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The System's Design and Construction for Solar Agricultural Water Pumps

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Abstract: ***One of the biggest issues in the world's energy system is the scarcity of energy resources and the horrifying pollution that results from their widespread usage, which calls for a solution to the long-term energy crisis that is currently taking place. Since the sun is the most powerful source of energy, scientists have been trying to figure out why solar energy cannot be used to create electricity for so long. Solar energy may be produced from sunlight either directly using photovoltaic (PV) technology or indirectly using concentrated solar power. This essay addresses a topic in agriculture where a specific application has been highlighted as having the potential to effectively alleviate the farming industry. In order to demonstrate how the model will really function in the irrigation industry in the near future, a solar water pumping system is explained along with the creation of a hardware model. In order to be further implemented for large-scale use, a micro model is tested with and proven here***
Keywords: Disel pump, photovoltaic, solar panel, solar radiation, Agricultural Water

I. INTRODUCTION

Solar radiations are produced as a byproduct of the sun's nuclear fission of hydrogen atoms into helium, which releases energy. The sun is a massive source of energy. The quantity of solar energy that the earth's surface receives when this solar radiation strikes it is around 1367 W (watt) per square metre. Then, these sun rays may be employed for a variety of things, including heating, Flat plate collectors, which absorb heat and transmit it to a fluid (such as water or air), can be used to generate electricity for solar heating. Photovoltaic cells are used in the solar energy production process to turn solar radiation (energy) into electricity for later use. Another renewable source of energy is solar power.

Our technology harnesses this solar energy to generate power that powers a water pump for use in agriculture. Farmers are no longer dependent on grid electricity as a result of the elimination of the power needed to run the pump. In areas of the world where various energy sources are being used for work, the need and demand for energy are growing geometrically. In comparison to other energy sources, solar energy is becoming more and more popular throughout the world since it is always available and produces no pollution..

The amount of solar energy that is made accessible varies depending on the geographical location, the time of day, and the season. The amount of solar irradiance that falls on a specific area determines the amount of solar energy that is accessible there. The amount of solar radiation falling on a surface is known as solar irradiance and is expressed in kW/m2. .

Although harnessing solar energy is a relatively recent concept, it is free and infinite. All forms of energy on earth are taken from the sun, which is the planet's main source of energy. The potential for solar energy is the highest of any renewable energy source. In comparison to other energy sources, solar energy has been shown to be extremely efficient and ecologically beneficial in many design and invention fields. In the form of electrical energy, solar energy may be utilised to pump water from wells or streams to overhead tanks for storage or for use directly on farms. The electrical pump and fuel pumps are two other techniques for pumping water. When compared to the solar pump, each of them has advantages and disadvantages. As contrast to water pumps that are driven by grid electricity or diesel, solar-powered pumps run on electricity produced by photovoltaic panels or the radiated heat energy from captured sunshine. In comparison to pumps driven by internal combustion engines (ICEs), the operation of solar-powered pumps is more cost-effective, primarily because of lower operating and maintenance expenses. When there is no access to the grid and other energy sources, particularly wind, are insufficient, solar pumps can be used.

Around the world, conventional electricity or electricity produced by diesel engines are typically used for water pumping. Solar water pumping reduces reliance on coal-, gas-, or diesel-based power. In addition to requiring expensive fuels, diesel and propane-based water pumping systems can produce noise and air pollution

A diesel pump is 2-4 times more expensive than a solar photovoltaic (PV) pump overall, as well as to operate and maintain. Solar pumping systems don't use any fuel, are minimal maintenance, and are environmentally benign. PV pumping is one of the most potential uses of solar energy, especially given the lack of grid electricity in rural and isolated places in the majority of the globe.

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With the exception of using solar energy as its power source, the technique is similar to any other conventional water pumping system. Due to the lack of access to energy and the rising cost of petrol, PV water pumping has become more and more important in recent yearsThe size of the PV array and incident solar radiation both affect the flow rate of pumped water. Comparing a correctly constructed PV system to traditional pumping systems, considerable long-term cost reductions are achieved. Additionally, tanks may be utilised to store water instead of the need for batteries to do so for energy. In underdeveloped nations, agricultural output is heavily reliant on rainfall, and it suffers when there isn't enough water during the summer.

Although summertime offers the most solar radiation, more water may be pumped to fulfil rising demand for water. Urban water supply systems require power to pump water in cities. PV pumping systems may be used for water supply in rural, urban, community, industry, and academic organisations.

II. LITERATURE REVIEW

Numerous investigations on solar-powered water pumping systems have been conducted during the past few of years. An observation from related investigations is as follows: For farms that need water in isolated, poor, and backward regions, solar water pumps can offer straightforward, effective, and low-labor watering choices.

The following are some significant considerations with solar water pumping systems: Instead of storing electricity in batteries, water is kept in metallic or plastic tanks. This lowers expenses and greatly simplifies the system

Additionally, a float switch stops the pump when the tank is full. The current supply to the pump is smoothed out using an electronic pump control system. It functions similarly to an automated gearbox in that it facilitates the pump's startup and nighttime operation. Slow and steady wins the race, as we've heard with the turtle and the hare.

Many solar pumps are designed to run slowly throughout the day, which enables water to be pushed across great distances and up steep slopes. Smaller diameter pipe is needed for slow pumps, which lowers installation costs..

Slow pumps are also more energy-efficient and enable the utilisation of scarce water resources, such a slowly replenishing well. Water conservation should be used to lower a system's total cost. Considering how costly photovoltaic or PV modules are, every effort to reduce water usage will reduce the cost of installation. Smaller systems with less efficient combustion engines are often where solar pumps are most competitive..

We studied the solar water pump's photovoltaic operation and contrasted it with the operation of a diesel water pump.

We found that employing different sensors for the various tasks allowed us to decrease the amount of physical labour required and efficiently utilise water.

The solar pump is compared to the diesel pump in such a way that the solar pump is found to be more cost-effective than the diesel pump.

Solar electric power is a great option for distant water pumping because of its affordability and dependability.

The initial cost of installing solar is significant, but the ongoing maintenance expenses are modest.

III. DESIGN & WORKING

A. Diagram

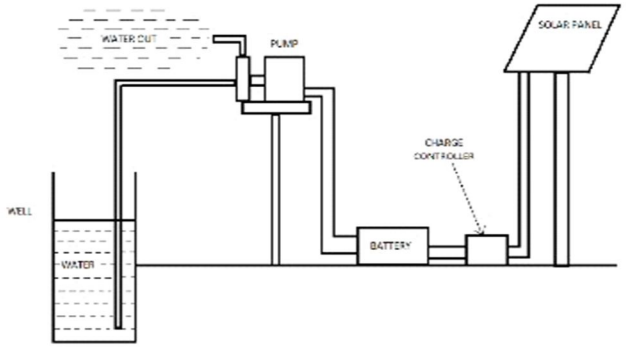

Fig 1 : Diagram for Solar Agricultural Water Pumping System

B. Working Principle

The charge controller is linked to the solar panel. The battery is charged using the charge controller. The panel keeps the battery charged to capacity.

One end of the pump is inserted into the bore hole, while the other end is placed in the tank. The pump is linked to the battery. The pump now draws water from the bore well to fill the tank when the switch is turned on.

C. Methodology

The solar water pumping module and the automatic irrigation module are the two primary components of the irrigation system. Solar panel, control circuit, battery, and a water pump driven by solar energy are all included in the solar pumping module..

Electrical energy that may be utilised to power the water pump is produced by solar panels with the necessary capacity. The direct current (dc) generated by a solar panel is converted into alternating current (ac) using a circuit known as a converter. The direct current generated by the solar panel is also stored in a battery. All of the systems' numerous processes are automated when using the automatic irrigation module, therefore ongoing monitoring and feedback are not necessary..

Components Used:

Solar Panel

Battery

Centrifugal Pump

Converter Circuit

Water Tank

1) Solar Panel

FIG 2 : Solar Panel

A bundled and linked assembly of many photovoltaic cells is what makes up a solar panel. The power of a solar panel's DC output determines its rating. It comprises of a 40 watt, 8 A, 21.6 V, crystalline silicon cell. It is 500 mm x 700 mm in dimension. The size of a panel allows one to assess its effectiveness. Solar panels employ the photovoltaic effect to produce electricity using solar energy in the form of light. The desired output voltage is then achieved by connecting electrical components in series. The photovoltaic principle, which underlies how solar cells function, is one of the most alluring non-conventional energy sources with a track record of dependability at all power levels, from micro to megawatt.

Through the photovoltaic effect, photovoltaic modules harness the light energy (photons) from the Sun to produce electricity.

Wafer-based crystalline silicon cells or thin-film cells are used in the majority of modules. The top layer or the rear layer of a module may serve as the structural (load-bearing) element. Additionally, cells need to be shielded from moisture and mechanical harm. The majority of modules are stiff, but there are also others that are semi-flexible and based on thin-film cells..

Electrically, each cell has to be linked to the next in a series. To make it simple for weatherproof connections to the rest of the system, the majority of photovoltaic modules employ MC4 connectors on the outside. Electrical connections between modules are done either in parallel or in series depending on the output voltage or current capability that is wanted. Silver, copper, or other nonmagnetic conductive transition metals may be present in the conducting wires that remove the current from the modules. In cases of partial module shading, bypass diodes may be added or employed externally to increase the output of the lighted module parts.

Concentrators, in which light is focussed by lenses or mirrors onto smaller cells, are among the unique solar PV modules. This makes it possible to employ cells with high cost per unit area (like gallium arsenide) in an economical manner. In order to properly support the panel structure, solar panels also need metal frames made up of racking elements, brackets, reflector shapes, and troughs.

2) Battery

A battery that is powered by electricity is made up of one or more electrochemical cells that have external connections for powering electrical equipment. Anode and cathode are the battery's positive and negative terminals, respectively. The terminal labelled "negative" is the source of the electrons that will flow and send energy to an external device when linked to an external circuit.

3) Centrifugal Pump

There are two different types of pumps on the market: centrifugal and reciprocating pumps. We choose a centrifugal pump since it has a higher discharge rate than a reciprocating one.

4) Converter Circuit

The direct current (dc) generated by the solar panel is transformed into alternating current (ac) via a circuit known as a convertor circuit, which may then be utilised to power the water pump. In order to convert the battery's output into ac current before it is utilised, the converter circuit is installed after the battery. 3.3.5 Tank, Water In essence, a tank is similar to a container into which water is pumped and stored. The (float) switch is used to control the tank.

D. Assembly Project

IV. CONCLUSION

The proposed approach resolves the government's and farmers' energy issue. With the implementation of this project, water waste has decreased and water shortage is now avoided. Additionally, this scheme removes farmers' reliance on the grid for irrigation electricity. Additionally, there is less human involvement in irrigation. enabling an easy-to-use irrigation system that promotes output and also lowers poverty and unemployment for struggling farmers who cannot afford and sustain a higher grid supply for production. After carefully examining the data from the solar pump testing and paying great attention to how the diesel and electric pumps performed:

Compared to the gasoline and electricity pumps, the solar requires minimal to no maintenance.

Compared to electrical and solar pumps, gasoline pumps have the highest efficiency and best performance..

The solar pump has the benefit of being the cleanest, most ecologically friendly, consuming the least amount of energy, and using the least expensive energy source (the sun's free energy).

A solar pump that uses the same amount of energy as a diesel or electric pump will produce greater results. Therefore, farmers and rural regions without connection to the national grid should utilise the solar pump..

A. Advantages

1) Cost effective: When compared to traditional systems, the SPV systems are more cost-effective due to their lifespan and cost to ultimate benefit. The farmer is also spared from having to invest money to draw lines from the grid to his field or fields.The government may save a significant amount of money by not connecting every agricultural area to the national electrical grid.

2) Reliable: In rural locations, the SPV provides a more dependable, constant, and predictable power choice than the conventional power supply..

3) Free fuel: The SPV system's energy source, sunlight, is a widely accessible, unbounded, dependable, and cost-free energy source. As a result, the SPV system has no fuel bills..

4) Low maintenance: They are popular in isolated rural regions since they require little maintenance and no refuelling, keeping operating and maintenance costs relatively low. The vendors provide annual maintenance contracts at substantially discounted rates for maintenance..

5) Local generation of power: The SPV system uses sunshine as a local resource. Greater energy security and access control are made possible by this.

6) Easy transportation: Due to its modular design, SPV systems are easily extendable to increase capacity and may be carried in sections or components.

7) Energy Conservation : One of the most efficient ways to save energy is undoubtedly solar energy, which also offers a way to decentralise PV generation in rural regions. Solar pumps use little energy, and a decentralised system prevents the needless use of T&D networks. Water conservation: When used in conjunction with water-saving strategies like drip irrigation and nighttime distribution of (daytime pumped and stored) water, SPV sets are very cost-effective. The SPV system enables the best possible use of the limited groundwater supply.

8) Environmental friendly :The use of sunlight as a fuel source results in clean, environmentally friendly, and decentralised energy generation, which reduces the need for fossil fuels, slows down deforestation, and avoids environmental damage.

B. Applications

For agricultural applications, it is employed. It is utilised in both homes and enterprises.

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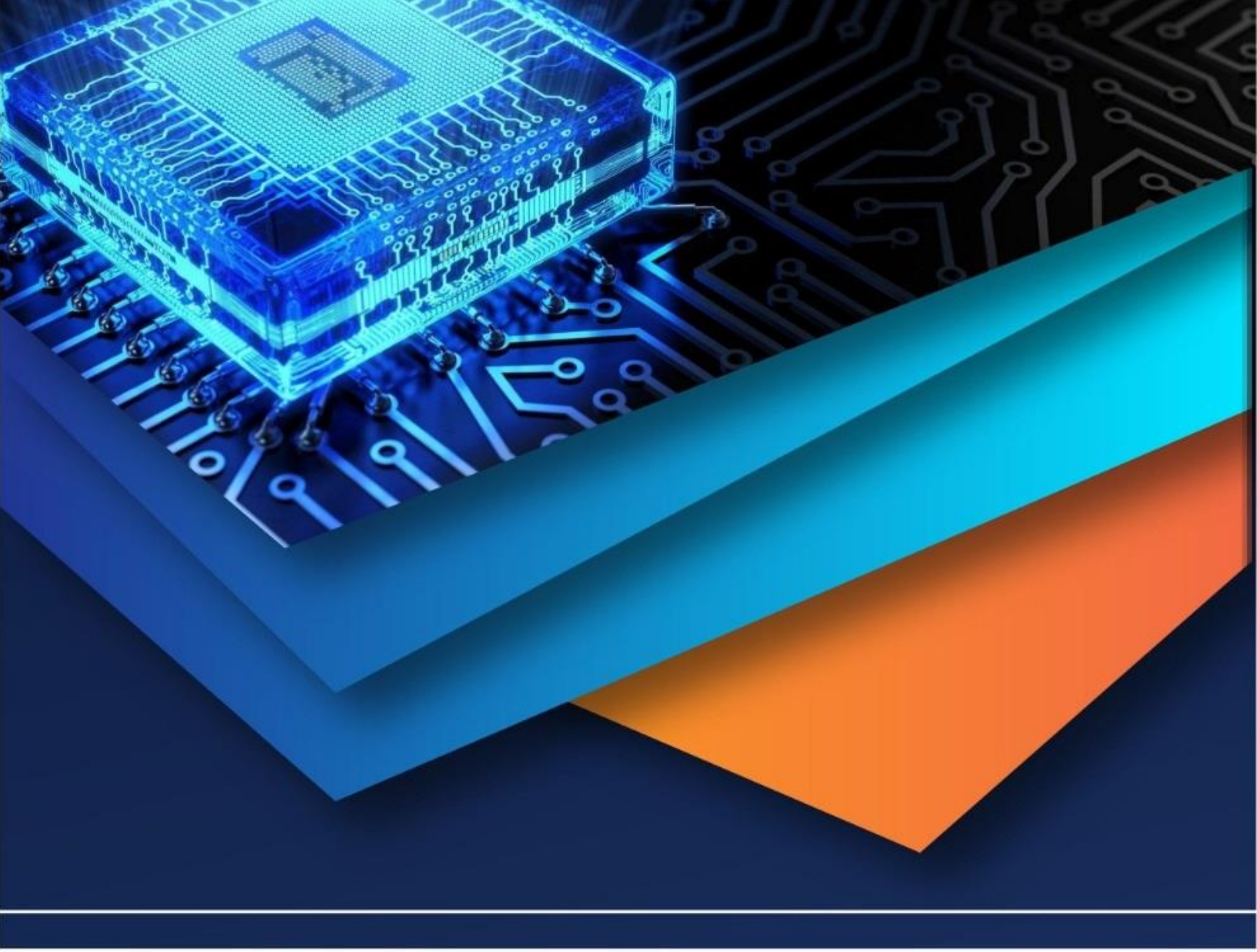

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