International Journal of Research
International Journal of Research (IJR)
e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 05, May 2015
Available at http://internationaljournalofresearch.org

Low cost Low power Solar Based Multilevel Water Pumping for Irrigation

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Abstract

From the last few years there have been a significant technological advances in the field of agriculture to help the farmers. one of which is power supply for pumping water, providing electricity for motor pump has became a critical situation in many villages. This paper aims to provide a solution for pumping water by employing low cost and low power solar panel.

Key Words:

Solar Power, Micro Solar pump, Microcontroller

Introduction

Agriculture in India has a significant history. Today, India ranks second worldwide in farm output. Agriculture and allied sectors like forestry and fisheries accounted for 16.6% of the GDP in 2009, about 50% of the total workforce. The economic contribution of agriculture to India's GDP is steadily declining with the country's broad-based economic growth. Still, agriculture is demographically the broadest economic sector and plays a significant role in the overall socio-economic fabric of India. In India most of the power generation is carried out by conventional energy sources, coal and mineral oil-based power plants which contribute heavily to greenhouse gases emission. Providing adequate and quality power to domestic and other consumers remains one of the major challenges before the country. The solar power is being increasingly utilized worldwide as a renewable source of energy. India has huge untapped solar off-grid opportunities, given its ability to provide energy to vast untapped remote rural areas, the scope of providing backup power to cell towers and its inherent potential to replace precious fossil fuels. In India, Solar water pumps were first introduced in off-grid areas to provide water.

Possibilities for solar irrigation in India

Many papers have been published comparing the traditional or diesel based water pumping to solar based for standalone water pumping [1-2]. Almost 70% of India's population depends on agriculture either directly or indirectly. There are about 21 million irrigation pump sets in India, of which about 9 million are run on diesel and the rest are grid-based [3] . The Ministry of New and Renewable Energy has a programme for the deployment of various solar PV applications, which including water pumping for agriculture and drinking. However, the deployment has been sparse thus far, with only 7,334 solar PV water pumps having been installed across the country as of March 2010 [3]. The possibilities of solar powered water pumping

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in India has a huge and demanding market. According to the various studies conducted the potential has been estimated as below. Centre for Study of Science, Technology and Policy (C-STEP).“Harnessing Solar Energy – Options for India” (2010) estimates that 9 million diesel water pumping sets are in use in India. If 50% of these diesel pumps were replaced with solar powered pump sets, diesel consumption could be reduced to the tune of about 225 billion litres/year. As per the study conducted by HWWI, titled “CDM Potential of SPV Pumps in India” (2005) about 70 million solar PV pumps can be installed by 2020. Of these, 14 million are likely to be installed in Uttar Pradesh and 11 million in Bihar. The KPMG report titled “The Rising Sun” (2011) estimates solar-powered agriculture pump sets to be approximately 16,200 MW by 2017-22. However, the potentials as mentioned above are likely to be realized depending upon the extent of government support and market conditions.

Solar Energy

Design of solar powered water pumping requires the estimation of available solar energy. The energy which comes from the sun is called as solar radiation which is commonly expressed in units of kilowatts per square meter. At the outer surface of the earth's atmosphere approximately 1.36kW/m^2 of solar radiation is received. By the time this energy reaches the earth surface it reduces to approximately 1kW/m^2. Based on the geographic of location the intensity of the radiation varies. Also based on the solar radiation incident angle the energy produces varies. The energy produced will have peak during the noon of a day. The amount of solar energy projected on a specific surface of a material is known as solar irradiance which is in kW/m^2 and measured at the surface of the material on which the solar radiation is projected.

Solar Panels

PV panels are made up of a series of solar cells. It consists of two or more specially prepared layers of semiconductor material which can be crystalline or thin film that produce DC electricity when exposed to sunlight. To deliver power to a pump, solar panels are arranged in arrays and interconnected by electrical wiring. For the system to be more effective the solar panels need to continuously and directly face incoming sunlight which requires double-axis tracking mechanism that control the panel tilt angle the angle of the panel relative to horizontal where 0° is horizontal and 90° is vertical to adjust for the elevation of the sun in the sky throughout the year. A tilt angle of +/- 15 degrees from latitude will increase energy production for the winter or summer months, respectively.

Working principle

The proposed system consists of low power solar panel, Microcontroller, Motor drive control l unit. A 30watt solar panel is used to drive the motor and PIC controller board. Microcontroller is a heart of this project which senses the solar panel voltage and the water levels in using water float sensor and takes a decision of switching ON or OFF DC water motor pump. Here ULN2003 is used to drive DC12V water pump. This project objective is to supply water for the fields in alternative way by generating electricity (through solar panels) in order to save 22% of the total power production in INDIA. The components required for the project is solar panel, Water sensor, relay, dc pump, microcontroller, water tank. When the sunlight falls on the solar panel, the control system gets activated and checks the water level in the base tank with the help of water level sensors connected to all stages, And depending upon the algorithm at a time only 1 motor is turned ON. Initially water

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is pumped from base level to intermediate stage, once the intermediate stage is filled then the 2nd pump turns ON so that water can be pumped to overhead tank. Since at a time only 1 motor will be switched ON we do not require high wattage solar panel (this is one advantage). If solar voltage drops to below threshold level, automatically external DC power source gets activated and runs the motor, so that there will be no interruption in the water pumping. This water pumping mechanism is designed to be executed only in the daytime. The quantity of water pumped is entirely dependent on the type of pump used and the amount of Sunlight striking the PV panels [8].

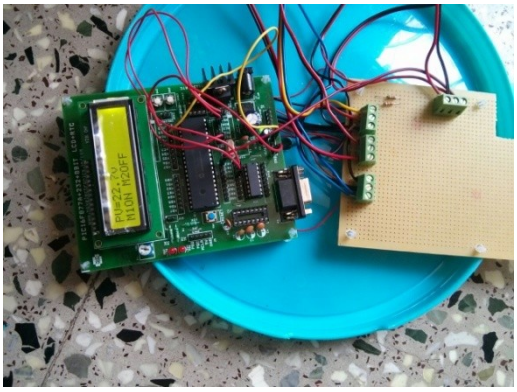

Fig: Physical Modules of Proposed System

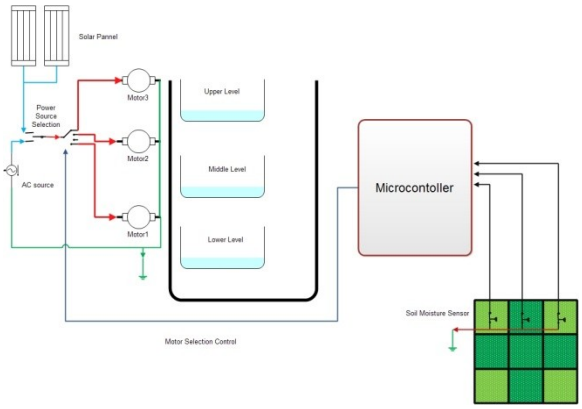

Fig: Graphical Representation of use of Proposed System for Automation of Irrigation

Conclusion

The key barrier to the large-scale dissemination of solar PV water pumps is the high capital cost incurred by farmers compared to the much lower capital cost of conventional pumps. Solar PV is a competitive option in the face of diesel, its adoption being contingent on the ease of access to subsidies. Another factor to be considered is the space requirement for the installation of a solar PV pump set. This factor limits adoption by small-scale farmers to whom land availability is a major. This paper managed to stumble upon the fact that the largest advantage of solar energy is its attribute as being free and unlimited source of energy. We have also found out that the research of the development of solar irrigation system requires vast knowledge and familiarity about renewable energy, as well as other parameters of control.

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