

## UTILIZATION OF SOLAR ENERGY FOR DRIVING A WATER PUMPING SYSTEM BY USING ARDUINO UNO FOR BETTER EFFICIENCY

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### ABSTRACT

As the energy demand and the environmental problems increase, the natural energy sources have become very important as an alternative to the conventional energy sources. The renewable energy sector is fast gaining ground as a new growth area for numerous countries with the vast potential it presents environmentally and economically. Solar energy plays an important role as a primary source of energy. With the impending scarcity of nonrenewable resources, people are considering using alternate sources of energy. From all other available resources sun energy is the most abundant and it's comparatively easy to convert it to electrical energy. Use of solar panel to convert sun's energy to electrical is very popular, but due to transition of the Sun from east to west the fixed solar panel may be able to generate optimum energy. The proposed system solves the problem by an arrangement for the solar panel to track the Sun. The project is divided into two stages, which are hardware and software development. In hardware development, solar panel has been used for capturing maximum light source. A DC servomotor have been used to move the solar panel at maximum voltage generated observed by Arduino UNO. The performance of the system has been tested and compared with static solar panel. This paper describes the design of a low cost, solar tracking system using Arduino UNO. This paper aims at the development of process to track the sun and attain maximum efficiency using Arduino UNO for real time monitoring.

**KEYWORDS:** Solar Tracking, microcontroller, Servo Motor, Arduino UNO, Solar Panel, Battery, Buck Convertor, Surface Centrifugal Pump.

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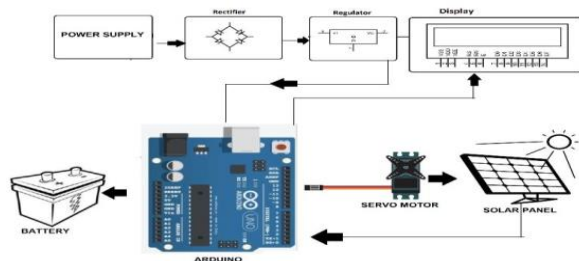
### INRODUCTION

The increasing demand for energy, the continuous reduction in existing sources of fossil fuels and the growing concern regarding environment pollution, have pushed mankind to explore new technologies for the production of electrical energy using clean, renewable sources, such as solar energy, wind energy, etc. Among the non-conventional, renewable energy sources, solar energy affords great potential for conversion into electric power, able to ensure an important part of the electrical energy needs of the planet. The conversion of solar light into electrical energy represents one of the most promising and challenging energetic

technologies, in continuous development, being clean, silent and reliable, with very low maintenance costs and minimal ecological impact. Different researches estimate that covering 0.16% of the land on earth with 10% efficient solar conversion systems would provide 20 TW of power, nearly twice the world's consumption rate of fossil energy. This proves the potential of solar energy which in turn points out the necessity of tracking mechanism in solar systems. Sunlight has two components, the direct beam that carries about 90% of the solar energy, and the diffuse sunlight that carries the remaining. The diffused portion is the blue sky on a clear day and it 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. Thus to get a constant output, an automated system is required which should be capable to constantly rotate the solar panel.

## METHODOLOGY

### A. Block Diagram



### B. Hardware

The main components are:

1. Solar panel
2. Servo motor
3. Arduino UNO
4. Pump
5. Battery

**Solar panel:** A solar cell (also called a photovoltaic cell) is an electrical device that converts the energy of light directly into electricity by the photovoltaic effect. A solar panel is a set of solar photovoltaic modules electrically connected and mounted on a supporting structure. The majority of modules use wafer based crystalline silicon cells or thin-film cells based on cadmium telluride or silicon. The structural member of a module can either be the top layer or the back layer. Electrical connections are made in series to achieve a desired output voltage and in parallel to provide a desired current capability.

**Servo motor:** A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. Servomotors are not a specific class of motor although the term servomotor is often used to refer to a motor suitable for use in a closed-loop control system. Servomotors are used in applications such as robotics, CNC machinery or automated manufacturing. A servomotor consumes power as it rotates to the commanded position but then the servomotor rests. Stepper motors continue to consume power to lock in and hold the commanded position. Servomotors are generally used as a high-performance alternative to the stepper motor. Stepper motors have some inherent ability to control position, as they have built-in output steps.

**Arduino UNO:** Arduino is a single-board microcontroller, intended to make the application of interactive objects or environments more accessible. It's an open source physical computing platform and a development environment for writing software for the board. 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. Arduino has some advantages for educational and interested recreational over other systems like Inexpensive, Open source and extensible software, extensible hardware.

**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 single-axis solar tracker. The paper continues with specific design methodologies pertaining to DC servomotor, Arduino UNO, solar panel, and Arduino software. The output given to the DC motor will determine the movement of the solar panel.

**LCD Display:** To monitor the status of the charge controller an SSCF20 20 line X 2 character LCD display was implemented into this project. This LCD display has a built-in HD44780 equivalent controller that makes it compatible with the Arduino microcontroller that the group used for the Portable Solar Power Supply. This LCD display has can display white text on a blue background. The interfacing is simplified with 4-bit and 8-bit communications. The dimension of this LCD display is 116.0 \* 36.0 \* 13.0 mm. It is wired to the Arduino microcontroller that the group built.

**Result and Discussion:** The result shows the current and voltage values received from both the static and tracking panel for different times in a day. From the result it is observed that at 8:00 am there is much improvement in current by tracking panel compared to the static panel. But as time goes on this difference in current between this two technology decreases up to around 1:00 pm. After that when the sun rotates more towards west this difference increases again. The highest current of static panel and tracking panel is 0.28amp and 0.34amp respectively at 12:00 pm. But in case of voltage the variation is lesser compare with current as the voltage has no direct relation with the sun light intensity. The maximum power output of the static panel and tracking solar panel is 3.18 and 4.03 watt respectively is found at 12:00 pm. Much more power gain is achieved in the morning and afternoon because the tracking system can accurately track the sun at these times while the static system cannot.

## CONCLUSION

**Increase in efficiency:** Solar radiation Tracker has played a vital role in increasing the efficiency of solar panels, thus proving to be a better technological achievement. The vital importance of a single axis solar tracker lies in its better efficiency and sustainability to give a

better output compared to a fixed solar panel. The tracking system is designed such that it can trap the solar energy in two directions. Generally, in a fixed axis panel it is not possible to track the maximum solar energy. Hence, maximum possible energy is trapped throughout the day as well as throughout the year. Thus, the output increases indicating that the efficiency more than a fixed solar panel (about 30 -40% more).

### **FUTURE SCOPE**

In Future the conventional energy is not sufficient for use so there is need of use non-conventional energy sources. This Project is very useful for power supply in rural areas where we can use high sensitive solar panels which can work in mild sun light also and by connecting number of solar tracker assemblies we will able to produce sufficient large quantity of power which will be able to supply power to medium size village. We can make use of solar panels in our day to day life for street lighting, in mobile phone chargers, water heaters, etc.

### **ADVANTAGES**

- The cost of single axis is less than dual-axis tracking system.
- The conservation of non-renewable energy resources.
- Independent control.
- Generating efficiency.
- Universal application.
- Lower amount of Waste and Pollution.
- Offsetting Green House Gases.
- Limiting the use of conventional energy sources.

### **LIMITATION**

- When there is cloudy atmosphere it is difficult to generate high voltage.
- Panel rotations require an extra power from outside of power used that produce by panel itself.
- The efficiency is 5-6% less than dual-axis Tracking System.

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