ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

*(An ISO 3297: 2007 Certified Organization)*

*Website: www.ijareeie.com*

**Vol. 6, Issue 5, May 2017**

# A Survey on Automatic Irrigation System Using Solar Panel

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**ABSTRACT**: Solar energy is the most abundant source of energy in the world. Solar power is not only an answer to today's energy crisis but also an environmental friendly form of energy. Photovoltaic generation is an efficient approach for using the solar energy. Solar panels (an array of photovoltaic cells) are nowadays extensively used for running street lights, for powering water heaters and to meet domestic loads. The cost of solar panels has been constantly decreasing which encourages its usage in various sectors. One of the application of this technology is used in irrigation systems for farming. Solar powered irrigation system can be a suitable alternative for farmers in the present state of energy crisis in India. This is a green way for energy production which provides free energy once an initial investment is made. In this paper, we propose an automatic irrigation system using solar power which drives water pumps to pump water from bore well to a tank and the outlet valve of tank is automatically regulated using controller and moisture sensor to control the flow rate of water from the tank to the irrigation field which optimizes the use of water.

**KEYWORDS:** Photovoltaic array, Controller, Array Voltage, DC Motors, Brushless DC Motors, Three Phase Permanent Magnet Motors, Surface Centrifugal Pump, Submersible Pump, Moisture Sensor Module

## I.INTRODUCTION

In this proposed system, we utilize the solar energy from solar panels to automatically pump water from bore well directly into a ground level storage tank depending on the intensity of sunlight. While conventional methods include pumping of water from bore well into a well and from this well onto field using another pump, our system uses only a single stage energy consumption wherein the water is pumped into a ground level tank from which a simple valve mechanism controls the flow of water into the field. This saves substantial amount of energy and efficient use of renewable energy. A valve is controlled using intelligent algorithm in which it regulates the flow of water into the field depending upon the moisture requirement of the land. In this system we use a soil moisture sensor that detects the amount of moisture present in the soil and depending upon the requirement of level of moisture content required for the crop the water flow is regulated thus, conserving the water by avoiding over flooding of crops.

Almost 70% of India's population depends on agriculture either directly or indirectly. While 44% of the 140 million sown hectares depend on irrigation, the rest relies on the monsoons. Irrigation, therefore, is essential for good crop yield. Most electrical consumption in this sector goes towards operating pump sets for irrigation. In 2006-7, India's agricultural sector accounted for 22% of the total electricity consumption, up from 10% in the 1970s. There are

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about 21 million irrigation pump sets in India, of which about 9 million are run on diesel and the rest are grid-based. Grid electricity for agriculture in India is provided at very low tariffs - in most cases, flat rates are charged based on the ratings of the pump. This is largely due to logistical difficulties faced with metering and charge collection. But this practice of providing electricity to farmers at highly subsidized rates has led to increasingly high consumption patterns and widespread use of inefficient pumps across the nation. Also, pumps of lower ratings are used to power applications requiring higher power. These factors, among others, have led to an invidious irrigation-energy nexus. Apart from this, limited and unreliable supply of grid electricity has led to farmers' extensive dependence on diesel for water pumping. In addressing this challenge, the efforts of the Gujarat government are noteworthy. They introduced the Jyoti gram Yojana, a programme that seeks to provide a reliable supply of power for agricultural and domestic purposes in rural areas.

According to the survey conducted by the Bureau of Electrical Energy in India in 2011 there are around 18 million agricultural pump sets and around 0.5 million new connections per year is installed with average capacity 5HP. Total annual consumption in agriculture sector is 131.96 billion KWh (19% of total electricity consumption). Solar powered smart irrigation technique is the future for the farmers and a solution for energy crisis. Sine PWM technique has been used for inverter operation for minimum harmonics which further increases the efficiency of the system. The rating of the system was calculated corresponding to the pump specifications.

## II.COMPONENTS AND EQUIPMENTS USED

**A. Photovoltaic Array:** An array of photovoltaic modules connected in series and possibly strings of modules connected in parallel.

**B. Controller:** An electronic device which matches the PV power to the motor and regulates the operating, starting and stopping of the PVP. The controller is mostly installed on the surface although some PVPs have the controller integrated in the submersible motor pump set.

**C. Array Voltage:** Some of the pumping systems have array voltages. This has the advantage that the array may be further from the borehole without significant voltage drop (dependent on cable size and current). Array positioning may be important where there is potential for theft.

**D. DC Motors:** DC motors reach efficiencies of up to 80% and are therefore significantly more efficient than sub-kW three phase motors which have efficiencies in region of 60% to 65%.

**E. Brushless DC Motors:** This combine the high efficiency of DC motors with low maintenance as opposed to brushed DC motors which require regular brush replacement (approximately everyone to two years – head and quality dependent).

F. **Threephase permanent magnet motors**: This similarly combines the efficiency of permanent magnet motors with low maintenance.

G. **Surface Centrifugal Pump**: Surface pumps are suitable for areas where the water level is within 7m below ground level. A surface or centrifugal pump is normally placed at ground level. The pump is suitable for pumping from shallow bore wells, open wells, reservoirs, lakes and canals. The solar pump driven by permanent DC motor is connected directly to an array of solar panels. The pumping has total dynamic head (suction plus delivery) of 14m. The maximum suction head is 7m or22 feet. The pump will not work if the water table is below 7m in depth. It is possible to increase the delivery head if the suction head is less than 7m. This enables one to pump water even from deep wells by installing the pump inside the well called 'cut-down'.

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Fig.1 Surface Centrifugal Pump

H. **Submersible Pump**: A submersible pump is one that is immersed in water. It pumps water by displacement. Submersible pumps are suited both to deep well and to surface water sources. Moat deep wells are submersible pumps. These pumps ar costlier but have a longer life and greater reliability than surface pumps.

**I. Moisture Sensor Module:** A moisture sensor is used to sense the level of moisture content present in the irrigation field. It has a level detection module in which we can set a reference value. This circuit can be used with analog probes that produce a voltage proportional to soil moisture such as VG400 probe shown in Fig. 3. The moisture content of the soil is found by using the soil moisture sensor such as VG400 which produces an equivalent output voltage proportional to the conductivity between the two probes.

Fig. 2 Moisture Sensor Module

## III.METHODOLOGY

### A. Block Diagram

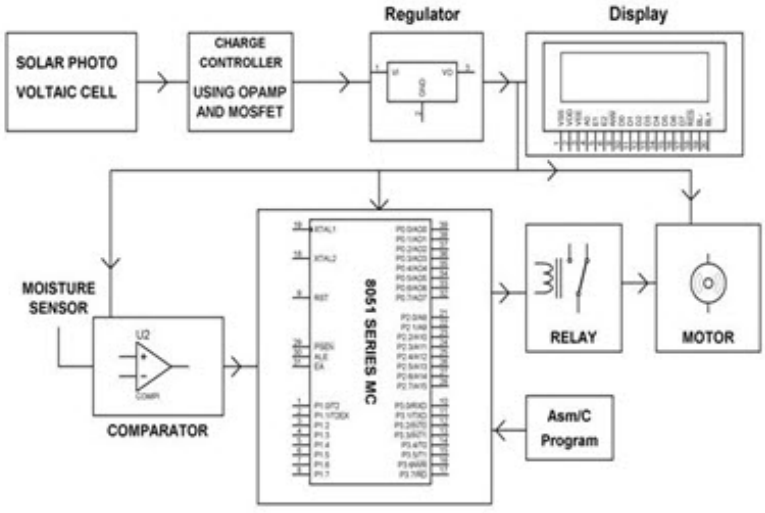


Fig.3 Block Diagram

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**B. Working**

- The power supply comprises of a step-down transformer, bridge rectifier, voltage regulator. Wherein the step-down transformer steps down the voltage to 12 volts AC, and a bridge rectifier converts AC to DC, then a voltage regulator regulates the voltage to 5V which is used for the microcontroller operation.

- The above block diagram is comprised of sensor parts, which are assembled using op-amp IC (operational amplifier IC). Op-amps are designed here as a comparator. Two copper wires are injected into the soil to sense the condition of the soil, whether it is wet or dry.

- **Dry Condition:** A microcontroller in this project is used to control the whole system by observing the sensors. When the sensors sense the soil condition as dry, then the comparator sends the command to the microcontroller, and it sends instruction to the relay-driver IC then, it reminds the motor to pump water to the crops. Here comparator acts as an interface between the sensing arrangement and the microcontroller The status of the soil and the water pump is displayed on the LCD which is interfaced to the microcontroller.

- **Wet Condition:** When the moisture sensor sense thee soil condition as wet, then the comparator sends the command to the microcontroller and it sends instruction to the relay driver IC, then it reminds the motor to stop the pumping to the crops. Here also the comparator acts as an interface between the sensing arrangement and the microcontroller. The status of the soil and the water pump is displayed on the LCD which is interfaced to the microcontroller.

- The dry and the wet condition of the soil is determined by the resistance of the soil. As we know that the resistance is directly proportional to the moisture. When the moisture sensor senses the resistance to be high, then the soil is at dry condition and when the moisture sensor senses the resistance to be low then the soil is at wet condition.

Fig.4 Working Circuit Model

## IV.ANALYSYS

**A. Low operating cost:** One of the important advantages is the negligible operating cost of the pump. Since there is no fuel required for the pump like electricity or diesel, the operating cost is minimal.

**B. Low Maintenance:** A well designed solar system requires little maintenance beyond cleaning of panels once a week. Most vendors provide the post installation service through trained technicians for every cluster, so that the farmers don't need to worry about availability of spares or other related problems.

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**C. Harmonious with nature:** Another important advantage is that it gives maximum water output when it is most needed i.e., in hot and dry months. Slow solar pumping allows us to utilize low yield water sources.

**D. Flexibility:** The panels need not be right beside the well. They can be anywhere up to 20m 60 feet away from the well, or anywhere you need the water. So, it offers freedom regarding the placement of panels. These pumps can also be turned on and off as per the requirement, provided the period between two operations is more than 30 seconds.

## V.CONCLUSION

Solar pumps do not utilize boreholes to full extent - a borehole with a safe yield of $5m^3$/hour will deliver more in 8 hours when pumped with a diesel engine than with a solar pump. It is understood that tracking will provide a better utilization factor but still not the same capacity as diesel.

By using the automatic irrigation system, it optimizes the usage of water by reducing wastage and reduces the human intervention for farmers. The excess energy produced using solar panel can also be given to the grid with small modifications in the system circuit, which can be a source of the revenue of the farmer, thus encouraging farming in India and same time giving a solution for energy crisis.

Proposed system is easy to implement and environment friendly solution for irrigation fields. The system was found to be successful when implemented for bore holes as they pump over the whole day. Solar pumps also offer clean solutions with no danger of borehole contamination.

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