“DESIGN OF CONTROLLER FOR SUBMERSIBLE WATER PUMP BASED ON SOLAR ENERGY”

Tejashwaree D. mankar^{1*}, Ravi.V. Krirsagar²

^{*1}Department of Electronic (VLSI) Engineering RTMNU University, India

²Department of Electronic & Telecommunication Engineering, RTMNU University, India

^{*1}tejum55555@gmail.com; ²ravi_kshirsagar@yahoo.com

***Corresponding Author: -**

Email: tejum55555@gmail.com

Abstract: -

This project work deals with the development of low-cost PV pumping system using a PMBLDC (permanent magnet brushless dc motor) drive coupled to a pump load. We are proposing to design and develop a constant current controller without current and position sensors therefore reducing to a large extent the overall cost of the drive system and to maintain the required output in case of low solar insolation during the winter and also in case of reduced solar output due to increase in cell temperature. The controller will drive a PMBLDC motor to pump the water to the tank. The input from the water level sensors attached to the tank indicates the water level to the controller and thereby automates the pumping system.

Keyword: - "Permanent magnet brushless DC motor", "photovoltaic array", "controller", "water pump system"

Distributed under Creative Commons CC BY-NC 4.0 OPEN ACCESS

I INTRODUCTION

As solar energy is the abundant amount of energy which is available every day except night and free of cost. Photovoltaic (PV) panels are often used for agricultural operations, especially in remote areas or where the use of an alternative energy source is desired. A benefit of using solar energy to power agricultural water pump systems is that increased water requirements for irrigation tend to coincide with the seasonal increase of incoming solar energy. Basically, this solar pump requires a controller before it should be connected to the PV module. This project consists of design of a controller along with the setup of solar water pump. This controller will be a unique controller designed in India. Usually, we have to import this controller from U.K. or Germany. After making this controller, the solar water pump can be used widely by farmers, villagers for farming purpose, Schools, Hospitals, Watering of cattle, Irrigation of fields and greenhouses.

II BLOCK DIAGRAM

The block diagram consists of

- 1) The PV array
- 2) Permanent magnet brushless DC motor(PMBLDC)
- 3) An electrical controller
- 4) An electric-powered pump

A. Photovoltaic (pv) cells -

Solar array Photovoltaic (PV) cells produce electricity directly from sunlight (not from heat). Light causes electrons to jump from the top layer of the cell, into “holes” in the layer underneath. When a circuit is made between top and bottom layers, the electric current flows.

Fig. 1 Solar energy

B. Permanent magnet brushless motor –

The separately excited and permanent magnet motors were found the more suitable for PV system, the PM motor offering a high power/weight and torque/current ratio.

Fig 2 DC motor I-V curve

C. An electrical controller-

Electrical controllers and safety devices are incorporated into PV-powered water pump systems to control the electric power input to the pump and to provide necessary electrical protection and switching.

D. An electric-powered pump-

The type of pump configuration and mounting can be either submersible, surface mount, or floating, depending on the water source.

III MOTOR WORKING

As the magnetic field generated by coil is proportional to the current flowing in it, then force between magnet and coil is also proportional to the current, then torque is further proportional to the current. At starting, current rises rapidly with increasing voltage until it is sufficient to create enough torque to break the motor loose from static friction. Once the motor starts to spin, the back EMF drops the current, and thereafter current rises more slowly with increasing voltage. To remove this discontinuity of pump controller is used.

IV WORKING OF CONTROLLER

- The controller normally includes a main switch to provide an electrical disconnect of the PV array from all other system components.
- Since the amount of power produced by the array depends on the intensity of incoming solar radiation, the controller can cause the pump to be switched off until sufficient power is available to meet the pump's specified minimum operating power input range.
- Likewise, when the PV panels produce too much power, the controller can limit the power output to the pump to prevent it from running faster than its maximum rated speed.

V EXPERIMENTAL SETUP

VI READINGS OF EXPERIMENT

Voltage V	Current A	Power W	Pressure Kg/sq.cm	Flow Lit/min
12.69	0.85	10.78	0	3.05
12.69	1.39	17.69	1	2.55
12.69	1.71	21.6	2	2.23
12.69	1.93	24.49	3	2.175

Depending on the readings of experiment we get following graphs

Fig 3 Graph of flow vs power

Fig 4 Graph of pressure vs power

VII CONCEPT OF CONTROLLER

Controller is circuit which is used for constant current to maintain continuity of motor in water pump. In designing we are using IC LM 334SM which is a constant current source IC. One IC provides 10mA current.

A. Features of LM 334SM

- Operates From 1V to 40V
- 0.02%/V Current Regulation
- Programmable From 1 μ A to 10mA
- True 2-Terminal Operation
- Available as Fully Specified Temperature sensor
- $\pm 3\%$ Initial Accuracy

B. Symbol

Fig 5 Circuit Diagram

C. Values and calculations

- $R_{set} = 6.4\Omega$

- Vin will be in the range of 1V to 40V which will be provided from solar panel.
- The output current will be constant.
- As the one IC provides 10mA current then 20 IC will provide current
 $=20 \times 10\text{mA}$
 $=2\text{ A}$

VIII CONCLUSION

- Solar water pumps can provide simple and low labour watering options for farms that require water in remote areas.
- An electronic pump controller is used to maintain the constant current supply to the pump.
- The graphs and the results shown are used for the design of controller.

REFERENCE

- [1].Marsh, L., 2001, '*Pumping water from remote locations for livestock watering*', Virginia Cooperative Extension, Publication 442-755, 8 pp.
- [2].Lance Brown. B.C. '*Livestock Watering Handbook*'. 2006. British Columbia Ministry of Agriculture and Lands. Abbotsford, B.C.
- [3].Bhim Singh, C.L. Putta Swamy, B.P. Singh, '*Analysis and development of a low-cost permanent magnet brushless DC motor drive for array fed water pumping system*', Elsevier Science B.V.
- [4].B.Kavitha, S.Karthikeyan, B.Iswarya, '*Design of solar PV water pumping system using BLDC drive using sensorless method*', The International Journal Of Engineering And Science (IJES) Volume 3, Issue 3 Pages, 41-46, 2014