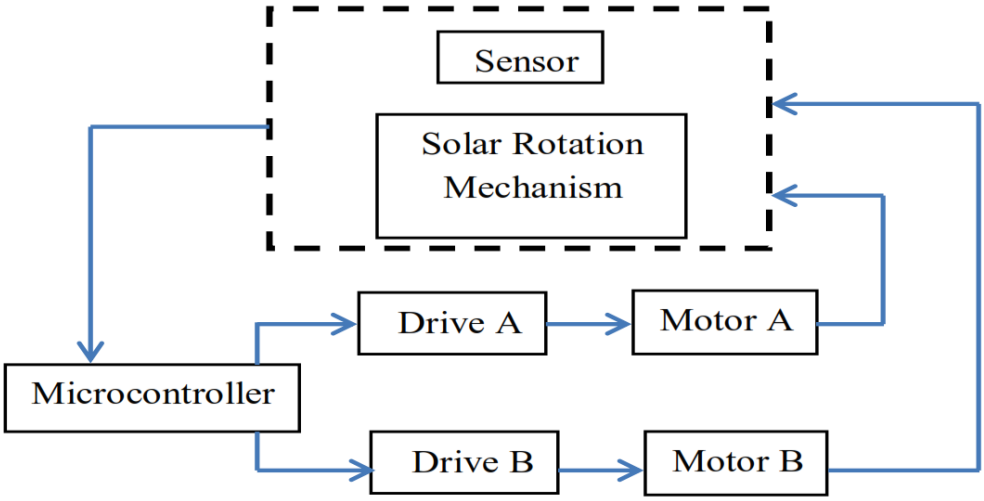

Fig .3 Solar tracking block

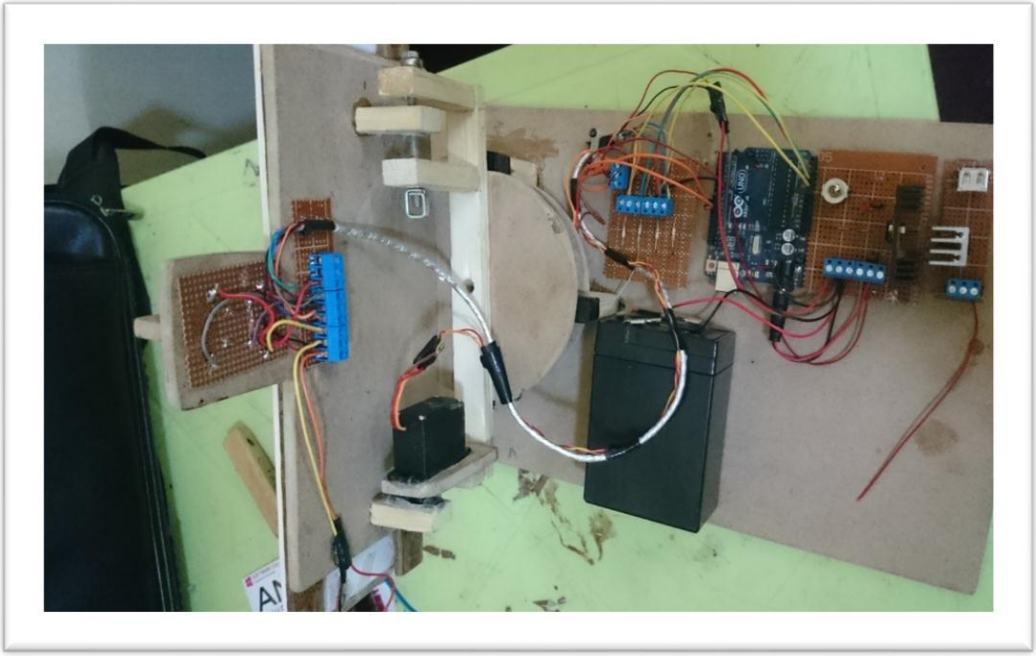

Fig. 4. Expermental testing of compleate system

6. RESULT AND DISCUSSION

Data collected through the monitoring system was analyzed to recognize the appearance of the effective solar system. The sun position is one of the main factors that caused instability measurement output voltage. The solar panel will not be able to achieve a maximum illumination from the sun from its standard position. As referring to graph, the output voltages for panel are slightly fluctuated. The comparison between static and moving panels shows that the solar panel with tracker produced higher output voltages as it gets optimum absorption. Fig 5.Shows the graph for a period of interval obtained from the experiment.

Based on the results obtained, it can be concluded that the system will react at their best with a constant voltage is produced. Arduino Uno turned out to be an easy platform implement the control strategy. The objective of the project was to design a system that tracks the sun for a solar panel. This was achieved through using light sensors that are able to detect the amount of sunlight that reaches the solar panel. The values obtained by the LDRs are compared and if there is a significant difference, there is actuation of the panel using a servo motor to the point where it is almost perpendicular to the rays of the sun. This was achieved using a system with three stages or subsystems. Each stage has its own role. The stages were:

- An input stage that was responsible for converting sunlight to a voltage.

- A control stage that was responsible for controlling actuation and decision making.

- A driver stage with the servo motor. It was responsible for actual movement of the panel.

The input stage is designed with a voltage divider circuit so that it gives desired range of illumination for bright illumination conditions or when there is dim lighting. This made it possible to get readings when there was cloudy weather. The potentiometer was adjusted to cater for such changes. The LDRs were found to be most suitable for this project because their resistance varies with light. They are readily available and are cost effective. Temperature sensors for instance would be costly. The control stage has a microcontroller that receives voltages from the LDRs and determines the action to be performed. The microcontroller is programmed to ensure it sends a signal to the servo motor that moves in accordance with the generated error. The final stage was the driving circuitry that consisted mainly of the servo motor. The servo motor had enough torque to drive the panel. Servo motors are noise free and are affordable, making them the best choice for the project.

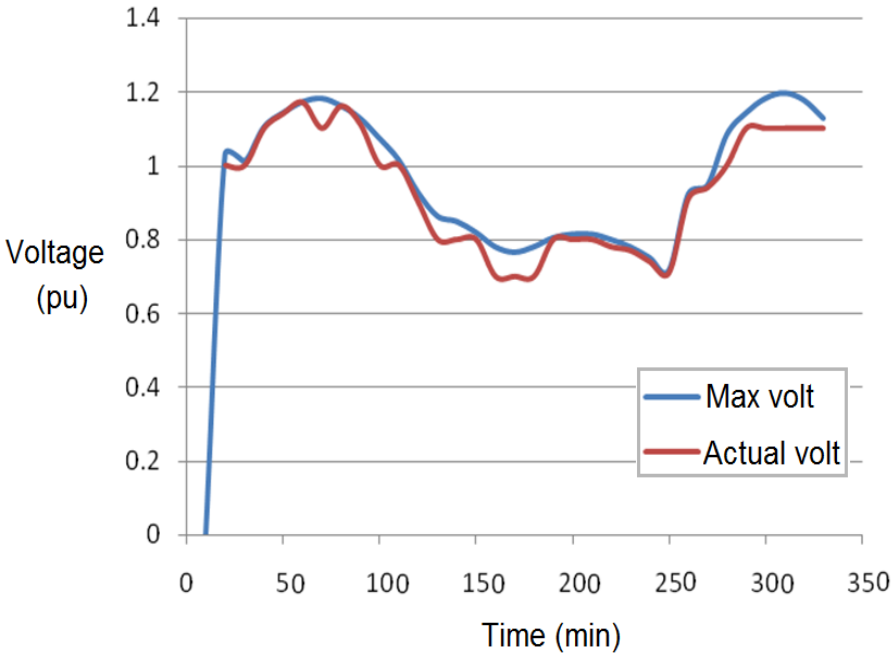

Fig.5. Output voltage comparative of solar panel

7. CONCLUSION

An effort has been made to design and construct a solar tracking system consisting of mechanical part and electrical part. The heart of the system is Arduino microcontroller with a software program developed on C++ programming language. Moreover, the proposed design of utilizes a four quadrant LDR sensors to sense the position of the sun generating an error signal to the control system to continuously receive the maximum solar radiation on the solar panel. The effectiveness of developed sun tracking system has been confirmed experimentally for maximizing the power output of the PV cell and increased it energy efficiency by about 31%.Thus the voltage received from solar tracking system is more than the static solar panel. The average voltage in fixed position is 5.03 V and in tracking position is 5.6 V. Comparing the total net electricity generation of the fixed position and smart solar tracking control, the smart system yielded 19.3% greater efficiency than the fixed system. A solar panel that tracks the sun was designed and implemented. The required program was written that specified the various actions required for the project to work. As a result, tracking was achieved. The system designed was a single axis tracker. While dual axis trackers are more efficient in tracking the sun, the additional circuitry and complexity was not required in this case. This is because there are no significant changes in the apparent position of the sun during the various seasons. Dual trackers are most suitable in regions where there is a change in the position of the sun. This project was implemented with minimum resources. The circuitry was kept simple, while ensuring efficiency is not affected.

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