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Multi-Axis Solar Panel for Irrigation with IOT

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Abstract: Electrical power generation is a crucial concern and role on a global scale of meet the need, different approaches of electrical power generating were used. Over the past ten years, there has been a fairly noticeable increase in the world's population. To produce electricity, non-renewable energy sources like coal and oil were employed. However, those sources have a quick impact on the ecosystem, which turns into a major issue. Therefore, people concentrate on renewable energy sources like solar, wind, etc. as a backup plan for protecting the environment. Solar energy is a significant primary energy source in those sources.
The project's main objectives are to rotate the solar panels automatically according to the sun's position and to use water as efficiently as feasible. Hardware and software components can be combined to construct multi-axis solar trackers with irrigation systems. The hardware consists of a servo motor, solar panel, moisture sensor, and LDR (light detecting resistor), and the software is the Arudiono micro controller.

Keywords: Irrigation, light detecting resistor, Arudiono micro controller, multi-axis solar trackers, ecosystem

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Introduction

In this paper, we propose an automatic irrigation system that uses a multi-axis solar tracker to monitor soil moisture levels and weather patterns on a regular basis. The irrigation system will then automatically turn on the water pump when the soil moisture falls below a predetermined threshold and no rain is predicted. Automatic or semi-automatic configurations are available for the suggested system.
In its automatic mode, the gadget turns on the water pump when the soil moisture drops below a predetermined threshold, which varies according on the type and age of the crop. When the soil's moisture content hits a predetermined level, the motor is turned off. The farmer would receive an email notice regarding the field conditions if the system was in semi-automatic mode. Then, through a web interface, the farmer can turn on the motor. The motor is designed to automatically shut off when reaching a certain threshold level of soil moisture. Additionally, the system gives the farmer real-time information regarding crop conditions and weather, enabling them to maintain an effective watering program going forward. The most labor-intensive operation in the daily agriculture sector is irrigation, which is also the most significant cultural practice. Watering efficiently and knowing when to water are two crucial parts of irrigation. There are sensors and techniques available to detect when plants might need water, so this can be done automatically. Automation includes every industrial activity's mechanism to increase production speed, lower costs, and make better use of available resources.
A growing number of environmentally friendly energy sources, such as solar power, are being used due to the increased demand for electricity and worries about the effects of fossil fuels on the environment. The single-axis tracking system's computed efficiency in relation to the static panel is 32.17%, whereas the dual-axis tracking system's efficiency in relation to the static panel is 81.68%.
Water is wasted as a result of seepage in drains and an unequal labor allocation. Water reaches the basins

in disproportionate amounts following crop growth, resulting in water waste and the development of the water logging problem.

Objectives

The provision of two distinct systems is the primary goal of this project.

1. To generate solar energy by utilizing the most amount of sunlight possible.
2. Create a system that will start generating early in the morning and stop it later in the evening.
3. Create an irrigation system that will automatically maximize the amount of water used in fields.

Entails putting all the mechanisms in place for better solar power output, economic savings, and efficient use of water resources.

An IOT module in the project can send notifications.

Literature SURVEY

Dr. Sandeep Gupta graduated with a B.Tech. and an M.E. in Electrical Engineering in 2006 and 2009, respectively. Power electronics, FACTS devices, power systems stability, and artificial intelligence in power system control design are among his areas of interest in study. He is an editor for numerous reputable international journals. He reviews articles for several journals published by Taylor & Francis, IEEE, IET, Elsevier, and Compel. Apart from giving talks at various national and international conferences, he has authored or co-authored more than 40 papers that have appeared in international journals.

Optimizing the energy collected from an on-board photovoltaic array on a solar assist plug-in hybrid electric tractor (SAPHT) was the goal of a 2011 study conducted by Hossein Mousazadeh et al. The article appeared in Vol. 133 of the Journal of Solar Energy Engineering. We designed and assessed a mobile structure sun tracking system using four light-dependent resistive sensors. The experimental testing showed that thirty percent more energy was gathered using the sun-tracking device than with the horizontally fixed mode. Four LDR sensors were used to detect the direct solar rays. Every pair of LDRs had an obstruction positioned in between them to serve as a shading device. An electronic drive board with a microcontroller served as the interface between the hardware and the software.

Two-dimensional tracking tracks the sun's diurnal motion and inclination, while a single track follows the sun's path from east to west (K.S. Madhu et al., 2012, International Journal of Scientific & Engineering Research vol. 3, 2229– 5518). Focused solar panels use lenses, mirrors and tracking devices to concentrate large amounts of sunlight into a narrow beam. PV converts light into electricity using the photoelectric effect. Solar radiation is the process by which sunlight is converted into electricity. Test results show that on average days, tracking solar plates have a power efficiency that is 26–38% higher than fixed plates. Furthermore, during cloudy or wet days, it varies at all levels.

Existing System

SINGLE AXIS SOLAR PANEL

This kind of system, where the solar panel is fixed in any direction to produce electricity, is also known as a fixed type solar panel system. As a result, the solar panel produces electricity as long as it is exposed to sunlight. This kind of solar panel was mounted on the roof or the ground. In a similar vein, any shadow cast by the environment or a change in climate also has an impact on the production of electricity.

Proposed System

LDRs use sunlight as a source. Two LDR drive motors ensure that solar radiation changes in the direction of the sun during the day. One of the most important measures to improve agricultural production is aquatic plants; However, due to water shortage and manual irrigation systems, the amount of water used may differ from what is actually needed. Therefore, this project includes an automatic irrigation system based on water-absorbing steel. It mixes well with the concrete ground surface and provides good drainage. The two parts of this project are multiple solar panels and irrigation system.

Proposed Block Diagram

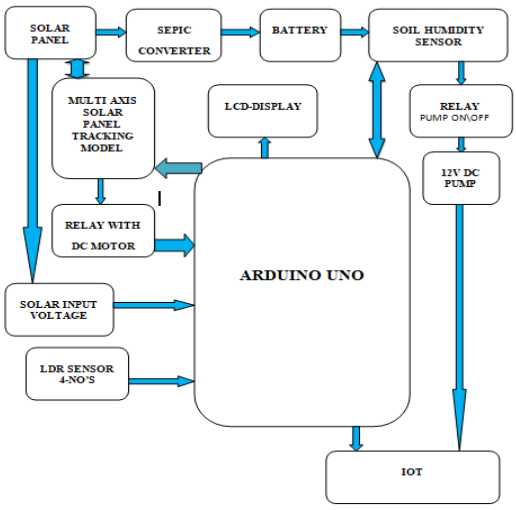

Fig 1 Block diagram of Proposed System

Multi Axis Solar Tracker

It is used to collect solar energy, and because it has multiple axes, it may rotate to face the sun in order to absorb as much sunlight as possible. It is also estimated that using a tracking system instead of a vertical line can increase solar radiation efficiency by 40%. You can produce 25% more energy annually with solar panels. Herewith. We discussed the angles

at which the sun rises and sets in January, July, September, and December.

Fig 2-a Sun rises and sets angle on January 2023 in Salem

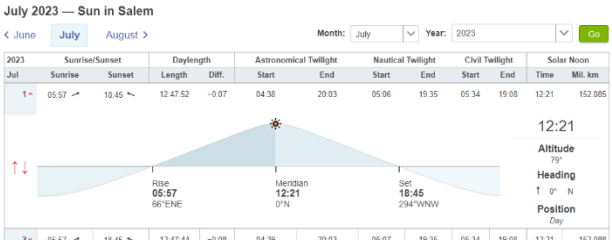

Fig 2-b Sun rises and sets angle on July 2023 in Salem

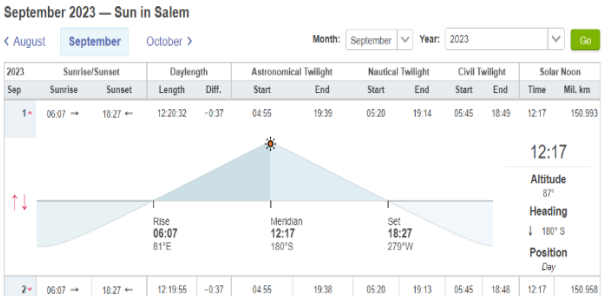

Fig 2-c Sun rises and sets angle on September 2023 in Salem

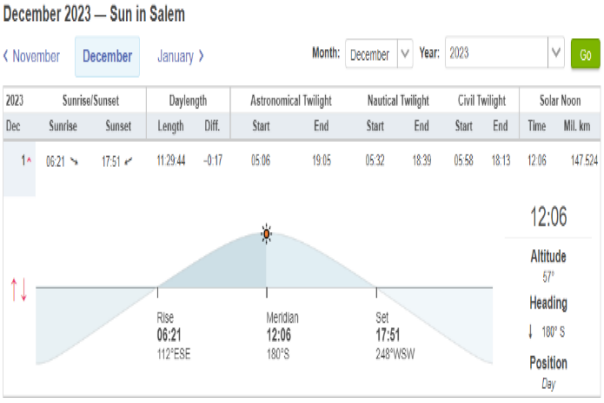

Fig 2-d Sun rises and sets angle on December 2023 in Salem

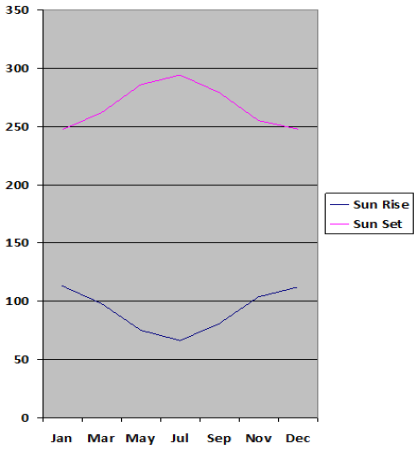

Fig 3 Sun rises and sets angle graph 2023 in Salem

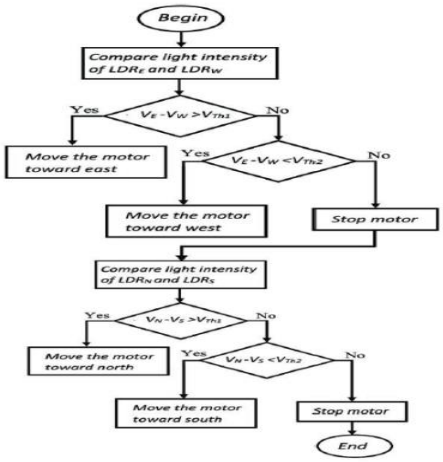

Fig 4 Flow Chart of Multi-Axis Solar Tracker

Irrigation System

For an emerging nation such as India. The primary occupation is also agriculture. Agriculture provides a direct or indirect source of income for 40% of the population. For many, it serves as their primary source of income. Because it contributes somewhat to the national income, irrigation systems that are operated manually must be mechanized due to their low efficiency. An automated irrigation system can provide more precise and accurate water delivery.

Result

SIMULATION OUTPUT

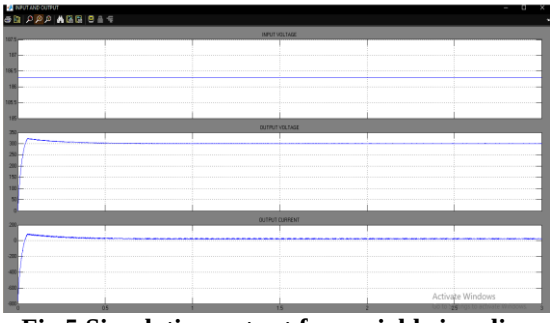

Fig 5 Simulation output for variable irradiance

With the aid of Arduino, the suggested multi-axis solar tracker maximizes solar power while automatically tracking the sun's location. A moderately large solar panel tracker would raise energy production by 30% at a place and cost several hundred dollars. Given that the cost of the solar panels in the vast arrays would be in the hundreds, a solar tracker is a highly economical addition. Another benefit is the space that is saved as opposed to adding extra panels.

Hardware Output

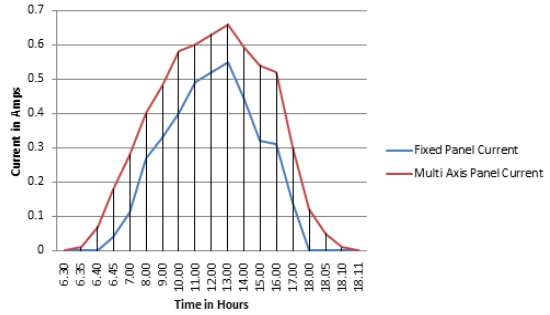

Fig 6-a Time vs Current reading of Hardware output on 08.03.2024 at Sandhiyur attayampatty, Salem

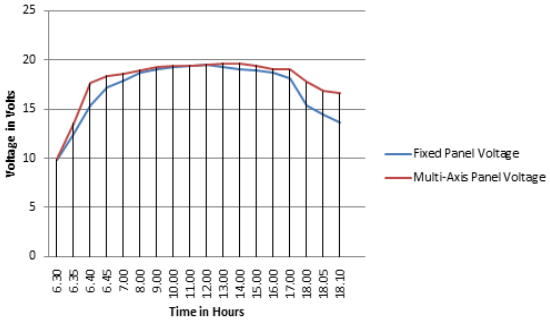

Fig 6-b Time vs Voltage reading of Hardware output on 08.03.2024 at Sandhiyur attayampatty, Salem

This irrigation system runs on autopilot. When the crops require watering, the technology might do it for them automatically. The projected energy for the water pump and control system is supplied by the solar-powered board. By optimizing water consumption, an autonomous irrigation system minimizes labor costs and conserves water. The system requires little assistance or care because it is self-starting. The daily pumping rates can also be increased with the usage of tracking arrays. This gadget shows that utilizing solar-powered photovoltaic cells to meet the directing needs of sprinkler water systems is both feasible and useful. This solution gradually fixes more irrigation problems, even if it requires a higher initial investment.

Conclusion

In summary, the project was completed satisfactorily and fulfilled the initial functional objectives. Therefore, in line with our goal

1. Consequently, a system was designed and power generated to use solar panels to delay stopping generation in the evening and start it early in the morning.
2. As a result, irrigation systems were created to automatically maximize the use of water at fields.
3. Ultimately, an IOT module that was also designed was used to monitor every operation.

References

1. J. Wu, et al., “Design and Dynamics of a Novel Solar Tracker with Parallel Mechanism,” IEEE/ASME Transactions on Mechatronics, vol. 21, no. 1, pp. 88-97, 2016.
2. Praveen Kumar B, Sasanka Jonnalagadda, Srihari M and Haji Bonothu, “Dual-Axis Solar Tracker” International Journal of Recent Scientific Research, 8, pp.15598-15603,2017.
3. N. Al-Rousan, et al., “Advances in solar photovoltaic tracking systems: A review,” Renewable and Sustainable Energy Reviews, vol. 82, no. 3, pp. 2548-2569, 2018.
4. N. Rawat, et al., “Solar PV parameter estimation using multi-objective optimization,” Bulletin of Electrical Engineering and Informatics, vol. 8, no. 4, pp. 1198-1205, 2019.
5. N. H. A. Rahman, et al., “Design and development of three stages maximum power tracking solar charge controller,” Indonesian Journal of Electrical Engineering and Computer Science, vol. 18, no. 3, pp. 1270-1278, 2020.
6. M. J. Fadhil, et al., “Design and implementation of smart Journal of Electrical Engineering and Computer Science, vol. 18, no. 3, pp. 1229-1235, 2020.
7. Das, M.; Akpinar, E.K. Investigation of the Effects of Solar Tracking System on Performance of the Solar Air Dryer. Renew. Energy 2021, 167, 907–916.
8. Diponkor, B.; Waliullah, G.M.; Hossain, M.A. Design and Implementation of Low-Cost Dual Axis Solar Tracking System Using Microcontroller. IITM J. Manag. IT 2021, 12, 88–92.
9. International Journal of Emerging Technologies and Innovative Research (www.jetir.org), ISSN:2349-5162, Vol.10, Issue 5, page no.l447-l452, May-2023