

Sustainable Assessment of Solar Electromechanical Devices

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Abstract— During this century, economic development for a better standard of living has been instrumental in deteriorating the environment. Indians are now consuming more resources than ever and polluting the earth with waste products. Environmental stability is an important issue that receives much attention today. Solar photovoltaic cells are an active system in which small panels faced with semiconducting material turn sunlight into electricity. In the present work, solar photovoltaic based low load stepper motor and medium load 1KWh power supply for home utilities, have been designed and fabricated for various electromechanical applications. Its technical and economical viability was tested. It consumed power from sun and hence it is cheaper and environmental friendly. The paper stresses the utility of solar powered motor.

Key words: Light load mechatronics applications, Medium load household/Industrial applications, Solar photovoltaic cells

I. INTRODUCTION

The past century has seen an exponential increase in the demand for energy. The increase in energy use is primarily the result of the rapidly growing world population using an increased amount of technology that requires a greater amount of energy to sustain it. The majority of current energy demand is being satisfied by energy sources that are finite, namely, fossil-based fuels.

Renewable energy technology bridges the gap between mounting global energy demand and supply of finite conventional energy sources. Photovoltaic's is a method of generating electrical power by converting solar radiation into direct current electricity using semiconductors that exhibit the photovoltaic effect. Photovoltaic power generation employs solar panels composed of a number of solar cells containing a photovoltaic material.

Mark Bridges, et al, (1999), highlighted the small amount of research that has been conducted into the environmental noise impact for coal processing plants. Another important reason is provided by the authors for studying the impact of noise in the industrial workplace, this being that the maximum noise exposure allowed for a worker is 85 DB equivalent continuous exposures for an eight hour period. Noise and vibration from individual equipment items can be further reduced by appropriate design, maintenance and isolation of sound power sources.

Though a lot of work has been done on solar inverter and solar energy but only limited work has been done for its application in electromechanical devices of various light load and medium load applications. The present research work discusses the fabrication and saving obtained from solar based light load motor and medium load household/industrial applications for cheaper and environmental friendly operation.

II. EXPERIMENTAL SET-UP

The specification and size of various equipments are as follows (Table I & Table II):

S.N.	Part Name	Specification	Remarks
1	Voltage Regulator	3-12 V	For various motors.
2	Solar Panel	Photovoltaic (PV) cells(15 V output), charging 0.6-0.9 A/hour	
3	Battery	12V ,DC,10 Ah	
4	Motor rating	6V DC,9V DC and 12V DC	
5	Timer 555 with resistances and capacitors		For automatic on/off applications.
6	AC Adapter	Input:100-240V AC, 0.8A-1.4A Output:12 V DC,0.7A	Energy to be supplied by AC adapter if sunlight is not available.

Table 1: Details of solar electromechanically device for light load

S.N.	Part Name	Specification	Remarks
1	Solar Panel	Photovoltaic (PV) cells, 24 V output	P _{max} = 250x4=1000 W V _{mp} =35.3V I _{mp} =25.3 A
2	Battery	24V DC,150 Ah	1 No.
3	Inverter	1 KWh ,sine wave	AC 110-240V
4	Solar charge controller	Rated voltage=24V Rated current=30A	
5	Capacity	1000W	

6	Load type	Colour TV: 65V,LCD Computer/Laptop=100 W, Washig machine =100W, lamps=11W
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Table 2: Details of solar electromechanically device for medium load

III. RESULTS AND DISCUSSION

A. Light Load Mechatronics Applications:

1) Stepper Motor Specifications:

Stepper motor getting power from battery: (12V, 1.0 A).

Battery storage capacity= 12V, 10.0 A.

Charging rate = 0.7 Ampere/hour

Battery charging time= 14 hrs

Energy saving for one hour operation= $12 \times 1.0 = 12$ Watt hour

Energy saving for 05 hour operation/day = $12 \times 1.0 \times 5 = 60$ watt hour

Energy saving for 30 day operation= $60 \times 30 = 1800$ Watt

Energy saving by one motor in a year = $1.8 \times 12 = 21.6$ KWh



Fig. 1: Solar system with lights and battery inside red colour box

Practically, there may be many such motors and energy saving is much higher. Total cost of solar electromechanical device was Rs.3000 but there was no running cost. Besides D.C.motor, other solar lighting devices such as CFL, LED's and mobile chargers were also operated from the energy stored in battery from solar panel(Fig.1). It is established that the solar run motor may find applications in growing utility of mechatronics equipments and provide solution of energy in various household utilities.

The above system was designed to give a daily working time of 6- 7 hours with the fully charged battery. The system provided for buffer storage for 4-5 appliances ranging from 3-12 Volts. In cloudy summer/rainy season/winter season (when there is no sun), we have additional stand-alone system i.e. an electrical charge of specification (12V, 0.7A) is used for light load system.

B. Medium Load Household/Industrial Applications:

1) Specifications:

Motor getting power from battery: Upto 1 KWh.

Such motors are used in washing machine, computers, lamps, mobile charger, water lifting pumps, fan, desert cooler, etc.

Battery storage capacity= 24 V, 150 Ah.

Four solar panel of 250W were installed on roof top at an inclination.

Energy saving by IKWh motor for 05 hour operation/day= $5 \times 1000 = 5000$ Watt hour

Energy saving for 30 day operation= $5000 \times 30 = 150000$ Watt hour

Energy saving by the motor in a year = $150000 \times 12 = 1800$ KWh

Electricity bills comes down by 15- 20% just by installing 1 KWh solar system. Moreover, it gives back up when there is no electricity. Total cost of solar solar panel, storage batteries, inverter for converting DC into AC, electromechanical device was Rs. 1,00,000 lakh but there was no running cost. Besides motor, other solar lighting devices such as CFL, LED's and mobile chargers were also operated from the energy stored in battery from solar panel.

Electricity generated from thermal power station is an expensive source of electricity; solar energy has turned it into an economical power source in the long-run. The amount of electricity generated from solar energy depends upon the available sunlight.

The biggest advantage of using Solar Power is that it is an inexhaustible source of energy. Once you have installed the system, you don't have to worry that you would ever be without electricity because the sun is always going to be there. The next advantage of using solar energy is that it doesn't emit any pollution into the environment. Solar panels don't release any emissions into the atmosphere while generating electricity. In the most remote locations, solar energy is the ideal source of electricity. A big advantage of solar energy systems is that a properly installed system doesn't require much maintenance. Electricity generated from thermal power station is an expensive source of electricity; solar energy has turned it into an economical power source in the long-run.

IV. CONCLUSIONS

The paper determined the feasibility of reducing greenhouse gas emissions by the use of connected photovoltaic (PV) power systems, whilst at the same time demonstrating the technical and economic viability of this new power technology to supplement traditional sources of electric power. It was established by testing the system during last 3 months that if charged for 8-9 hrs in sun light summer, battery is capable to supply stored energy to a stepper motor of 12V,1.0 and a set of equipments such as LED's ,CFL(7W) , mobile chargers for 4-5 hours for light load mechatronics applications. For medium load applications, the solar system is capable of supplying energy upto IKWh and it is going to be economical in long run because there is no running cost. The developed solar system is portable, environmental friendly and free from maintenance. It is established that the solar run motor may find applications in growing utility of mechatronics equipments and provide solution of energy in all household utilities.

V. REFERENCES

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