Solor Powered Water Pumping System

Sri Goda R[1] , Prof. Sathisha G[2]
[1]Dept of Computer Science and Engineering
[2] Assistant Professor, Dept of Computer Science and Engineering
[1, 2] Atria Institute of Technology, Bangalore

Abstract- *One of the basic needs of human being include electricity. With the increase in price of fossil fuels generation of electricity becomes way easier and cost effective with the renewable energy sources. Solar energy is a largely available free renewable source of energy from sun which is used for various applications. A solar photovoltaic water pumping system is one such that offers an alternate means to meet the electricity demand for irrigation ,domestic and livestock watering. The solar water pumping systems play a significant role under the circumstances of inadequate supply of conventional source of energy. The main objective of the proposed system is to ensure that the system intake maximum sunlight using MPPT controllers, controlling the water flow in the pump with required pressure and monitoring water level using sensors and indicating the same to the user with a message using IoT system.*

Keywords- MPPT controllers, water sensors, pressure sensors, IoT system.

I. INTRODUCTION

From agriculture to the energy industry ,pumps are found in a wide range of applications .The main working principle of a water pump basically depends upon the positive displacement principle and kinetic energy which helps pushing the water. There are several technology alternatives including windmills, generators, hand powered pumps, solar arrays for power generation or to lift to groundwater systems. The main driving factors for selecting the appropriate technology are regional feasibility ,water demand ,system efficiencies and initial and long terms costs. solar powered pumping systems are commonly considered for use instead of other forms of alternative energy because they are durable and exhibit long-term economic benefits .A solar water pump system is commonly seen in residential and commercial uses, as well as for irrigation of agricultural land.

Generally solar water pumping systems are classified as either direct current(DC) or alternating current(AC) systems depending on their motor's ability. Recently, the concept of brushless DC(BLDC) motors for solar pumping water applications was presented as well.

Solar water pumping is based on photovoltaic technology that converts light from the sun into electricity to pump water. solar panels used in this system are connected to a motor(DC/AC).The electricity supplied by the PV panel is converted into mechanical energy which is then converted to hydraulic energy by the pump.

Pressure, flow and power are the three main variables that describe the capacity of the system to pump water. For design purposes the work done by a pump to lift a certain amount of water to the storage tank is regarded as pressure. The work a pump must do is regarded as the elevation difference between the water source and the storage tank. The pump will draw a certain power which a PV array needs to supply. The following sections will provide descriptions of individual system components involved in solar powered water pumping systems and design considerations for the proposed system.

Basic Components of solar water pumping system

A solar powered water pumping system has the following basic components (Figure 1)

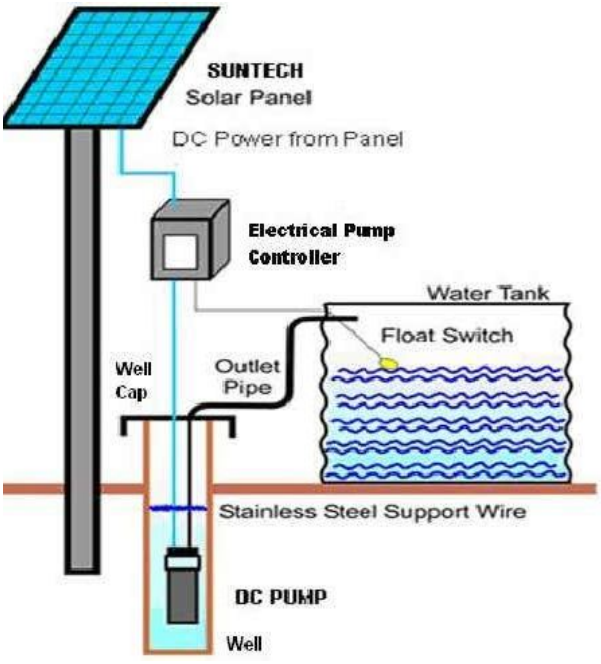

Figure 1. Basic structure of solar powered water pumping system

Photovoltaic (PV) panels : PV panels are also called solar panels. They make up most of the system cost where the size of the PV-system is directly dependent on the size of pump ,amount of water that is required and the solar irradiance available. An assembly of photovoltaic cells mounted in a framework is called a PV module. Agroup of solar panels or modules is called an array. Most of the modules user wafer-based crystalline silicon cells or thin-film cells and are made from semiconductor materials. The solar cells are connected in series to obtain desired voltage and then one to another in parallel to increase amperage. A panel is rated in watts of power it can produce. The light from the sun when strikes the cell ,electrons are knocked loose from the materials atoms. The electrons are captured in the form DC current when the electrical conductors attached to the positive and negative sides of thermal material. This electricity can then be used to power a load ,such as water pump.

Water pumps : These are the heart and soul of the solar water pumping system. pumps can be high-flow/low-head to low-flow/high-head ,that is pump produces a unique combination of flow and pressure for a given input power. Solar pumps are rated based on the required voltage of electricity.Some accessories that would make the pumps function optimally include filters, float valves, switches, etc. DC water pumps are commonly used in these systems.

Motor pump-set: The pumping systems are generally configured into following types of motor pump sets:

1. Submersible pump with displacement/centrifugal motor pump set
2. Submersible pump with surface mounter motor.
3. Surface mounted pump sets.
4. Reciprocating displacement pump.
5. Floating motor pump.

Among the above-mentioned pump sets, the most commonly used is centrifugal motor pump set as they are easy to install and submerged away from the potential damage. Unlike submersible pumps, surface pumps are placed near to the water surface for moving water through a pipeline and thereby developing high heads for water long distances or to high elevations.

Controller: The controller is a solid-state device which control the charging and discharging of the batteries, hence the main function is to control the charge on the batteries. The controller provides an LCD display that cycle through a display of battery voltage, array current, and load current. It provides temperature compensated charging so that the rate of chargeis controlled for both temperature and state of charge. The controller will shut off charging when the battery reaches a charge of 15.2 VDC and disconnect the load when the battery voltage reaches 11.4 VDC. These set points have been established to prevent damage to the battery from an overcharge condition or a low voltage condition. Thereby has a manual disconnect switch that allows to electrically disconnect the batteries from the system.

Inverters: On rare instance, the end user may need to power a 120/24 AC load for such systems with specific AC power requirements must have inverter installed. The main function of the inverter is to convert the direct current received for the solar panels into AC for the pump. To accommodate the inrush characteristics of the AC motor the panel and inverter must be sizes accordingly.

Float switch:To detect the level of liquid within a tank we use float switch. The switch may be used in a pump as an indicator, an alarm, or other devices. These switches can vary from small to large. It can be as small as a mercury switch inside a hinged float or as complex as a series of optical or conductance sensors producing discrete outputs as the water reaches many different levels within the tank. To turn off/on the pump we use generally use float switch while filling the tank. To protect the pump from low water conditions in the well, low water cut-off electrodes are used[2].

II. LITERATURE SURVEY

In solar water pumping system using IoT monitoring system [1],has executed the complete design and operation of IoT based automatic water pump controller using website. To keep the PV-panel output voltage constant and to help in operating the solar arrays close to the maximum-power point, dc-dc converter can be used. In Solar powered water pumping system[2], the proposed model takesinto account the sub models of thepumping system and uses two optimization criteria, firstly, for the reliabilitywe use LPSP concept, that is loss of power supply probability and the life cycle cost (LCC) for theeconomic evaluation. It provides the explanation on working of the water pumping system and what the differences with the other energy sources are.

III. PROPOSED SYSTEM

The proposed system mainly includes the use of MPPT(maximum power point tracking) or solar trackers controllers, water leakage sensors and ultrasonic sensors to provide enhanced working model of solar powered pumping system.

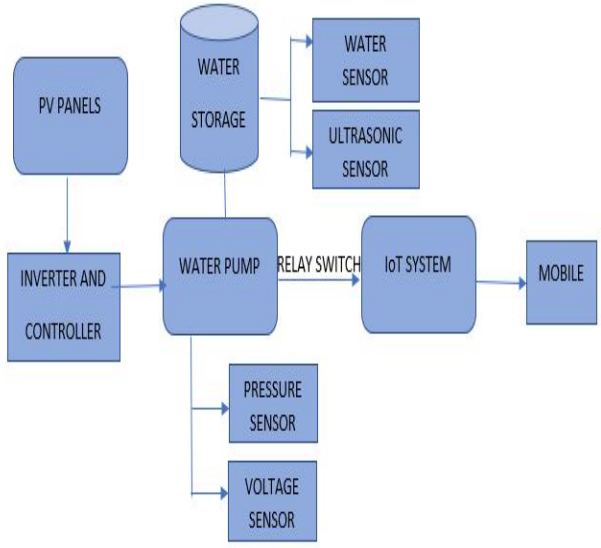

Figure 2. Proposed block diagram of solar powered water pumping system.

Key components of the proposed system:

1. MPPT controllers or solar trackers:The focus is on increasing the efficiency of the solar panels using solar trackers or MPPT controllers are used to enhance the generation of electricity significantly by placing the panels normal to the incident sunlight, and hence enhance electricity generation significantly. solar trackers aid the panels in keeping an orientation that makes them perpendicular to sunlight because if the solar panels are fixed, they cannot have sunlight striking them perpendicular all the time of the day. Solar trackers assist the solar panels in keeping an orientation that enables them to be perpendicular to sunlight.

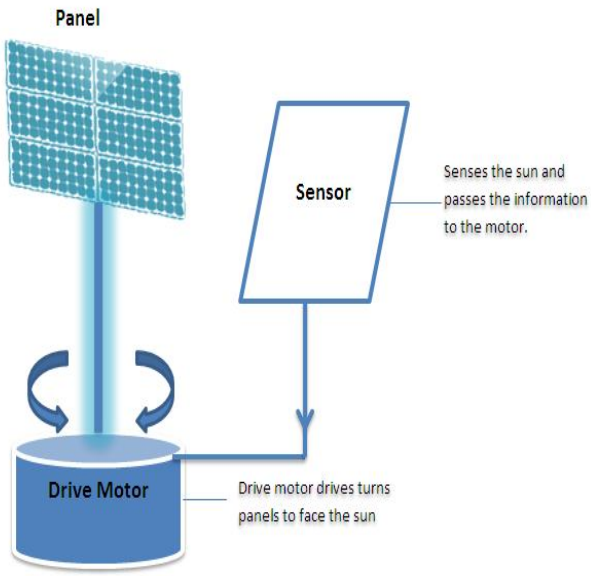

Figure3. solar panels with tracking sensors

Mainly there are two types of solar trackers that are used, Active and Passive – Both produce the same result but working in a different manner.

Passive trackers –To move the tracker it depends on solar heat. Based on the heat generated by the sun, and the sun's position, a low boiling point compressed fluid is driven to one side or the other to move the tracker.

Active trackers – For large connections these type of trackers are generally used. It is a sensor-based controller that monitors the position of the sun's movement. By using a motor these controllers, in turn moves the trackers to the right position.

2. **Water Sensors:** Based on the system design requirements and specifications, the first main function of this system is to detect water leakage and tracks of the domestic plumping network. But water leakages generally occur in the distribution units of the system.By this water leakage sensors which will be classified in the hardware components specification will be experimentally true and result an acceptable result. To change the direction of the flowing water these sensors can be fixed and . located mechanically in accurate way on the distribution water hoses above the hoses and around the elbows.These sensors collect information and decides the risk and sends the message to the user using a GSM module connected to Arduino. Besides, also decreases the risk by opening the water solenoid valves.

3. **Ultrasonic Sensors**: To measure the water level in a tank or storage these ultrasonic sensors are used. Any monitoring remote assistance application controls the pump and turns on/off based on the required water level in the tank. In this it helps to avoid overflowing or underflowing level of water in the tank. Hence with these ultrasonic sensors we can find the water depth calculation by finding the distance between the transceiver and the surface of the water. A short ultrasonic pulse is transmitted by the sensor and can be used to measure the travel time of that pulse to the liquid and back. To determine the water depth this distance is then subtracted from the total depth of the tank. The ultrasonic sensor as a trigger and an echo pin. The Arduino provides a high signal of 10microseconds to this pin. After the HC-SR04 is triggered, it sends out eight 40Khz sound waves to the surface of the water. To determine the time spent between triggering and receiving of the echothe Arduino reads the echo pin when the wave is echoed back to the sensor on getting to the surface of the water. Since we know that the speed of sound is around 340m/s then we can calculate the distance using:

Distance = (time/2)*speed of sound

To calibrate our tank to our taste the value total length of the tank is required so that it helps determining the level of the water .

This method of measuring with ultrasonic sensors is more precisely defined as water level measuring. This method will produce the same results irrespective of the storage. It is mainly important to note that the sensor should be placed at a fixed point above wherever the water is stored. In this way it can have benefits over underwater submersion and greatly increasing the overall lifespan of the sensor.

IV. CONCLUSION

The main aim of the article has executed the system design with IoT based technique to provide significant improvement in energy saving techniques. Now a days, Renewable energy system offers an alternative way for sustainable development of a country. Thus, a PV water pumping system that uses solar energy as renewable energy source is reliable and economically viable alternative to electric and diesel pumps found especially in irrigation, domestic and livestock watering.

V. FUTURE SCOPE

Factors affecting the performance and efficiency improving techniques, use of highly efficient PV modules including bifacial modules and degradation pf PV generator are areas for further research for lowering the cost, improving the performance and enhancing pumping system lifetime. That is by detecting the water quality problems that may damage or corrode the pump or motor and with the help of the technology to detect any malfunctioning of solar panels or battery connected with an alert message to the user.

REFERENCES

[1] Veena K R, Shyamala G, Bhavyashree ,Solar Water Pumping System Using IOT Monitoring System, PiCES(volume 2,Issue 10,jan 2019).
[2] Rahul Tamoli, Rohit Agrawal, Paras Arora, Vikalp Sharma, Pradeep Kumar,Solar Powered Water Pumping System, ijemr(volume 7 ,Issue 2)
[3] Anonymous, http://www.suncyclopedia.com
[4] P. K. Singh, O. Singh and S. Pandey, "Micro-controller-based Water Pumping System using Solar Energy," *2018*
[5] A. K. Mishra and B. Singh, "Stage Solar PV Powered Water Pump with a Storage System," *2018 8th IEEE India International Conference on Power Electronics (IICPE),*
[6] S. Murshid and B. Singh, "Analysis and Control of Weak Grid Interfaced Autonomous Solar Water Pumping System for Industrial and Commercial Applications," in *IEEE Transactions on Industry Applications*, vol. 55, no. 6,