DESIGN AND DEVELOPMENT OF HELIOS EXTRACTOR

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Abstract :In today's world each and everything directly or indirectly depends mainly on electric power, so it's necessary to generate a good amount of power via various methods. Though we are able to generate power by various methods we have energy crises and some issues in meeting the needs of the consumer. As it's a preliminary need people depend on alternate power sources like diesel generator, uninterrupted power supply, but some of them use solar panels in this regard as it is durable and has many advantages .A solar photovoltaic (SPV) cells based dual axis tracking system on Arduino Uno platform is implemented in this article for achieving maximum power during a day. The key idea of this article is implementing an automatic dual axis solar tracking system. Alignment of solar panel with the Sunlight for getting maximum solar radiation is experimented. This system tracks the maximum intensity of light in terms of maximum power point (MPP). When the light intensity decreases, its alignment is changed automatically for catching maximum light intensity. This article shows implementation and analysis of dual axis solar tracker, while various solar axis trackers are available in the market. Meanwhile, the proposed technique is able to identify axis quickly with simple technique and aligned with sun rays in order to achieve MPP as the output regardless motor speed.

A major concern of most countries is the ability to secure their national borders against illegal immigrants, smuggling and infiltration of terrorists.

The power generated from this can be used for border / remote security surveillance and also for residential lighting using the model shown below ,the major highlight of this model is that it doesn't need any human assistance its automatic.

Keywords **– Arduino, photovoltaic cell, maximum power point, solar energy.**

I. INTRODUCTION

About 1300 watts/hour/meter in regular days. Still 30% of this capacity is returned back, at rest outcomes in a reel amazing 4.2 KW-hours of energy per meter in a normal day [2]. Hence it can be understood that solar energy is a better option than fossil fuels based on discussed facts.

As per geographical status of Bangladesh, it grips best solar reservoirs in the world. In the hot summer time, the normal bright sunshine time is near to 7.6 hours in the Bangladesh country [3].

Generally solar energy can be produced through solar concentrated panels or solar photovoltaic (SPV) panels. Solar concentrated panels are not preferred in the remote areas or small generating units than SPV panels due to its installation cost. SPV panels are manufactured by silicon, germanium, etc. material but silicon is most popular in between them due to its cost and efficiency.

First time silicon solar cells efficiency was about 20% in year of 1985 whereas there has been uniform rise in the solar cells efficiency. Most of the solar cells still work lower than 45%. As a consequence, majority of energy consumers for solar panels are pressurized to either buy a count of panel to fulfill their energy demands or arrange costly single system with higher productions. There is a variety of solar cells with comparably larger efficiencies but they impel to higher cost.

The efficiency of the solar cells can be increase by maximum power point tracking technique. This technique also reduces the cost factor. In this technique, operator can get maximum power point on the solar panels by which get maximum efficiency which result in enhanced power output. These trackers can be single or dual axis.

Single axis trackers act according to the sun light and they have proved their quality through 38% more generation than the stationary panels. The generations of power by single axis trackers also depend upon weather, situation and period [8]. Dual axis trackers identified sunlight from both axis so these are more efficient than single axis trackers but they have higher manufacturing cost.

In this article, a dual axis tracking system is proposed. It is low cost, lesser maintenance, minimum complexity and still finds the needed efficiency. So, dual axis solar tracking system is investigated in the next sections.

II. OBJECTIVE

Despite the fact that there are many techniques for extracting solar energy there was no simple technique to extract energy compared to other methods so we have designed a simple tracking system which is cost effective, user friendly and efficient too.so that it helps mankind to utilize solar energy in an efficient manner and use it wherever necessary.

III. OPERATING PRINCIPLE

The circuit of Helios Extractor system is divided into three main parts. They are:

i. Input stage that consisting of sensors and resistors.

ii. Embedded software-based program in the microcontroller chip (ARDIUNO UNO).

iii. Driving circuit consisting of a special kind of motor called servo motor.

The stage of input has 4 LDR's, LDR1, LDR2, LDR3 and LDR4 that is so arranged to calculate the average light intensity in the particular direction. A "C" program inserted into the microcontroller chip creates embedded software. The components of the system are well covered by a cardboard. A structure known as Partitioner, which separates the 4 LDRs being activated at the same instance when there is a sun light in some particular direction. Its sensor assembly has four sensors that is LDRs. These are used for measuring the intensity of light and producing analog voltage variation that is transmitted to control modules that is driver module. They find the exact location of the Sun both in vertical and horizontal axis i.e. east, west, north and south including the sub-directions. Sensors are mounted on solar panel assembly and fixed using screws.

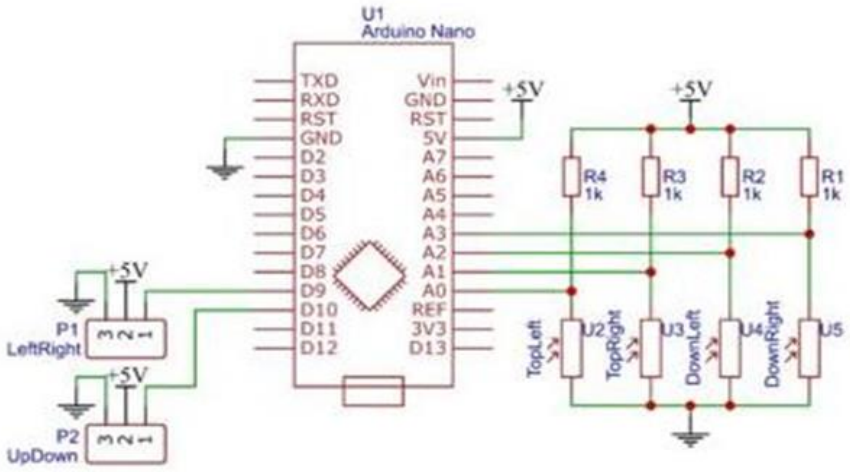

Fig 1: Circuit diagram of the embedded system

Fig 2: Developed hardware module

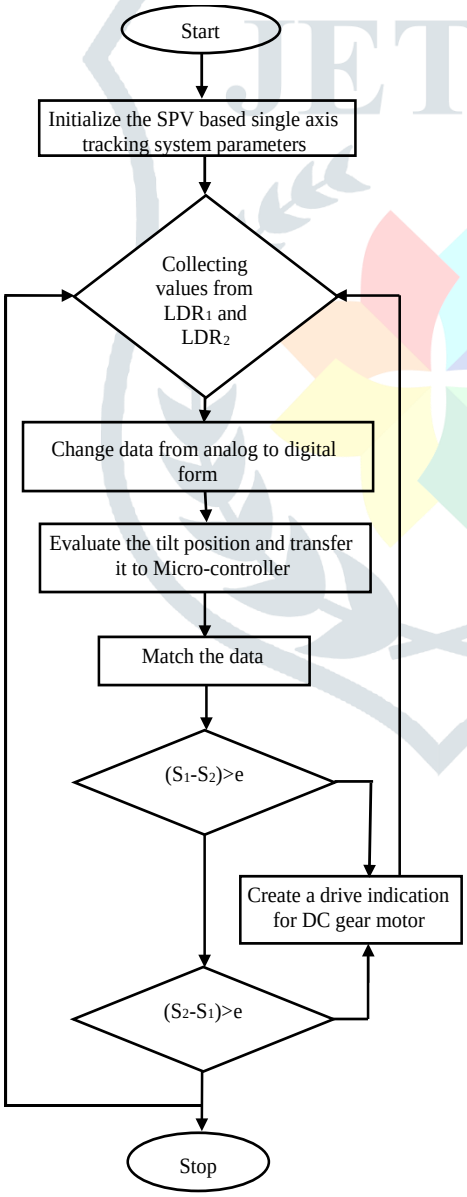

Fig 3: Flow chart of the operational procedure

IV. COMPONENT DESCRIPTION

A. *Arduino*

A micro-controller slat which depends upon the Atmega328 is presented with Arduino Uno is in the Figure 3. It is having fourteen input and output pins. Six pins can be considered as Pulse Width Modulation (PWM) outputs, another sixth as analog inputs, next one connected to crystal oscillator (16 Mhz) and last one connects with the Universal Serial Bus (USB). The Arduino Uno slat is directly interconnecting to computer/laptop by USB chord. Arduino Uno is open source software and very simple to apply control rules in the chip of micro-controller slat. This works as per developed written program, and program is inserted into micro-controller memory. The prime aim of this program is to provide control commands and correlate with many Functions.

Fig 4: Arduino board

B. LDR sensor group

LDR is a resistance which inversely proportional to the light intensity. Practically, it's a resistor. Sensors are settled on solar panel and situated on the periphery of a cover. LDR is divided through thick outers, and is known as balancer. Its sensor group has two sensors. These are utilized for scaling the intensity of light and producing analog voltage indication to be transmitted to control modules. They judge the location of the Sun in the vertical axis i.e. east and west corner. Sensors are putted on solar panel and situated around the cover. Below figure shows the arrangement of LDRs on top of solar panel.

C. Servo motor

This is a special kind of motor. The motor movement is measured and controlled with PWM technique.
A servo motor is electric machine category that is capable to move with a large torque. This type of servo motor is applied in the several places, and is severely available in the houses and working sites where ever position control is necessary. It consists of 3 colored cables/wires they are

RED : positive supply (+5v to+12v).
BROWN : negative supply or ground signal
ORANGE : control signal or PWM signal.
Below figure shows the arrangement of servo motor

Fig 5: Servo motor

D. Solar panel

A solar panel converts sunlight into an electric current or heat used to provide electricity for home or building. Solar panels are constructed as a collection of lots of small solar cells that are spread over a large area to provide enough power. The larger the concentration of light hits the cell the more electricity or heat is produced.

Solar panels work by converting light photons into electricity through the solar photovoltaic (PV) effect. This allows for direct conversion of sunlight into solar power, or electricity. Solar panels use layers of semi-conducting material, most commonly silicon.

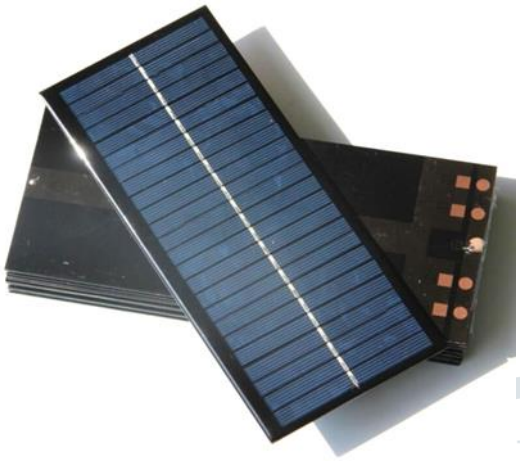

Fig 6: solar panel

SL. NO	Pin Category	Pin Name
01	Power	Vin, 3.3V, 5V, GND
02	Reset	Reset
03	Analog Pins	A0-A5
04	Input/ Output Pins	Digital Pins 0 – 13
05	Serial	0(Tx),1(Rx)
06	Inbuilt LED	13
07	External Interrupts	2,3

Table1: Arduino pin description

Sl no.	Name	Function
01	Red	Positive supply(+5v)
02	Brown	Ground/ negative supply
03	Orange	PWM signal

Table2: Servo motor pin description

List of components required

1. Servo Motor – SG90
2. ArduinoUNO
3. LDR(light dependent resisitor)
4. Solar panel
5. Resistors -1 kilo ohm
6. Connecting wires
7. Adaptor –12V,2A

V. ADVANTAGES

1. Can extract solar power at any point of time during the day.
2. Lightweight and hence portable (size may vary according to requirements).
3. Power extracted can be utilized for lighting and security applications.
4. Use of helios extractor efficiency can go up to 25-40%
5. It is very simple compared to trackers with other techniques.
6. It is cost effective

VI. *DISADVANTAGES*

1. Cannot perform efficiently under heavy rainfall conditions and extreme weather conditions as it may cause damage to the module.

VII. *APPLICATIONS*

1. Remote power supply.
2. Highway lighting and street lights.
3. Border security and surveillance.
4. Residential lighting.
5. Electric vehicles as a battery charging source.

VIII. *RESULTS AND DISCUSSIONS*

Multi axis solar tracking system is designed through taking special specifications. This system is capable to check and detect the intensity of Sun light and accordingly to find higher intensity as result. According to the result obtained by the system the Arduino will send the signals to the Servo motor According to the signals send by Arduino the motors will rotate in particular angle so that the panel will get the maximum intensity of light.

The complete setup of multi-axis tracking system is shown in figure. By using this solar tracking system we can make full use of light from the sun. Straightly collects incoming light of Sun rays on its area regularly so that it can produce extra electric power through the solar panel.
A fact is confirmed that solar tracking system is reliable and best possible item for finding optimal solar power from the light of Sun in this article.

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