The Powerful Activity and Sensitivity for the Sunlight Tracker Based on The Arduino Platform

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Abstract
The control systems in the world move rapidly towards the small size, accuracy, speedup and cheap. One of the most famous platform system that used in the control is the Arduino board. in this paper the Arduino Uno board is used to control on the system that govern the position of the solar cell in order to get the maximum generated power by tracking automatically the position of the sun. In this Approach two axis sun Tracker System with two servo motor is used with solar cell and LCD to monitor the voltage that generates. The results show that the new system is more reliable and lower cost as compare with other system Based on Microcontroller and the voltage get from solar cell is approximately near to the designed maximum voltage for solar cell.
Keywords: control systems, Arduino board, solar cell, sun Tracker System .

الخلاصة
أنظمة التحكم في العالم تتحرك بسرعة نحو صغر الحجم، الدقة، السرعة وقليلة الكلفة .واحد من الانظمة الأساسيه الأكثر شهرة المستخدمة في السيطرة هي بوردة اردوينو .في هذه البحث يتم استخدام لوحة اردوينو أونو للسيطرة على النظام الذي يتحكم بموقع الخلايا الشمسية من أجل الحصول على الحد الأقصى من توليد الطاقة عن طريق تتبع تلقائي لموقع الشمس.في هذه الطريقة يتم استخدام نظام تعقب الشمس عن طريق اثنان من المحاور مع اثنين من ألسيرفوموتور مع الخلايا الشمسية وشاشات الكريستال السائل لرصد الفولتية الكهربائية التي تولد.أظهرت النتائج أن النظام الجديد هو أكثر موثوقية وأقل تكلفةا ذا ما قورن مع نظام آخر معتمد على المتحكم. والجهد المستحصل من الخلايا الشمسية هو قريب من أقصى جهد تصميمي للخلية الشمسية.
الكلمات المفتاحية :- انظمة السيطرة , لوحة اردوينو , الخلايا الشمسية , نظام تعقب الشمس .

1) Introduction
The main objective of the "arduino platform board" is to achieve easy and fast prototyping in the implementation of the control system design thereby allowing hook up the "Liquid Crystal Display" and display text on it in less of hours instead of spend many hours (Saxena and Dutta, 1990). The main features of the ‘‘Arduino platform board’’ are the ability to interface with sensors and equipment. provide powerful and flexibility for hardware projectsin which you merely need equipment to respond to several sensors readings (Tamara and Mike , 2007). It is more suitable in applications of design and building electronics projects. Arduino board consists of electronics programmable circuit (microcontroller) with the software or an Integrated Development Environment (IDE) which runs on the personal computer. It can be used to write the code for the program which we need then upload the code to the physical board (microcontroller). It consists all the electronic devices that needed to support the microcontroller .it is consider as brains behind most ofthe electronic projects. Another simplicity aspect of arduino IDE that uses simplified version of C++ makes it easier to learn the programming (David , 2009).

2) The Arduino Platform
An "Arduino platform" is a singular –board microcontroller that makes employ the science & engineering field projects more attainable .In the hardware portion an" arduino platform board" contains an Atmel 8,16 or 32 bit "AVR Microcontrollers"

with integral components that facilitate programming and amalgamation into other circuits.

The Arduino board configuration is inbuilt with "USB Serial Chip" to programming and Communicate with microcontroller that is built in inside it over "USB" .so; the PC "personal computer" can do the functions of programming as the programmer device.

The open source essential feature of the "Arduino board" has to availability of dozen shield(i.e.Daughter Cards),which we can merely add the already designed shields to the "Arduino board" directly over various pins and communicate with Arduino board pins directly just like the Bluetooth shield, driver motor shield ,Wi-Fishield, etc.

On the software aspect, the free Arduino" Integrated Development Environment IDE "provides a big library functions to govern and read the I/O pins. So, there is no need to create own functions. As it is open source, we can get directly advantages of developing works for another developer (Hamilton, 1999).

The Arduino software open source aspect is well suited with all types of an operating system like windows, Linux, Macintosh,etc..

Finally, the arduino platform board is very easy to implement by beginners.

2.1 ArduinoArchitecture:

Essentially, Arduino board uses the processor of Harvard architecture which includes the separate memory for the program code and program data for each one. the At mega 328 microcontroller which used by arduino board contains 32kb of flash memory ,2kb of SRAM and 1kb of EPROM and operates with a 16 MHZ clock speed (Amin *et.al.*,2008).

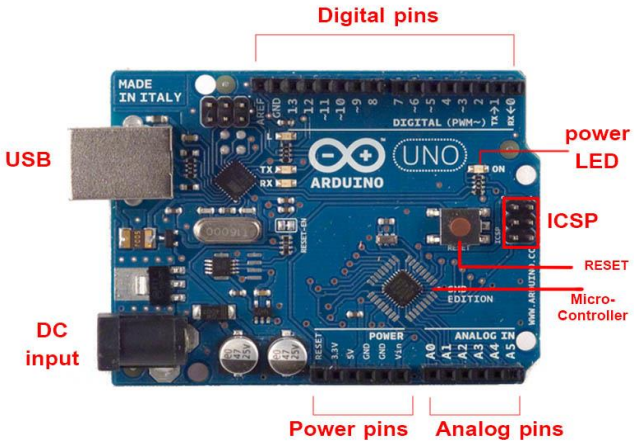


figure1: The Arduino Uno board configuration pins

A. Digital pins:

The Arduino Uno board that is shown in fig.1 consists of 14-digital I/O pinsFrom(0 through 13).it can be noticed that the sign (~) after the digital pins(3,5,6,9,10&11)refers to work of this pins as pulse-width modulation in addition as normal digital pins. This means that these pins have the ability to simulate analog output(like fading an LED in and out).pins 0&1 (Tx and Rx) are responsible for serial communications and act as a transmitter and receiver respectively.

B. Analog pins:

Arduino Uno board provides six analog pins(A0 through A5) which can be connect the analog sensors to read the signal (like a temperature)and Convert it to a digital value that can be read.

C. Power(USB / DC input):

The arduino board can be powered by the DC input with power supply between 6 to 12 volts and not greater than 20 volt because that will destroy the board. Also the arduino board can be powered through a USB cable coming from your personal computer **(Han ,2008)**.

D. Power pins:

The pins labeled aspower pins (5v,3.3v,GND) can be used to power the constructed circuit with 5v and 3.3v if needed and the GND pins to ground the circuit.

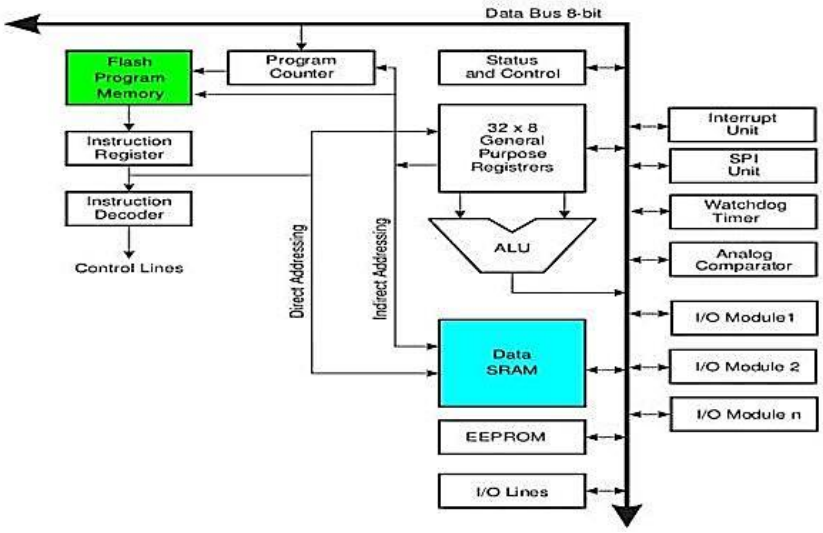


Figure 2:the Arduino architecture

2.2 Arduino programming:

The important feature of Arduino programming tool that can be load the programs in to the instrument devoid of the requirement of programmable equipment.

The Arduino IDE windows that shown in fig.3 covers four main sectors **(Jyotirmay Gadewadikar, 2012)**:

1- Menu bar contain file, Edit, sketch, tools, help

2-Toolbar Button that allows you to verify and check for errors compiling through the verify button and by using upload button will be capable to upload the written code .the sketch can be kept by the save button (sketches means each program written using Arduino software IDE).

3-The Text Editorzone can be used to write the code of the program(sketch).

4- The position of running operation and o/p window show by this sections.

To display compile message, complete error messages and other information. The configured board and serial port display by right hand top corner.

Figure 3: Arduino IDE windows.

Select the Arduino board kind and port:

To" compile" and "upload" the sketch to the "Arduino board".We essential select what kind of "Arduino board" are using by track the route as shown in fig.4

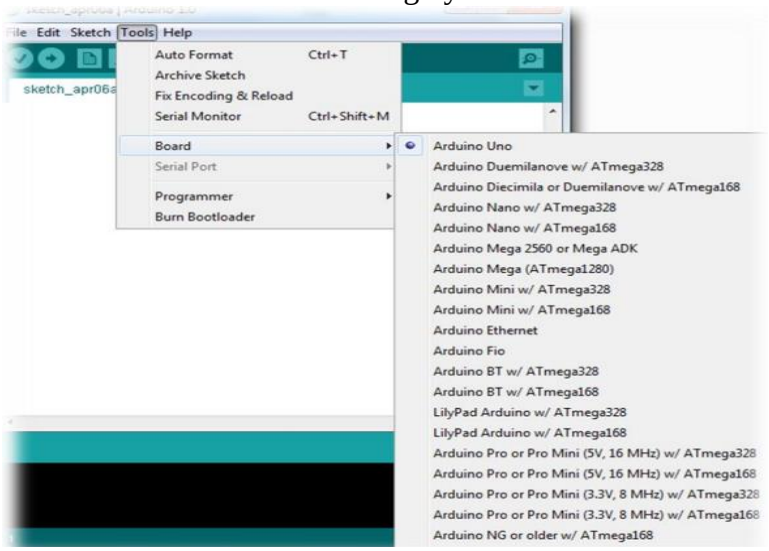


Figure 4: Pathway to select type of Arduino board

Now calculate the "serial port" the "Arduino board" will communicate overBy track the route as shown in fig5.

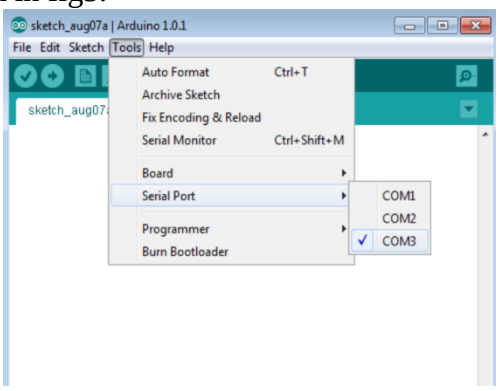


Figure 5: Select the serial port

2.3 Advantages of Arduino platform Technology:

There are several Benefits of Arduino Technology which can summarize as follow: (**Antonio *et.al*., 2007)**:-

1. It is cheap
2. It is deliver open source hardware feature that permit users to advance their own kit.
3. The Arduino IDE delivers a big library functions to manage and read the I/O pins .so, there is no necessity to generate own functions.
4. The software of the Arduino is compatible with all types of an operating system Platform like windows, Linux, and Mac, etc.
5. It's not need for programming device because of use of an ordinary computer as the programmer.
6. For beginners, it is very simple to use.

3 - The Components of System

3.1 Light dependent resistor

The" light dependent resistor" (LDR) or" a photo resistor" (photocell) is A light-controlled adjustable resistor. The LDR "light dependent resistor" made from high resistance semiconductor materials. Because of the characteristics of this material the resistance of photo resistor reduces with growing incident light intensity. In other words it offers the phenomenon of photo conductivity. If the fallen beam on a photo resistor override a definite frequency, photons, Absorbed by the semiconductors materials provides bound electrons adequate Energy to change into the conduction band and give increase to The free electrons (and their hole twin) conduct electricity , thereby causes lowering resistance.

To sense the light by the light sensor over the input analog pins the controller needs “light dependent resistor” (LDR) or a photo resistor located in the circuit. Two sensors used to sense the light beam in top right and down right position and the additional two used in top left and down left position **(Ignacio *et.al*., 2011)**.

Greatest applications of light-sensitive detector circuits want to apply the "light dependent resistor (LDR) as the sensing device part.

3.2 The DC Servo Motor

The "servo motor" is types of motors whose o/p shaft can be go in a definite Angular location by sending it a coded signal. The "servo motor" will preserve the status of the shaft direction as long as persist applying the coded signal. If the coded signal will be change the angular direction of the shaft will alteration **(Mousazadeh *et.al*., 2012)**.

The general kind of servo arises with position control. The servo motor contains of three main components – control structure – output sensor – A feedback system. It is apply an automatic closed loop control scheme. This application permits the servo to be controlled by a feedback signal Generated by comparing o/p signal and reference signal. Today servo-Mechanismis enforcement in automatic machine tools, satellite – tracking Antennas, remote control airplanes, and antiaircraft – control system.

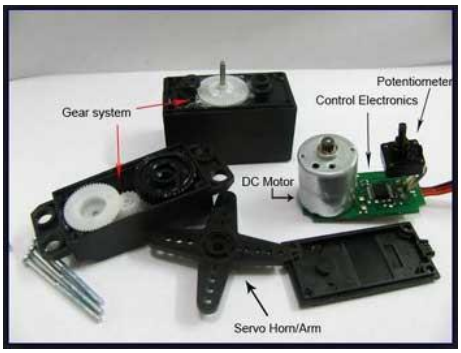


Figure 6: the Servomotor

3.3 Liquid crystal display

LCDs are applied in a wide range of implementation. From ubiquitous pocket Calculator, and hand watch to an advanced VGA computer screen, and television .they are popular utilized in instruments panel control in plants, Aircraft cockpit displays, and gaming devices. The LCD screen is more energy-Efficient. It's low electrical power consuming than CRT (cathode ray tube). They have replaced CRT in most of applications. The LCDs are electronically modulated optical device composed of an array of teeny segments known as Pixels that can be manipulated to display information. This basic concepts is common to all Liquid Crystal Display .another advantages of LCD over CRT the Size factor .this makes LCDs practical for applications where size (as well as)Weight are important **(Shingleton, 2012)**.

Fig. 7: The Liquid Crystal Display (LCD)

Results and discussion

In this paper a new method for implementing the control system for solar panel was done which is based on the Arduino Uno board. By this board the new control system is done in order to govern the movement of the solar panel according to the sun light that means it will follow the light in order to get the maximum benefit from the sun and get optimum power and higher voltage from solar panel. The software for this mission was written in arduino C language which is easier from other languages such as machine language which is used in microcontroller. In this Arduino program the orders is written in order to monitor the process of sun light sink at each moment with time delay less than one second by using the four light sensors (one for each direction [north south east west]) in which the best position for get the maximum power is selected that is variable at each time. This procedure was tested under different position of sun(sunshine, morning, afternoon, sunset) in order to check the performance of the system and how can adapting the system according to sun light intensity and gets the maximum voltage from the solar panel. In this paper the solar panel used has the maximum design voltage as 6 volts. The experiments were done (as shown in figure 12 and table 1)with different daytime that means different intensity of light. In the beginning with the first experiment at the sunshine time the

sun near to earth line and its intensity is minimum therefore the solar panel give the voltage near to 4.72 volts (as shown in figure 8) with vertical angle of 0 and horizontal angle values of 89. The second experiment was done (as shown in figure 9) in the morning with vertical 0º and horizontal of 180ºand the solar panel give the voltage of 5.15 volts. The next experiment was done in the afternoon (as shown in figure 3) when the sun within maximum intensity with vertical angle is 64º and horizontal angle of 180º the voltage get is 6.3 volts(as in figure 10). The last experiment was done in sunset time at the minimum intensity of light (as shown in figure 11) with vertical angle about 180º and horizontal angle about 1800ºand the voltage gained about 5.58 volts.

Fig. 8: the voltage obtained near 4.7v from exp. 1

Fig 9: the voltage obtained near 5.1v from exp. 2

Fig 10: the voltage obtained near 6.3v from exp. 3

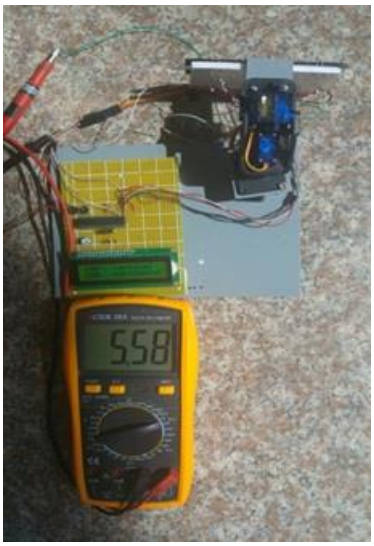


Fig 11: the voltage obtained near 5.58v from exp. 4

Conclusion

In the results obtained from the experiments we can conclude that the new method for tracking the light of sun in order to get maximum voltage which is based on the Arduino Uno platform gives good and optimum results for each case in different time. This method prove that the cost will be reduced for the system of control because this component is very cheap and easy to used and also not complex in programming and the beginner can dealing with it. The system is high speed control system and will tracking the light in each moment therefore will give the best results than the other system if the solar panel is fixed at one place.

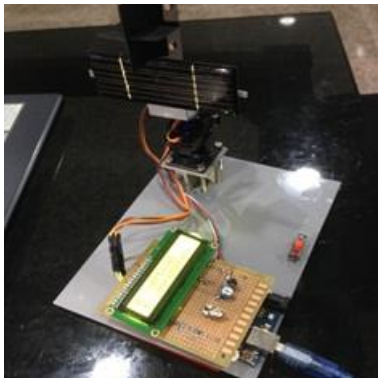
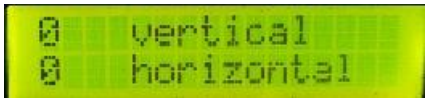
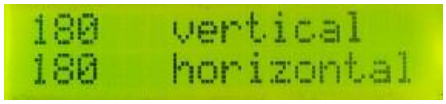
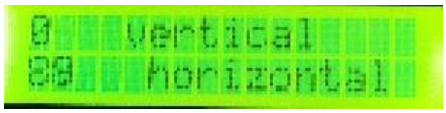
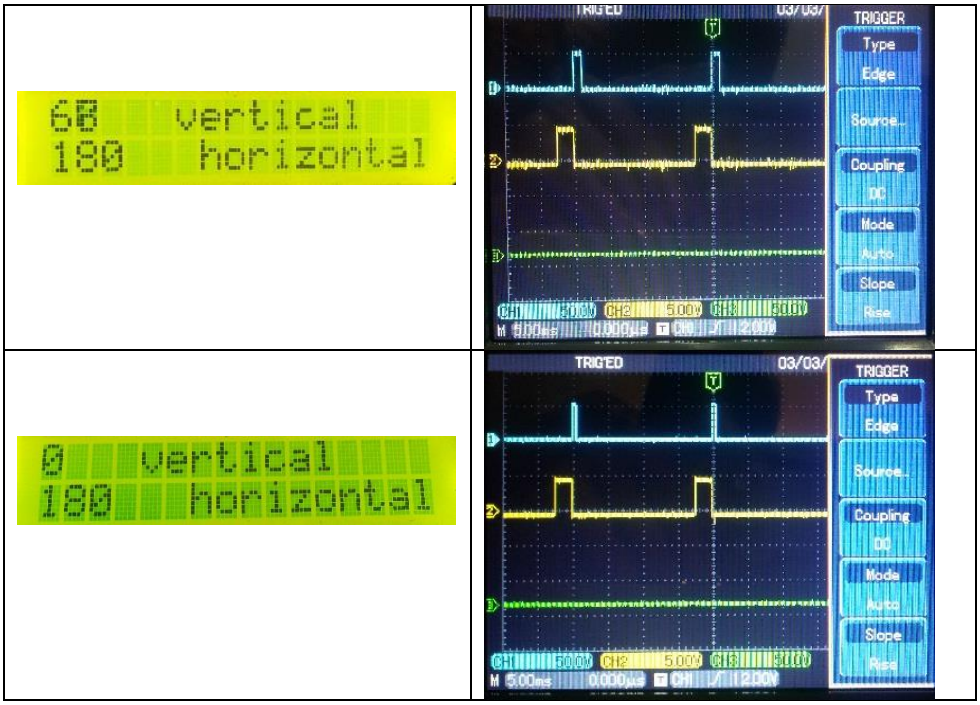


Fig 12: the total configuration of the device

Table1: CH1= show the o/p wave form to vertical servo (blue color), CH2= show the o/p wave form to horizontal servo (yellow color)

LCD Reading	Oscilloscope wave form
	
	
	



Note: the LCD reading represents the solar panel position according to light intensity.

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