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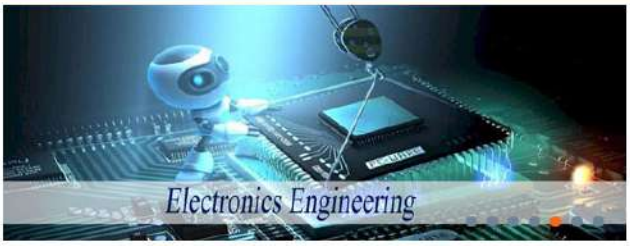

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Development of Alternative Energy System for Wearable Electronic Device

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ABSTRACT: The wearable electronic device has drawn a lot of attention of researcher from last few decades. These electronic devices require energy which is provided through battery. The battery has limitation because of that there is a need to search alternative energy for electronic device. The alternative source of energy supplements batteries in wearable electronics application. Alternative energy harvesting is new trend and used in many electronic applications. In this research work, the main focus is to generate electrical energy while moving small weight up and down. This alternative energy adds with the energy provided for wearable electronic device. While moving weight up and down through pulley electrical energy is generated. The pulley is attached to the shaft of generator which generates small electrical energy. The generated electrical energy is added with battery through energy harvesting module. The energy harvesting module adds small amount of energy generated with previously generated. The generated energy can stored for long time using the captured energy further charges the rechargeable batteries used for wearable electronic devices.

KEYWORDS: Alternative Energy Harvesting, Energy Harvesting Module, Generator, Wearable Electronic Device, Weight lifting technique.

I.INTRODUCTION

The term Alternative Energy Harvesting is popularly used when electricity is generated from sources such as ambient temperature, vibrations or movement of human body [1, 3]. Since there are now electronic circuits whose power requirement is of the order of mill watts, even though its energy yield is relatively low.Energy is one of the inputs for economical development of country. Energy generation and utilization are two sides of coin. Development without energy is unthinkable. Economic growth is desirable for developing countries and energy is essential for economic growth [4-5].

Electronic technologies have been growing rapidly throughout the last few decades. Uses of electronic devices in day to day life have also drastically increased. Every electronic device requires energy. Energy is either generated or harvested.

Researchers have searched for ways to store the energy from heat and vibrations or motion of the body for many decades. The type of energy harvesting depends on the kind of energy[6-9].Vibration energy harvesting has growing for small electronics devices such as mobile phones, wearable devices, wireless sensor nodes, human health monitoring devices. The purpose of such kind of research is to power small power electronics gadgets using vibration energy [10].Wearable electrical or electronic systems constitute a very strong growth market [11]. Wearable portable electronic is still a fairly new field of research and as a result much of the terminology has still to gain widespread acceptance [12].Portable electronic device have drawn a lot of attention from the research community and the industry during the last few years as it is pointed out by the numerous and year by year increasing corresponding research and development efforts [13-16].

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II. METHODOLOGY AND EXPERIMENTATION

The electrical energy is generated through the movement of weight up and down. The weight is connected to shaft of generator through pulley. The following Fig. 1 shows the experimental setup of energy generated from weight lifting technique.

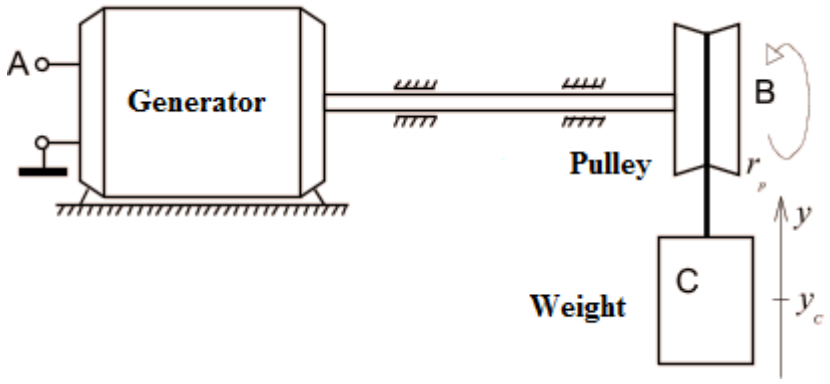

Fig. 1 Experimental setup of energy generated from weight lifting technique

In this work, energy harvested from the movement of shaft of generator. The main block of energy harvesting system is the generator. Here shaft of generator is connected to pulley. The weight is attached to pulley through thin rope. The weight mechanically goes up and down while applying external force to pulley with the movement of weight up and down, pulley move forward and backward direction. The generator converts mechanical energy into electrical energy. In this work the pulley is attached to shaft of generator because of that while weight moves up and down cause's movement of the shaft of generator. The movement of shaft generates electrical energy.

Fig. 2 shows the experimental setup of energy generated from weight lifting technique with gearbox.

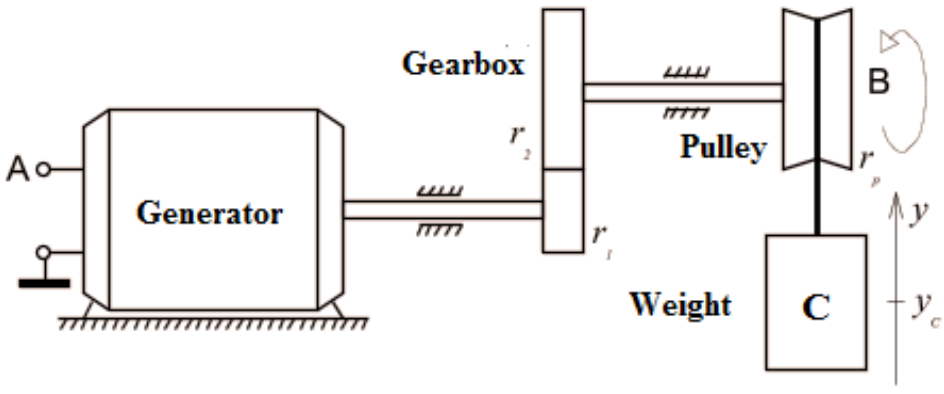

Fig. 2 Experimental setup of energy generated from weight lifting technique with gearbox

The generated energy from weight lifting technique is increases but need to add the energy with previously stored energy. In such a case Capacitor or Battery can be used. If the capacitor is selected for energy storage then the amount of energy stored in capacitor would be less. To store more energy, a diode pump circuit is used to accumulate the generated energy. In this case the device is expected to store energy and add next generated energy through diode pump circuit.

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The generator used for the present experimentation has 100rpm at 12V.The other parts attached to generator are thin rope, weight and pulley. The length of the rope is 35cm,the radius of pulley is 3cm and weight selected for experimentation are 10gm,20gm,30gm,40gm,50gm,60gm and 70gm.Table1 shows the voltage generated with respect to one rotation of generator. Table 1 shows the generated voltage for different weight attached to generator.

Table 1 Generated Voltage (V) for different weight attached to generator

Weight	Position	Voltage Generated(V)		
10gm	UP	0.141	0.198	0.204
	Down	0.414	0.414	0.414
20gm	UP	0.140	0.148	0.206
	Down	0.610	0.804	0.875
30gm	UP	0.151	0.168	0.221
	Down	1.048	1.249	1.697
40gm	UP	0.165	0.171	0.241
	Down	1.10	1.85	1.86
50gm	UP	0.195	0.200	0.222
	Down	1.96	2.12	2.21
60gm	UP	0.280	0.300	0.311
	Down	1.89	2.156	2.185
70gm	UP	0.310	0.366	0.411
	Down	2.022	2.188	2.210

The gearbox is attached to shaft of generator which increases the rotation of shaft. The gearbox connected to pulley, the weight is attached vertically like pendulum using rope which has light weight. This helps to increase the generated voltage.

III. EXPERIMENTATION WITH ENERGY HARVESTING MODULE

For accumulation of the generated electrical signal, there is a need to use energy harvesting module. The following Fig.3 shows the experimental setup of energy generated from weight lifting technique with energy harvesting module

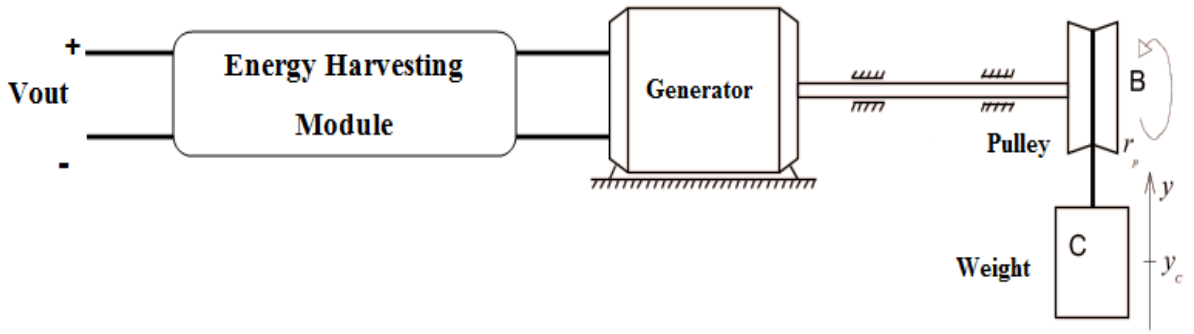

Fig. 3 Experimental setup of energy generated from weight lifting technique with energy harvesting module

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Up and down movement of weight up and down causes the pulley to rotate the shaft of the generator. The rotation of the shaft of the generator produces electrical energy. The generation of electrical energy depends upon the movement of shaft. The movement of shaft is dependent upon weight attached to pulley and distance between pulley and weight. As attached weight increases the shaft moves rapidly with up and down movement of weight. As weight goes down the generated electrical energy is very less. The output of generator is connected to energy harvesting module. The energy harvesting module stores the small amount of energy in capacitor bank. The generated energy is added in energy harvesting module. The energy harvesting module is a device which can accept electrical energy and store this energy. The harvesting module is self powered and always accept the energy get at input. This module is capture the energy generated, accumulate and store from external energy source.

V. RESULT AND DISCUSSION

The electrical energy is generated from weight lifting technique for different weights. Initially the energy harvesting module is discharged. Usually it is set to 0.5V.When the weight is set to top position of pulley, the generator produces some finite voltage. This voltages increase as the weight moves down. Variation of voltage is recorded during this case and maximum voltage is recorded. Measurement of electrical energy has been carried out at least for eight different cycles. This is repeated eight times and maximum voltage is recorded. The electrical energy is captured in form of voltage. Table2 shows the Generated Voltage (V) for different weight attached to generator with energy harvesting module.

Table 2 Generated Voltage (V) for different weight attached to generator with energy harvesting module

Initial output voltage of module=0.50V

Cycles	Voltage Generated(V)					
	Wt=20gm	Wt=30gm	Wt=40gm	Wt=50gm	Wt=60gm	Wt=70gm
1	0.506	0.99	0.917	1.81	2.03	2.10
2	0.626	1.1	1.28	2.23	2.45	2.52
3	0.626	1.19	1.37	2.5	2.65	2.76
4	0.626	1.23	1.46	2.55	2.74	2.86
5	0.626	1.26	1.54	2.55	2.75	2.87
6	0.626	1.267	1.55	2.55	2.76	2.89
7	0.626	1.28	1.56	2.55	2.76	2.89
8	0.626	1.29	1.56	2.55	2.76	2.89

For small weight attached to pulley generates energy less. While increasing the weight, the generated voltage also increases. After certain cycles the generated output voltage remains constant.Fig. 4 shows the voltages generated with respect to cycles of different weights.

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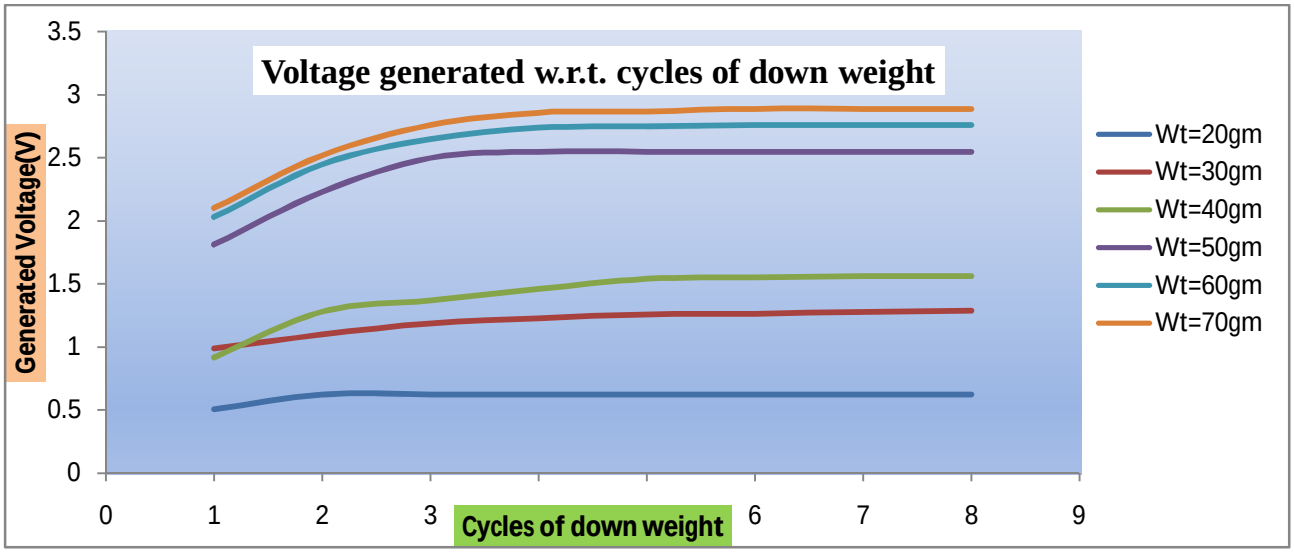

Fig. 4 Voltages generated with respect to cycles of different weights

VI.CONCLUSION

The generated electrical energy is totally depending on weight attached to the thin rope. While moving weight up and down, the pulley moves right and left causes movement of the shaft. If it moves slowly then generated signal is also low. If pulley moves fast then generated signal is large. In first case, the pulley is rotated without energy harvesting module because of that generated energy cannot be stored. The energy generated from rotating pulley down is much more than energy generated from up the weight. The electrical energy generated is proportional to weight.
In second case, the generated energy from generator is stored in energy harvesting module. In this case different weights are attached to shaft of generator through pulley. This experiment is carried out for eight different weights and measures the generated voltage. The generated voltage increased and that stored in capacitor bank. The advantage of energy harvesting module is generated energy accumulate in previous energy so that stored energy increased to certain limits.

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