Solar Tracking and Cleaning with Energy Utilization for Agriculture Purpose

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***Abstract*—The Rapid increasing demand for energy, the continuous depletion in existing sources of fuels and increasing concern regarding environment pollution, have forced mankind to explore new non-conventional energy, renewable energy resources such as solar energy. But the continuous change in the relative angle of the sun with respect to the earth reduces the power delivered by solar panel. In this scenario solar tracking system is the best alternative to increase the efficiency of PV panel. Hence to increase the efficiency of the panel, panel must be moved in co-ordination with the sun rays automatically. By using the servo motor panel can be moved in single-axis i.e from East to West. In general, due to dust and other external factors depositing on the panel, the efficiency of the panel is reduced. The panel should be cleaned periodically. By installing the automatic cleaning system using the water spray, the dust particle on the panel can be cleaned and hence efficiency can be improved. The regular watering becomes the main factor for the agricultural land and As this proposed system is being implemented in the agricultural land, the use of soil moisture sensor plays a major role to water the land based on the moisture content in the soil which is measured by the soil moisture sensor. And the water is being supplied by the motor after detection of low moisture content in the soil. And this system also includes the security of the agricultural land, entire boundary of land is to be fenced and any unusual detection such as human or animals is been detected and alerted by the buzzer.**

Keywords—Brushless DC Motor, Battery, Charge controller, electronic control unit, solar panel, throttle.

I. INTRODUCTION

Solar Tracker follows the movement sun across the sky. When solar panels are coupled with solar trackers, the panels can follow the path of the sun and produce more renewable energy. Earlier manual trackers were used as it requires someone to physically adjust the panels at different times throughout the day to follow the movement of sun. This is not always practically possible, as it needs someone to constantly monitor path of the sun and change the position of the solar panels.

Solar panels are those devices from which electricity is produced by absorption of sunlight usually called as photovoltaic effect. Solar Panel can be used for a wide variety of applications for the production of electricity by residential and commercial solar electric system. The potential annual solar radiation in India is about 5000 trillion kWh per year.

Solar panel here used to generate electricity which is used for watering the agricultural land, and also in providing electric supply to the buzzer which is used for the security of the agricultural field.

Sun rays are not constant throughout the day as sun travels from East to West. Hence placing solar panel at one fixed place reduces the efficiency of the panel by 30%. By use of this system, the efficiency can be increased by placing LDR sensors and servo motor to the solar panel. The LDR sensors are placed at both the sides of the panel where both the sensors are parallel to each other.

With the help of these sensors, it is able to detect the sun rays passing. Sun rays with more intensity falling on any one of LDR sensor placed, makes the solar panel to move towards it with the help of servo motor. Servo motor moves the panel in single axis direction, which enables to achieve more efficiency of the panel.

In addition to it, the external factors such as dust falling on the surface of panel reduces the life of the panel as the aluminum strips of the panel gets rust. And due to the dust on the panel reduces the intensity of sun rays which falls on the panel.

Hence regularly cleaning must be done, which can also be done by automatic cleaning system which consists of water spray. The water spray with constant force wipes out the dust placed on the panel and which will be cleaned automatically in certain period of time.

As this system is being implemented for the agricultural land, the supply of water for the agricultural land whenever required place a very important role. With the help of the soil moisture sensor, which measures the moisture level of the soil.

Whenever there is a detection of less moisture in the soil, the system automatically pumps the water to the field or land using Arduino UNO and motor, which also reduces the physical work of the farmer.

This proposed system also consists of security of the land. Hence by enabling the fence at the boundary of the land, it alerts the farmer in case of any unusual detection of animals or humans with the help of peripheral devices like ADC,PIR sensor and buzzer.[1]

II. METHODOLOGY

In the first stage a primary research must be conducted in order to check if the proposed system is possible to be made technically.
In the second step one must look into the various sensors, controllers and motors.
In further step, this paper is further divided into categories based on it's functions. One part as the solar tracking and cleaning system and the other part as the energy utilization for agricultural land using soil moisture sensor.

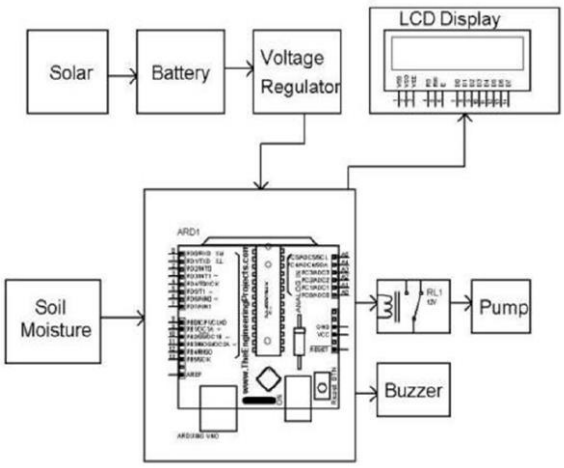

Figure 1. Circuit diagram of solar tracking and cleaning system.

They are two possible ways to achieve maximum efficiency of a solar panel. The first possible way to achieve is a solar tracking system using micro controller. Firstly, the device detects the position of the sun and the movement of solar panel is controlled, so that the maximum radiation of the sun can be made to fall on the solar panel. The second possible way to achieve is using a charge controller which makes the inverter to work at maximum power range. Hence in any climatic conditions the maximum power is being achieved.

These are the two possible ways to achieve more efficiency from solar panel and solar energy from sun as well. There are many applications in smart irrigation using Arduino, soil moisture sensor, fence with buzzer alarm, relay module and solar panel.

This proposed system detects the moisture level of the soil which in turn helps in watering the agricultural land automatically using Arduino UNO. This system reads the moisture level from the soil and automatically switches on the motor, if the moisture level is less than the set limit. If the moisture level is equal or above the set limit, the system switches off the LED indicator. The water level of the tank and soil moisture level is displayed on a 16X2 LCD. The water level of the tank is detected by a float switch. Whenever the tank is filled, the motor automatically switches off.

The fence using buzzer ensures the safety of the agricultural land, bungalows in the forest, farmhouse etc. from animals and other humans to enter into the fence. In this way, the farmers can protect the crops from animals and thieves. In many popular countries, fence using buzzer are being implanted and gradually becoming popular in the countries like India.

Thus the buzzer fences are less cost effective. Using buzzer fencing animal grazing can be reduced so that the yield of the field is increased.

And mainly if the dust particles are detected on the solar panel, then it needs to be cleaned, because the accumulation of the dust particles reduces the efficiency of the solar panel by 50% per month. Hence using the water sprinklers set on-side by solar panels which cleans the panel automatically.[2]

III. ALGORITHM

Step 1: Initialize the sensors, input and peripheral ports of Arduino.

Step 2: Arduino reads LDR's depending upon the intensity of the light.

Step 3: Depending upon the maximum intensity of the light the Arduino takes the decision to rotate the panel to get the maximum power.

Step 4: If sunlight on LDR1 > LDR2 then, panel tilts from west to east.
If sunlight on LDR2 > LDR1 then, panel tilts from east to west.

Step 5: Maximum power is generated from the above process.

Step 6: Generated power is stored in the battery.

Step 7: In addition to this, the external factors such as dust which gets deposited on the surface of the panel must be removed for the maximum efficiency. Water Sprayer placed on the top of the panel cleans dust at regular interval of time set to 12 hours.

Step 8: By using the generated power from the above process, soil moisture sensor senses the moisture level depending upon the type of soil.

Step 9: With the help of the Arduino, If low moisture of the soil is detected then water is supplied to the field automatically. And once the soil moisture level reaches the desired level, the water supply is switched off automatically.

Step 10: Fence for the field is installed with Motion PIR sensor and buzzer , which detects and alarms whenever there is a movement of humans or animals near the fence. The same power generated is used for the fencing.

IV. RESULT

Table 1: Specifications of 6W Solar Panel

Rated Power Range	1-30W
Current at Max power (Imp)	0.38A
No of Cells	18
Module Voltage	5V

Power	4W
Voltage at Max Power (Vmp)	8.91V
Dimensions L×W×H	1955×992×40mm
Panel Type	Polycrystalline

Table 2: Specifications of Soil Moisture Sensor

Power Consumption	<7mA
Supply Voltage	3.5V to20V (DC)
Operational Temperature	-40ºC to 85ºC
Accuracy at 25ºC	±2%
Output	0 to 3V related to moisture content

Table 3: Variation in soil water tension for different types of soil.[3]

Soil Type	**Soil Moisture Tension (centibars)**
Sand or loamy soil	40-50
Sandy loam	50-70
Loam	60-90
Clay loam or Clay	90-120

V. FUTURE SCOPE:

In this proposed system, the power stored in the battery can be used in a climatic condition such as cloudy & rainy seasons and also in case of any other emergency. The other applications of solar panel tracking includes home automation, industrial parameter control etc. with some modifications.

Using multiple sensors and many other experimental challenges such as irrigation system based on timer set to water the field and so on. And in future it can be extended to small scale irrigation system especially for business crops.

VI. CONCLUSION:

As this proposed system acts as a single system which includes both, tracking as well as cleaning system. Usually, dust gets accumulated on the surface of the panel which results in damage of the aluminum strip of the solar panel. So, this damage of the solar panel can be prevented by implementing the cleaning system which thereby increases the efficiency of the solar panel.

By this, the life span of the solar panel can be increased, decreases the cost of cleaning process manually also tracking efficiency is increased.

Individually by using tracking system the efficiency is increased approximately by 30% and by cleaning mechanism the efficiency is increased by an amount of 50% per month. Also, by implementing the fence, this may protect farmland and estates by animals and using soil moisture sensor the required amount of water is supplied automatically to the agriculture field whenever required.

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REFERENCES

[1] Begum, S., Banu, R., Ahammed, G.A. and Parameshachari, B.D., 2017, December. Performance degradation issues of PV solar power plant. In *2017 International Conference on Electrical, Electronics, Communication, Computer, and Optimization Techniques (ICEECCOT)* (pp. 311-313). IEEE.

[2] M. Sreenivasulu Naik, C. Radhamma, S. Yunus "PV Based Automatic Irrigation System".

[3] Anchit Garg, Priyamitra Munoth, Rohit Goyal " Application of Soil Moisture Sensors in Agriculture: A Review"

[4] Dr PUSHAN KUMAR DUTTA, Dr KETHEPALLI MALLIKARJUNA " Sensor based Solar Tracker System using Electronic Circuits for Moisture Detection and Auto-Irrigation"

[5] The International Conference on Technologies and Materials for Renewable Energy, Environment and Sustainability, TMREES14 "Influence of Dirt Accumulation on Performance of PV Panels

[6] "Non-conventional Energy Sources" – G.D RAI [12] "SMART SUN TRACKING WITH AUTOMATED CLEANIN SYSTEM FOR PV MODULES" AMIRAH AFIQAH BINTI AHMED

[7] A. Bharathi Sankar, R. Seyezhai "Simulation and Implementation of Solar Powered Electric Vehicle" Department of EEE, SSN College of Engineering, Chennai, India, Circuits and Systems, 2016, 7, 643-661 Published Online May 2016 in SciRes. http://www.scirp.org/journal/cs http://dx.doi.org/10.4236/cs.2016.76055

[8] Gangesh Shukla1, Karmit Raval2, Dhruvi Solanki3, Urvashi Patel4, Dhaval Dave5 "A study on Campus-Friendly Solar Powered Electric Vehicle" B.Tech Student, Dept. of EE, Parul University, Vadodara, Gujarat, India Asst. Professor, Dept. of EE, Parul University, Vadodara, Gujarat, India, International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 06 Issue: 02 | Feb 2019 www.irjet.net

[9] Tathagata Pachal, Akhilesh. K. Dewangan, "Electric Solar Vehicle – RayRacer" Thesis for: B.Tech - Mechanical Engg Advisor: Ashok Kumar Sahoo, Akshaya Kumar Rout, Isham Panigrahi April 2016 DOI:10.13140/RG.2.1.4276.5201

[10] Dr. K. Hema Latha, "Design and Development of Solar Powered Vehicle" Assistant Professor, Mechanical Engineering Department Muffakham Jah College of Engineering and Technology, Banjara Hills, Hyderabad, India. International Journal of Engineering Research & Technology (IJERT) http://www.ijert.org ISSN: 2278-0181 IJERTV8IS080267 (This work is licensed under a Creative Commons Attribution 4.0 International License.) Published by : www.ijert.org Vol. 8 Issue 08, August-2019

[11] RITVIK MALIYA1, MOHD NAZIM2, JP KESARI "A REVIEW PAPER ON SOLAR ELECTRIC VEHICLES" Student, Dept. of Mechanical Engineering, Delhi Technological University, New Delhi , Dept. of Mechanical Engineering, Delhi Technological University, New Delhi ,Associate professor, Dept. of Mechanical Engineering, Delhi Technological University, New Delhi International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 08 Issue: 03 | Mar 2021 www.irjet.net p-ISSN: 2395-0072

[12] Kavya Prayaga, R A Sanjeevkumar, T Anathapadmanabha, H R Sudarshan Reddy Modelling of Nine Level Cascaded Hbridge PV Power Fed Inverter Using Matlab/Simulink International Conference on Advanced Computing and Communication System (ICACCS-2017) (2017) Jan.06-07

[13] B. Karur and S. R A, "Multi-level Transformerless PV inverter Based Real and Reactive Power Injection for Single Phase System," 2020 IEEE International Conference on Distributed Computing, VLSI, Electrical Circuits and Robotics (DISCOVER), 2020, pp. 258-262, doi: 10.1109/DISCOVER50404.2020.9278123.

[14] R A Sanjeevkumar Sumit A Novel Generalised Topology of a Reduced Part Count Supply Multilevel Inverter with Level Boosting Network to Improve the Quality of GlobalTransitions Proceedings (2021), 10.1016/j.gltp.2021.08.019ISSN 2666-285X

[15] Soujanya Kulkarni, Sanjeevkumar R A Modified Transister Clamped H-bridge –based Cascaded Multilevel inverter with high reliability International Journal of Research in Advent Technology, 6 (6) (2018)June