Design and Performance of Photo Voltaic Pumping System

C. K. Panigrahi, Chitralekha Jena, Satyapriya Satpathy, Pradosh Ranjan Parida

Abstract: - Energy in general and electrical energy in particular is not only at the center of sustainable development, but also at the center of development itself. Thus Energy is critical for sustainable development because it is not only necessary for economic development, but also because this necessity drives societies towards environmentally unsound energy use and could severely compromise the planet itself. With steep increase in the supply – demand gap of energy, the shortage of energy has become global problem. With seemingly poor trend of capacity increase, the burden of importing energy is increasing particularly for India in the south Asian countries. Now it has become essential to opt for alternative sources of energy. Use of solar energy in all the sectors is one of the feasible options. Electric pumps can be conveniently replaced by solar PV pumps. The initiative needs very less investment and will power. In this paper, an effort has been made to show the effectiveness of PV solar pump in place of a conventional electric pump in industry.

Keywords: PV solar pump,

I. INTRODUCTION

Energy conservation refers to reducing energy through using less of an energy service. Energy conservation differs from efficient energy use , which refers to using less energy for a constant service. Even though energy conservation reduces energy services, it can result in increased financial capital. Energy use by humans has huge negative impacts on the environment.Heavy dependence on commercial fuels such as coal and oil as a short term measure for meeting increasing demand is alarming in view of depleting fossil fuels and leads to environmental pollution. As another answerer pointed out, burning coal releases mercury into the atmosphere. Mercury is very toxic in small doses. Coal is one of the biggest energy sources, as it's used to produce much of the electricity in big energy using countries such as China, the US and Australia. Even hydroelectric power has costs. Hydroelectric dams require the flooding of large areas of land, destroying habitat. Dams may block the migration of river-spawning fish who can't get around the dam barriers to lay their eggs. Dead trees left under water in the reservoirs contain trace amounts of mercury (like coal, since coal comes from fossilized fern trees), which in flooded areas leaches out into the water supply, contaminating fish and making them unsafe for humans to eat.

Manuscript Received on January 2015.

Dr. C. K. Panigrahi, Professor, School of Electrical Engineering, KIIT University, Patia, Bhubaneswar, Odisha, India.

Chitralekha Jena, PhD Scholar, Jadavpur University, Kolkata, West Bengal, India.

Satyapriya Satapathy, Assistant Professor cum H. O. D. I/C, Department of Steel Making Technology, Biju Patnaik National Steel Institute, Puri, India.

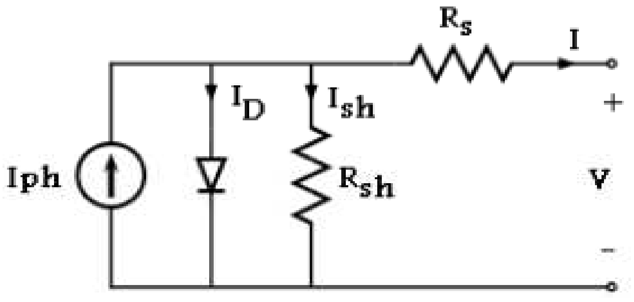
Pradosh Ranjan Parida, PhD Scholar, Jadavpur University, Kolkata, West Bengal, India.

Oil and natural gas extraction is hugely damaging to the areas of the planet where it's practiced. Just look at the oil tar sands projects in Alberta, Canada, where vast areas of land are being dug up, steam injected into the tarry sands to extract the oil, and the contaminated waste water being dumped in massive containment ponds. Birds landing in these ponds get coated in toxic oily sludge and often die within days. Some forms of energy are less harmful. Solar energy, for instance, can be captured and converted to heat for a home, with very few negative impacts. Water is the vital necessity of the life.Safe drinking water is an important need for the population around the word, in developing countries it is still a problem to bring water for all population.Irrigation is vital to produce acceptable quality and yield of crops ..PV pumping system can be used to provide regular water supply in remote areas as the electricity supply is frequently not available.Solar panels (also called Photovoltaic or PV panels) are used to generate electricity from sunlight. The electricity can be used to power a water pump, normally used for village water supply, livestock watering and small-scale crop irrigation, e.g. vegetable plants in a home garden. The water is pumped from underground into a tank, which must be large enough to store sufficient water to supply the village needs during cloudy weather. Installing a solar powered water pump is a fairly expensive option ,although the systems last for a long time and are reliable. The requirement of SPV pump:- Should be powered from solar panel and/or battery combination, Self priming up to 100 vertical feet, Prevention of one-way check valve for reverse flow, Automatic operation, Optional motor cooling fins, Application of SPV pumps, Irrigation, Community water supply, Fish Farming, Poultry Farming, Cattle Watering, Industries for fluid pumping. The solar energy based dual pump piped water supply scheme, developed by city-based Groundwater Surveys and Development Agency (GSDA), was recently introduced in Jharkhand's Lara village. This is the first time that the scheme has been introduced outside state. The Union government had earlier approved implementation of the scheme in 10,000 villages in 82 Naxalite-affected districts in the states of Andhra Pradesh, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Maharashtra, Orissa, Uttar Pradesh and West Bengal. The scheme is to ensure that villages in these states get sustainable tap water supply throughout the year without the use of electricity.

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication Pvt. Ltd.

II. PROBLEM FORMULATION

Simulation of PV module



Band gap energy: $Eg = Ego-(alpha\times T\times T)/(T+beta) \times q$

Photocurrent: $I_{ph}=[(I_{scr}+k_i(T+T_{refk}))](s/100)$

Saturation current: The saturation current of the solar photovoltaic cell can be expressed as

$I_{rs}=I_{rr}(T/T_{refk})3exp(q.E_g(1/T_{refk}-1/T)/(K.A)))$

Output current: The output current of the solar photovoltaic cell can be expressed as Io

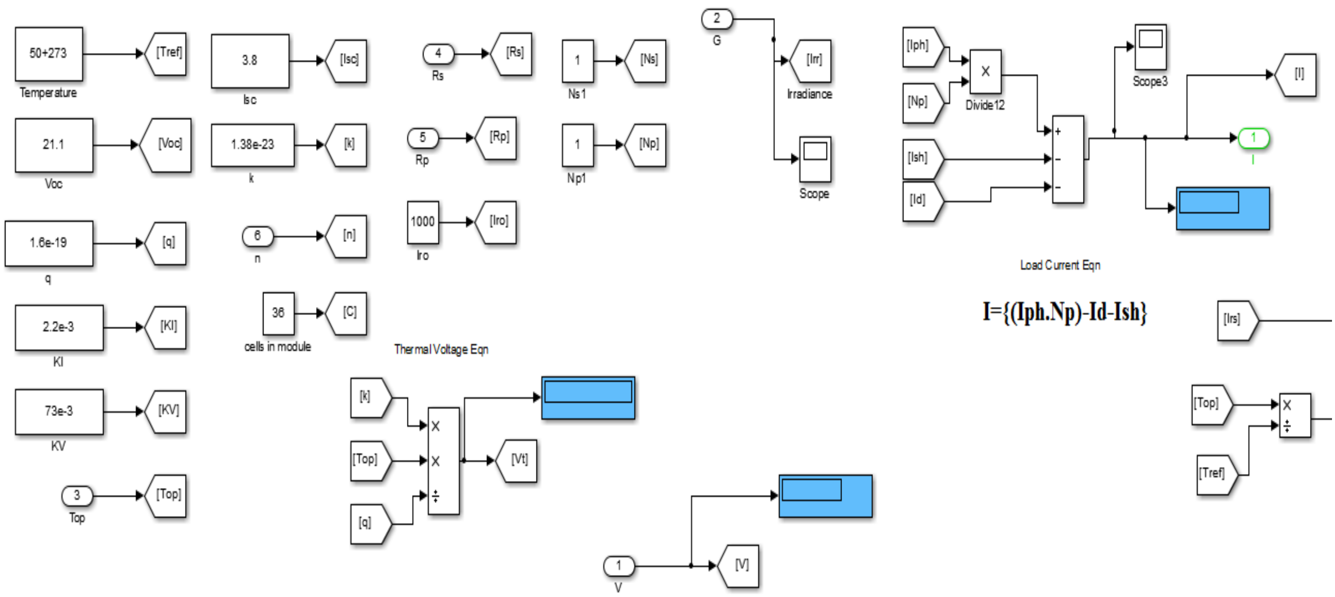
$I_o=N_p\times I_{ph}\pm N_p\times I_{rs}\times (exp(q/(k\times T\times A) \times V_o./N_s)-1)$

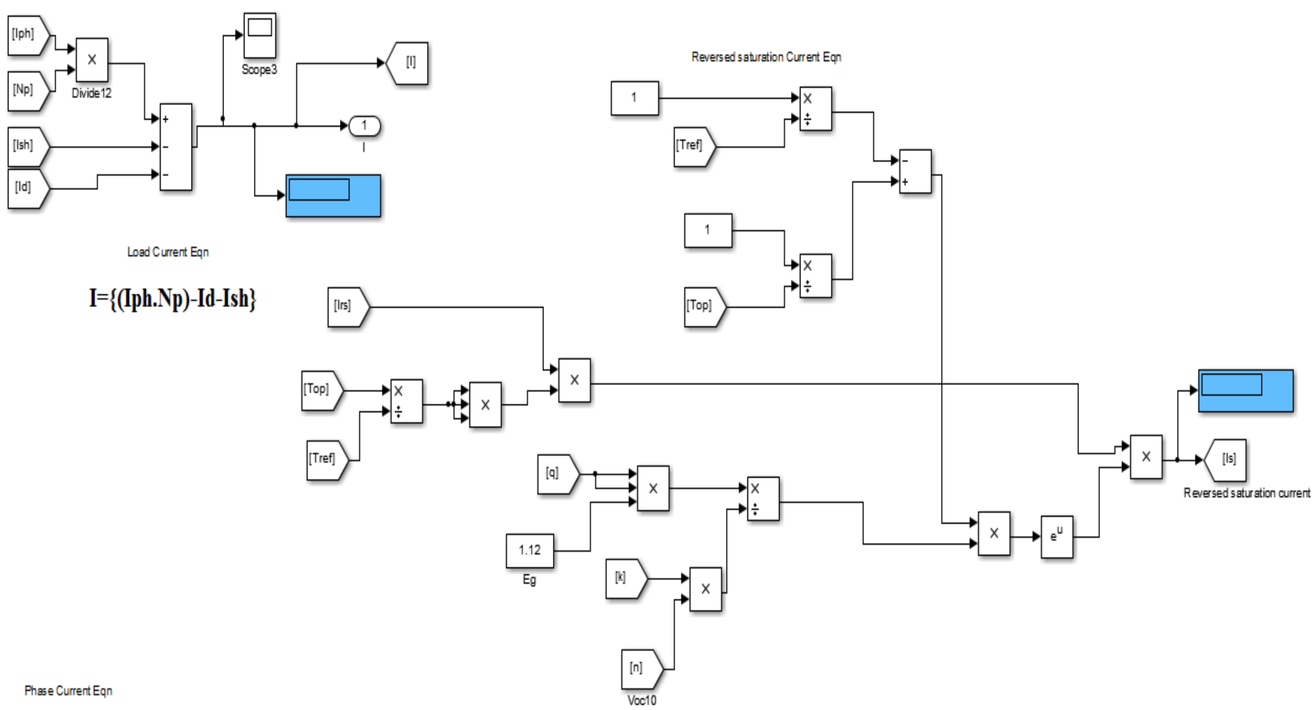
Power-The output power of the solar photovoltaic cell can be expressed as Po and it is the product of output voltage and current. $P_o = V_o\times I_o$

Maximum power-$P_{max}=V_{max}\times I_{max}$

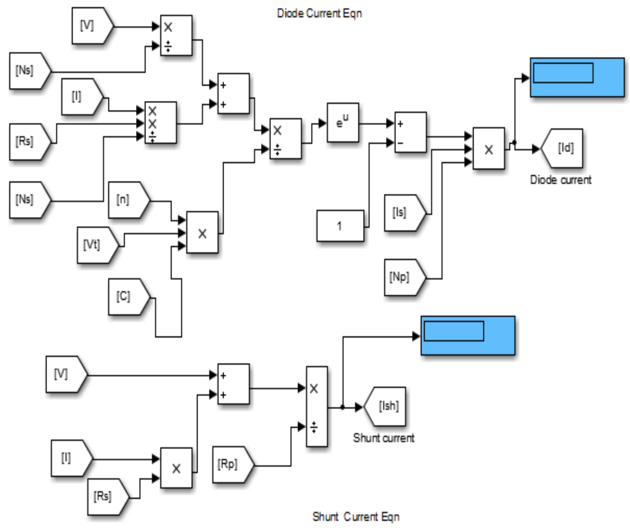
III. SIMULATION RESULTS

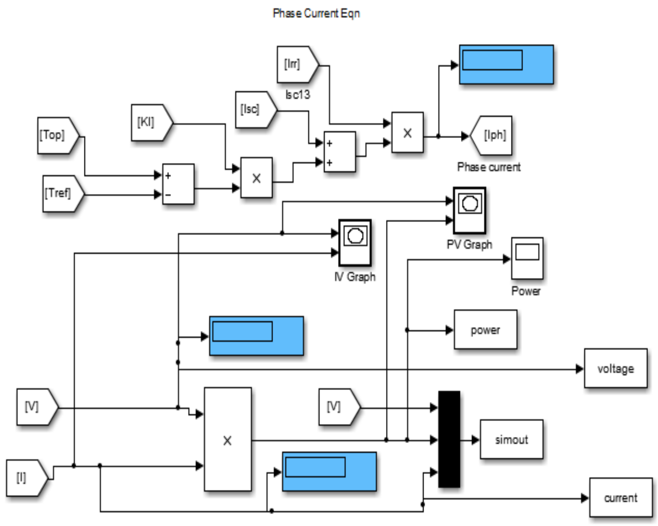
Simulink Model of PV Panel

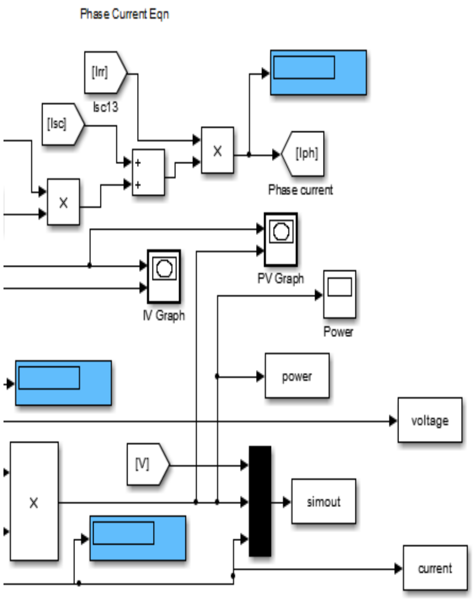


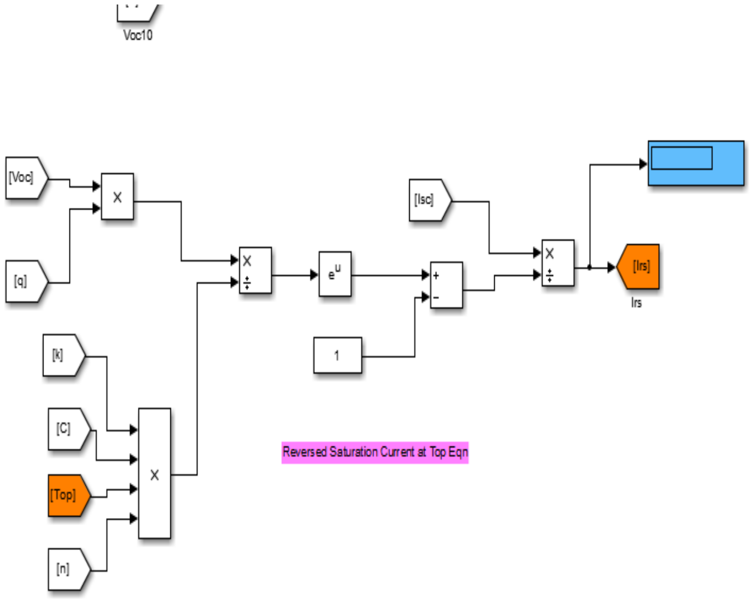


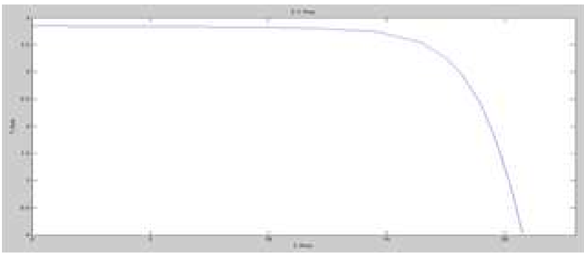
Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication Pvt. Ltd.



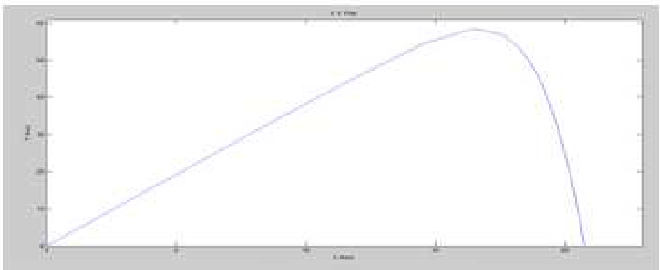








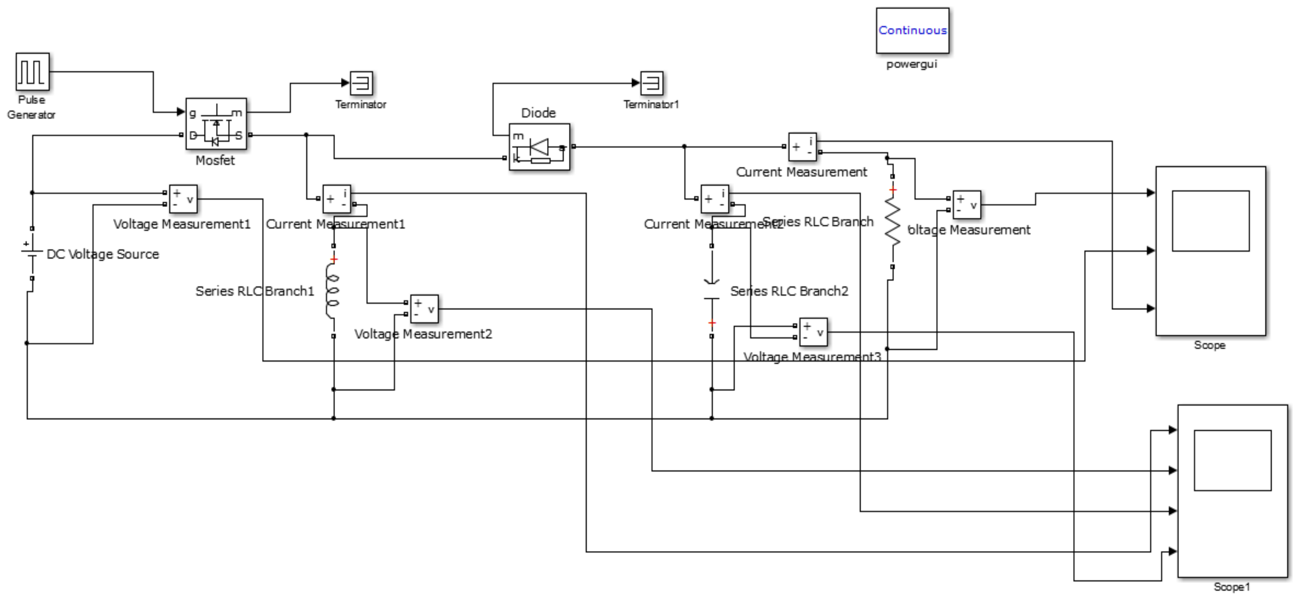
IV graph

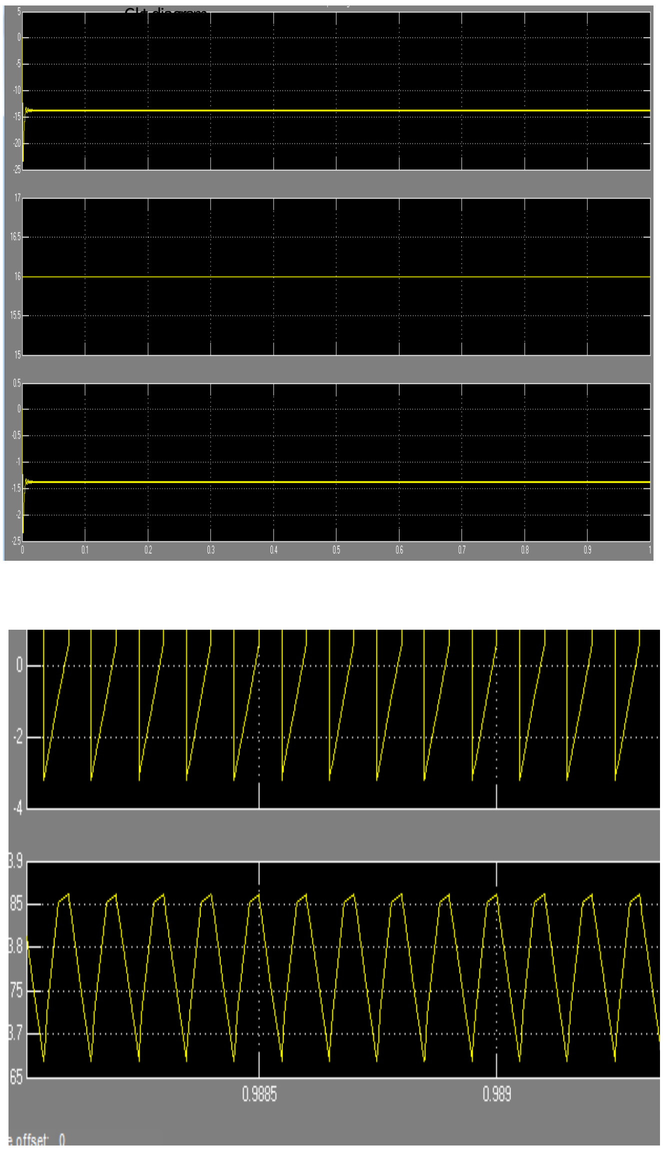


PV graph

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication Pvt. Ltd.

Simulink of Buck-Boost Converter





Graph of Inductor current , voltage & Capacitor current, voltage

Recommendations:

Comparison of Dual Pump System

Conventional energy v/s Solar energy

Sr.No.	Factors of performance for comparison.	Calculations for the span of 25 years	
		Conventional Submersible Pump	Solar energy based Submersible pump
1	Life	10	25
2	Capital Cost	50227.00	225000.00
3	Operational Cost		
	1. Energy Charges		
	a)Conventional energy based Submersible Pump @ 600/- month	180000.00	
	b).Solar energy Based submersible pump		0.00
	2. Maintenance.		
	a) Conventional energy based Submersible Pump		
	Preventive Maintenance @1000.00 per year	250000.00	
	Major Repairs and Overhauling / Replacement of pump after 10 years @ Rs 22000.00	33000.00	
	b). Solar energy Based submersible pump		
	Preventive Maintenance @ Rs 50.00 per month. Cleaning of panels.		15000.00
	Major repairs and overhauling		0.00
	Total	288277.00	240000.00
	Saving	0.00	48277.00
	After 25 years of performance saving due to Solar Energy Based Submersible pump is Rs-		48277.000

IV. CONCLUSION

Renewable energy sector growth in India during the last four years has been significant, even for electricity generation from renewable sources. In the view of rampant energy scarcity, there is need to increase the use of renewable energy sources for sustainable energy development. The Central Government or governmental agencies can mainly act as a catalyst and facilitator, with implementation being carried out by the States or by the private sector. Solar pump may be a good solution to reduce the demand supply gap and can be used in remote areas.

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication Pvt. Ltd.

REFERENCES

[1] Narayana, P.B.; Reddy, B.R.S.; Motepalli, P.; Dubey, S., "Design & simulation of solar DC pump in simulink," *Energy Efficient Technologies for Sustainability (ICEETS), 2013 International Conference on* , vol., no., pp.429,431, 10-12 April 2013.

[2] Kappali, M.; Uday Kumar, R.Y., "An approach to reduce the size and cost of PV panel in solar water pumping," *Industrial and Information Systems (ICIIS), 2010 International Conference on* , vol., no., pp.608,613, July 29 2010-Aug. 1 2010 doi: 10.1109/ICIINFS.2010.5578633.

[3] Surendra, T. S.; Subbaraman, S. V V, "Solar PV water pumping comes of age in India," *Photovoltaic Specialists Conference, 2002. Conference Record of the Twenty-Ninth IEEE* , vol., no., pp.1485,1488, 19-24 May 2002 doi: 10.1109/PVSC.2002.1190891.

[4] Shrestha, J.N., "Solar PV water pumping system for rural development in Nepal: problems and prospects," *Energy Conversion Engineering Conference, 1996. IECEC 96., Proceedings of the 31st Intersociety* , vol.3, no., pp.1657,1662 vol.3, 11-16 Aug 1996, doi: 10.1109/IECEC.1996.553350.

[5] Yousuf, N.B.; Salim, K.M.; Haider, R.; Alam, M.R.; Zia, F.B., "Development of a three phase induction motor controller for solar powered water pump," *Developments in Renewable Energy Technology (ICDRET), 2012 2nd International Conference on the* , vol., no., pp.1,5, 5-7 Jan. 2012.

[6] Kappali, M.; Uday Kumar, R.Y., "An approach to reduce the size and cost of PV panel in solar water pumping," *Industrial and Information Systems (ICIIS), 2010 International Conference on* , vol., no., pp.608,613, July 29 2010-Aug. 1 2010 doi: 10.1109/ICIINFS.2010.5578633.

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication Pvt. Ltd.