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DESIGN AND FABRICATION OF AGRICULTURAL SOLAR PUMP

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Abstract - *Renewable energy sources that are abundant in nature and Solar Energy source specially, has the capability to provide energy requirements with almost zero emission. The solar energy is available in large quantities and no other source in renewable energy has as much potential as solar energy. The solar-powered water pumping system can be used in all walks of Works however it is widely used and suitable for rural areas that witness energy crisis situations. Due to geographical positions, sultanate of oman and gulf region has ample sunshine throughout the year which makes it ideal location for utilization of solar energy. Farms, Villages, and Cattle herds in developing countries need hydraulic output power of less than a 1kw (kilowatt). Many of these users are too far away from an electrical grid to economically tap that can be used as a source of power, or engine-driven pumping system that tends to be highly expensive as well as unreliable due to the high cost of purchased fuel, insufficient maintenance and repair capabilities.[4]*

Key Words: **Solar energy, Solar panel, Pump, Zero Emission.**

1. INTRODUCTION

Sun a huge source which generates energy through nuclear fission of hydrogen nuclei into helium and as a by product of this released energy in the sun the solar radiations are emitted. This solar radiation then strike the earth surface and the amount of solar radiation received by earth surface is around 1367 W (watt) per square meter. These solar radiation can then be used for several purposes like heating, The power production in solar heating can be by using flat plate collectors which absorbs and transfers heat to form of a fluid (water or air). The solar power production involves the use of photo voltaic cells to convert solar radiation (energy) into electricity for further utilization. Solar energy is also a renewable source of energy which is free of cost and abundantly available in nature and most importantly it is eco-friendly. Our system makes uses of this solar radiation to produce power which runs a agricultural water pump. Thus the power required to run the pump is eliminated which removes the dependency of farmers on grid power.[1]

1.1 Literature Review

Within the last couple years, A variety of studies have been focused upon solar powered water pumping system. An insight of similar studies is seen as follows: Solar water pumps can provide simple, efficient and low labor watering options for farms that require water in remote and under-developed backward areas. Several key points to keep in mind about solar water pumping systems include: Water storage in metallic or plastic tanks is used instead of power storage in battery. This reduces costs and makes the system a lot simpler. A float switch also turns the pump off when the tank is full[2].

An electronic pump controller system is used to smooth out the current supply to the pump. It acts like an automatic transmission in a sense that it helps the pump to start and also operate in low light conditions. As we have heard with the turtle and the hare, slow and steady wins the race. Many solar pumps are made in regards to pump slowly over the course of the day, this allows water to be pushed over considerable distances and vertical rises. Slow pumps require small diameter piping, reduced installation cost. Slow pumps also require less power and allow the use of limited water resources, such as a slowly recharged well. To reduce the overall cost of a system, water conservation should be practiced. Photovoltic or PV modules are very expensive, and reducing water use in any manner will save on the installation cost. Solar pumps are generally most competitive in the case of smaller systems where combustion engines are least economiv[3].

1.2 Principle of Solar Water Pump

Solar water pumping system is based on PV technology that converts the sunlight into electricity to pump water. The PV panels are then connected to a motor (DC or AC) which converts the electrical energy supplied by PV panel into form of mechanical energy which is then converted to hydraulic energy by the pump. The capacity of a solar pumping system to pump water consists of three main variables: pressure, flow, and its power to the pump. For design purposes, its pressure can be regarded as the work

done by a pump to lift or discharge a certain amount of water up to the storage tank. The difference of elevation between the water source and storage tank determines the work, pump is supposed to do. The water pump will draw out a certain power which a PV array needs to provide. A schematic of a typical direct-coupled DC solar PV water pumping system with MPPT.

1.3 Solar-Powered Water Pumping System Configurations

There are basically two types of solar-powered water pumping systems, Battery-coupled pumping system and Direct-coupled pumping system. A variety of factors must be taken into consideration, such as in Battery-coupled water pumping systems; the systems consist of photovoltaic (PV) panels, charge control, regulator, batteries, pump controller, pressure switch and tank as well as DC water pump shown below (Figure).

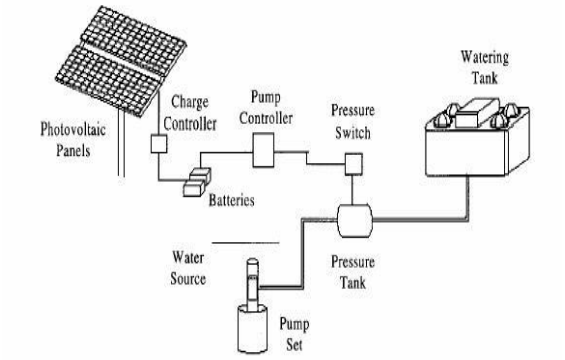


Fig (a): DC-Coupled Water Pumping System

Thus, during night and low light conditions, the system is still capable to deliver a constant amount of water for livestock. The use of batteries however has its drawbacks such as; First, batteries can reduce the efficiency of the overall system due to the fact that the operating voltage is produced by the batteries and not the PV panels.

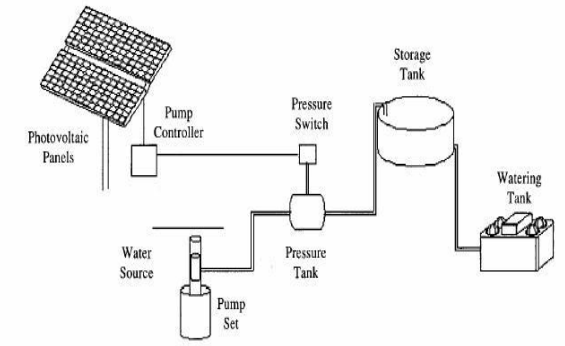


Fig (b): Battery-Coupled Pumping System

In case of direct-coupled pumping systems, the electricity from the PV modules is sent to the pump, which then pumps water through a pipe to where it is required. This system is designed in such a way that it is used to pump water only during the day. The amount of water pumped is totally depends on the amount of sunlight falling on the PV panels and the type of pump used. Due to the intensity of the sun and the angle at which it hits the PV panel changes throughout the day, And thus the amount of water pumped by this system also changes throughout the day. For example, during most favorable sunlight periods (late morning to late afternoon on bright sunny days) the pump operates near 100 percent efficiency with maximum amount of water flow. However, (during early morning and late afternoon), pump efficiency might drop by as much as 25 percent or more under low-light conditions. Water-storage capacity is also important in this pumping system. During the cloudy days, pump efficiency may drop off even more. And to make up for these fluctuating flow rates, a good selection between the pump and PV module(s) is very necessary to achieve efficient operation of the desired system.

2. METHODOLOGY

The irrigation system consists of two main modules- Solar water pumping module and Automatic irrigation module. The Solar pumping module has the following components: solar panel, control circuit, battery and a water pump powered by the help of solar energy. The solar panels of desired capacity is used to generate electrical energy that can be used to drive the water pump. Convertor circuit is a electric circuit used to convert the direct current (dc) produced via solar panel into alternating current (ac). Battery is also a component used to store the direct current produced from the solar panel. In case of Automatic Irrigation module all the various process in the systems are automatic and do not require constant tracking and feedbacks.

Components Used:

- Solar Panel
- Battery
- Centrifugal Pump
- Converter Circuit
- Water Tank

A. Solar Panel:

A solar panel is a packaged and connected assembly of several photovoltaic cells. Solar panel is rated based on its DC output power. It consists of crystalline silicon cell with

8 A/21.6 V; 40 watt power. It has a size of 500 mm x 700 mm. The efficiency of panel is inspected by the area of a panel. Solar panels uses light energy coming from the sun to generate electricity via form of photovoltaic effect. Electrical connections are then made in series to achieve a desired output voltage.

B. Battery:

An electric operated battery is a device consisting of one or several electro-chemical cells with external connections that are provided to power the electrical devices. Mostly positive terminal of the battery is cathode and its negative terminal is called anode. When connected to an external circuit, the terminal marked as negative is the source of electrons that will flow and transmit energy to an external device.

C. Centrifugal Pump:

There are two types of pumps available in market either reciprocating and centrifugal pump. We are using centrifugal pump which can give maximum discharge as compare to reciprocating one.

D .Converter Circuit:

A circuit called as convertor circuit is used to convert the direct current (dc) produced via solar panel into alternating current (ac) that can then be used to run the water pump. Convertor circuit is placed after the battery so that output from the battery is converted into ac current before it is used.

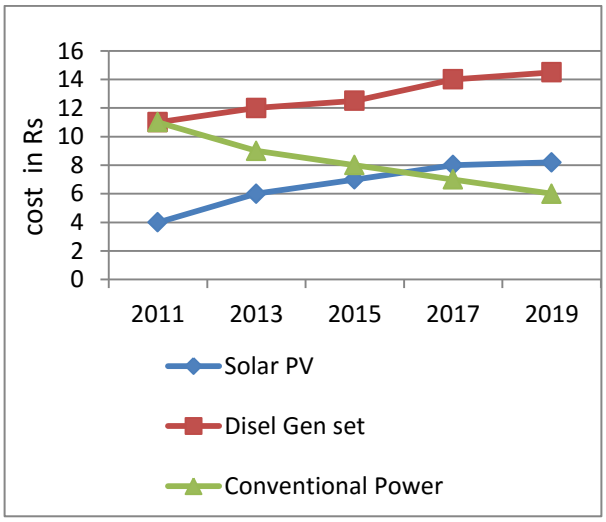
E. Water Tank:

A tank is basically like a container where the water is pumped and stored. The Tank is controlled using a (float) switch.

Table-1: Bill of Materials

SR No.	Component	Description
1.	Solar Panel	Polycrystalline 500mm x700mm
2.	Centrifugal pump	Maximum Discharge 700LPH
3.	Battery	12 volts
4.	Electric Motor	0.25HP

Chart -1: Cost Comparisons of Pumping Systems



3. ADVANTAGES AND APPLICATIONS

3.1 Advantages:

- Prevents Wastage of Water.
- Requires no grid power supply.
- It relies on renewable source of energy.
- It does not require much feedback and attention of people.

3.2 Application:

- Suitable in agricultural fields.
- Used to maintain experimental plants.

4. CONCLUSION

The Proposed solution solves the energy crisis of the farmers as well as the government. With implementation of this project the water wastage is now reduced and also prevents the scarcity of water. This project also eliminates the dependence of farmers on grid power supply for irrigation purposes. As well as human intervention in irrigation is reduced. Making possible a hassle-free Irrigation system that supports production and also reduces poverty and unemployment for poor farmers that cannot afford and sustain over Grid supply for production.

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