DESIGN OF PORTABLE POWER GENERATOR FOR ELECTRONIC GADGETS

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Abstract

Today in this modern world energy and power are the one of the basic needs of every one due to extensive use of electronic gadgets in each every field of human life .The use these gadgets consumes more energy and hence the demand is increasing, on the other hand, the available many conventional energy resources are getting exhausted. In this research we are converting mechanical movement while walking foot step into electrical energy. This uses simple drive mechanism such as push to rotate assembly. The control mechanism carries thespur gear assembly and D.C electromagnetic generator, Battery for charging and controlling circuit for controlling the output power generation. The generatedpower is stored by means of battery and this is used foractivating the connected loads in case of energy requirement in critical situation like rescue and military operation as well as the situation or area where the power is not available easily. In this research we are generating electrical power using non- conventional method by simply walking or running. This method utilization the force which is obtained during the walking steps is converted in to electrical energy with the help of mechanical systems.

Keywords

Electromagnetic power Generator, N o n -conventional energy system, D.C. Generator, Spur gear, Shaft.

1. Introduction

Harvesting the energy with the foot power with human locomotion is very much easy and practically achievable, so to enhance the life for the better tomorrow the country which relies on the non-conventional energy resources will be going to lead this world and one of the simple approaches is to generate the electricity from human walking and running. This type of approach is very useful in the field of Military application, Automation of Industries, Smart irrigation and Agriculture, e-learning platform of Education where the process and systems are totally depends on the electronic gadgets like desktop computers. Laptop computers, mobile phones, tablet computers, e-readers, storage devices such as flash drives. The people move round the clock. Asa result large amount of power can be generated with the use of this promising technology. This process involves number of simple setup which can be assemble near the shoes sole When people going to walk on the road their body weight compresses the assembly which rotates a dynamo or DC generator the voltage is generated, The generated power is stored in dry battery or capacitor bank to charge the secondary battery of electronic gadgets . Greater movement of people will generate more energy.

In this research the weight of the person which acts on the shoe sole is used to generate electrical energy. When a person walks on the road, a force acts on the shoes and ultimately the push to rotate mechanism which is a basically a converter from linear motion to angular motion with high accuracy and get release to original position after the lifting of foot and hence this is going to repeated continuously and we are getting the angular motion from the linear motion frequently. At the other end of this assembly we attached the spur gear assembly box which increases the speed of outer shaft of this spur gear assembly so that a sufficient rpm can be achieved to run the rotor of the DC generator to produce the sufficient electrical energy for the charging of battery or capacitor bank. Whenever a person walks or runs a mechanical energy is generated. This energy may be used and converted into electrical energy. The Mechanical energy is converted into electrical energy using DC generator or Electromagnetic generator. Generated energy can be stored in Batteries, and then the output of the battery connected to the battery operated electronic gadgets to get seamless operation. This type of portable electricity generator may useful for different application depends on requirements.

1.1 objectives of this research

To design and develop and testing the prototype of portable power generator for electronic gadgets. Also fabricate the model which will work on the systems for required application. In this research we are converting Mechanical energy into Electrical energy. We are trying to utilize the wasted energy in a useful way. By using linear to rotational motion unit arrangement we are converting to and fro motion of the human walking into rotational motion for the dynamo or DC generator. To design and testing the prototype and to make the analysis for the further improvement The main aim of this research is to develop of portable and efficient power generation method, which in turns helps to solve the power requirement in difficult situation where the power arability shortage and to bring down the pollution as well as reduce the greenhouse gases.

2. Literature review

Shenck N., Paradiso J (2001) By using the piezoelectric shoe power the technical solution for the energy harvesting the two approaches are commonly used: one method is to harness the energy dissipated in bending the ball of the foot, using a flexible device mounted under the insole. The second method is to harness foot strike energy by flattening curved, pre-stressed devices (e.g., metal strips spring coupled with a rigid piezoelectric) Hosaka H (2003) Energy harvesting is the process of capturing minute amounts of free energy from the ambient background. An energy harvesting system requires an energy source, an energy conversion device such as a piezoelectric element that can translate the energy into electrical form, an energy harvesting module that captures stores and manages power for the device, an end application device. Amirtharajah et al,(2005) Advancement in technical developments have increased the performance of the electronic devices in capturing trace amounts of energy from the environment and transforming them into electrical energy. In addition, advancements in microcontroller and microprocessor technology have increased power efficiency, effectively reducing power consumption requirements. In combination, these developments have sparked interest in the engineering community to develop more and more applications that utilize energy harvesting for the principal technologies used for the transduction of ambient energy into usable electrical energy include photovoltaic (100 mW/cm2 direct, 6 μW/cm2 indoor), thermoelectric-See beck effect (100mW/cm2), piezoelectric (100 μW/cm2), and electromagnetic (300 μW/cm3, vibrations). In detail kinetic energy harvesting requires a transduction mechanism to generate electrical energy from motion and the generator will require a mechanical system that couples environmental displacements to the transduction mechanism Bhosale P.A et al (2017) The transduction mechanism itself can generate electricity by exploiting the mechanical strain or relative displacement occurring within the system. The strain effect utilizes the deformation within the mechanical system and typically employs active materials (e.g., piezoelectric, piezoceramic and piezopolymer). The mechanical vibrations are considered today among the most promising sources for both the discrete power density for the abundance of sources: industrial machinery, household appliances, transportation, and human movement. Piezoelectric and electromagnetic transduction methods are two most promising approaches for kinetic energy harvesting. Piezoelectric generators have the advantages of simple structure, easiness to fabricate, and less peripheral components. On the other hand, although the output voltage is very high, the current flowing out from piezoelectric generators is too low to be used due to the very high impedance of such materials (< 100 kΩ). The electromagnetic generators can generate high output current levels but the voltage is very low (typically < 1V). Macro-scale devices are readily fabricated using high performance bulk magnets and multi turn coils. However, calibrating micro-scale systems is difficult due to the relatively poor properties of planar magnets, the restrictions on the number of planar coil turns, and the too small vibration amplitudes. Both kinetic harvesting techniques have been shown to be capable of delivering power to the load from microwatts to mill watts Khaligh A [2010]. energy from various environments to power electronics, the amount of available raw energy (for example, sunlight, vibration, heat) and the surface area or net mass that the device permits limit the power yield in pervasive computing's everyday inhabited settings. With the exception of heel-strike harvesting in electric shoes (7 W potentially available for 1 cm deflection at 70 kg per 1 Hz walk, Yaglioglu O [2002] solar cells inn bright light, available powers generally hover at mW or μW levels. But the heel-strike energy may be different from energy harvesting. In light of the distinct functions of muscle, it may be distinguished between two general methods of harvesting energy: parasitic and mutualistic. For parasitic energy harvesting, the electricity is harvested at the expense of metabolic energy of the user. In this method, the energy is harvested during the periods when muscles normally perform positive work, causing muscles to perform more positive work than they would otherwise. As power requirements drop for most wearable devices, it is no longer infeasible to harvest a useful amount of energy "parasitically" from a normal range of human activity. Many attempts have been made in the past to tap this source, leading to the consideration of a host of technologies Chapman P., Raju M [2008] ranging from the construction of various electromechanical generators to the surgical placement of piezoelectric material in animals Paradiso A, Starner T [2005]. On the other hand, mutualistic energy harvesting is accomplished by selectively harvesting energy at times and in locations when muscles normally decelerate the body. Rather than braking entirely with muscles, a generator would perform some of the required negative work converting the mechanical energy of the body into electrical power. In this manner, mutualistic energy harvesting would be similar to regenerative braking in hybrid cars Abhishek N, Shivasharana Yalag, [2016].The sport shoe differs from ordinary shoes in its energy dissipating sole. While walking in ordinary "hard" shoes, the foot is rapidly decelerated from its relatively high downward speed to zero velocity relative to the ground: the force applied to the foot to achieve this deceleration is an impulse. The result is that the force and displacement values over time for the bottom and top of the midsole are not the same; there is an energy loss in the sole while it performs this filtering function. The energy lost is in the higher harmonics of the step and is dissipated through internal losses in the sole. When the sole springs back after the step it does not exert as much force as before, returning less energy than was put into it, and it is this energy that we are trying to capture). Kymissis J. et al. [2017]The energy obtained from the shoe is not free—as the harvested power grows, there is a noticeable additional load as the shoe demands more energy to be put into it while supplying less restoring force.

3. Methodology

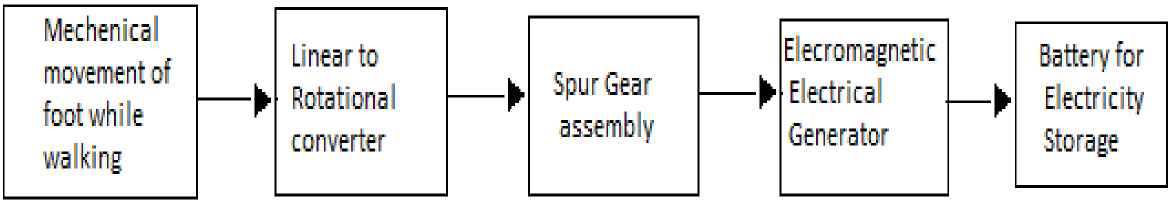

Figure1. Block Diagram of portable generator for Electronic Gadgets

The general block diagram of portable generator for Electronic Gadgets is shown in Figure 1. The Figure 2 gives the idea of linear to rotational motion unit comprising: a handle, a bushing fixedly A bushing fixedly attached to unit head end of the unit Handle; an extension member in rotatable and slide able communication with the unit handle and the bushing, at least References Cited two engagement members extending orthogonally from the extension member and slide- ably engage with one of the groves; a spring rod, with a unit head end and a cap end, located within the extension member; an integral cap located on the cap end of the spring rod; a compression spring, in slide able communication with the spring rod, the unit head end of the compression head pushing against the unit head base the cap end of the compression spring pushing against the integral cap.The generator arrangement is used to generate the electric power. Now a day's power demand is increased, so the power generation arrangement is used to generate the electrical power in order to compensate the electric power demand in emergency situation. In this arrangement the mechanical energy is converted into electrical energy.

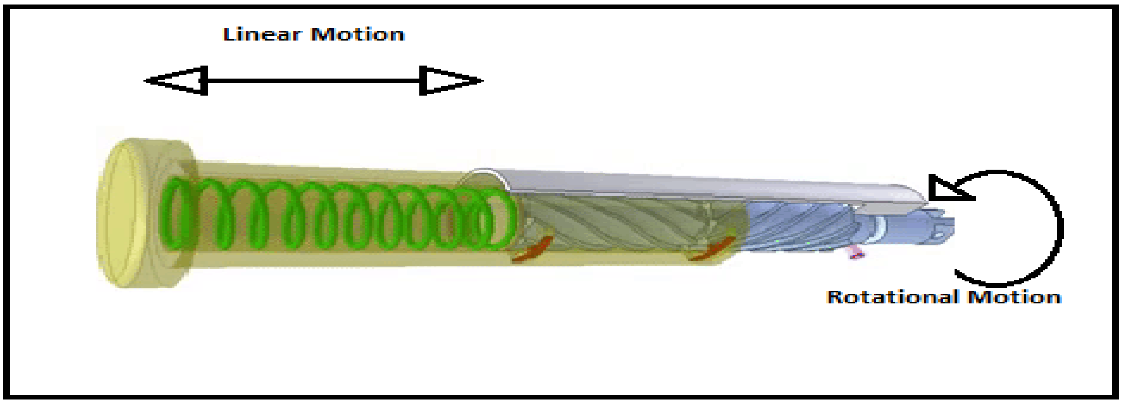

Figure 2. Linear to rotational motion Assembly.

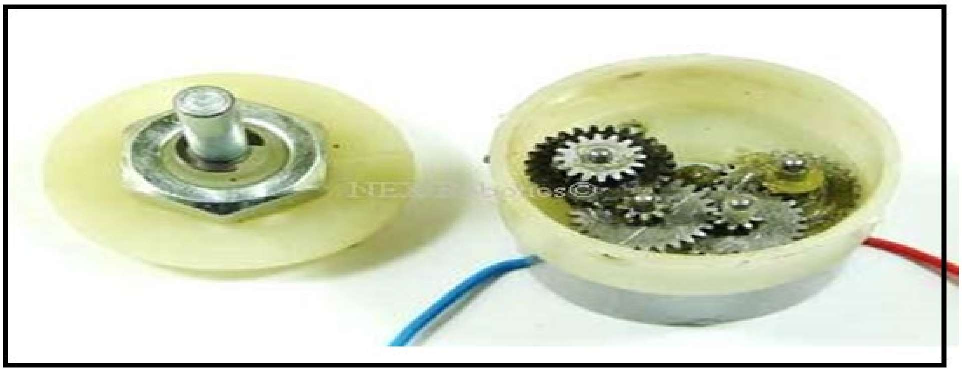

Figure 3. Spur Gears assembly

In Figure 3. Spur Gear generator arrangements are used for dc motors coupled with one of our unique spur gearheads. The internal construction of our spur gearhead consists of straight-toothed, inter-meshed gears that control the torque and speed output of the gear motor. The gear train consists of large and small gears mounted on parallel shafts that are offset from each other. As the smaller gears mesh with the larger gears, it increases and transforms torque into speed. The gear train arrangement of a spur gearhead is designed to hold the entire load on a single point of contact between the two gears; adding more gears lowers input torque and increases output angular speed. The complete and real image of this mechanism is shown in fig 3 given below. The impact load is put on surface on thes One end of spring is attached to the other surface of step (plate) and another end is fixed to the stand. Firstly, the spring is compress down due to impact of load. During this process the energy is absorb in the spring. When the weight is removed from thetop of the plate, the spring comes back to its original position. By releasing the energy inside it and the plate moves upward and return its original position. When the spring is compressed due to impact of weight on plate, the energy is absorbed in the spring and the excel move downward direction vertically and the shaft is in contact with gear assembly. So, excel rotates clock wise direction. The shaft is directly coupled with dynamo (generator). So, dynamo generates electricity. When the foot is lifted the spring expends releasing the energy stored inside it, the excel moves in downward direction vertically and If we want to store the electrical energy for future use, we connectthe dynamo to the battery which stores the energy in the form of D.C. in the battery. The table 1 shows the material and components used with specific material used for the this portable generator.

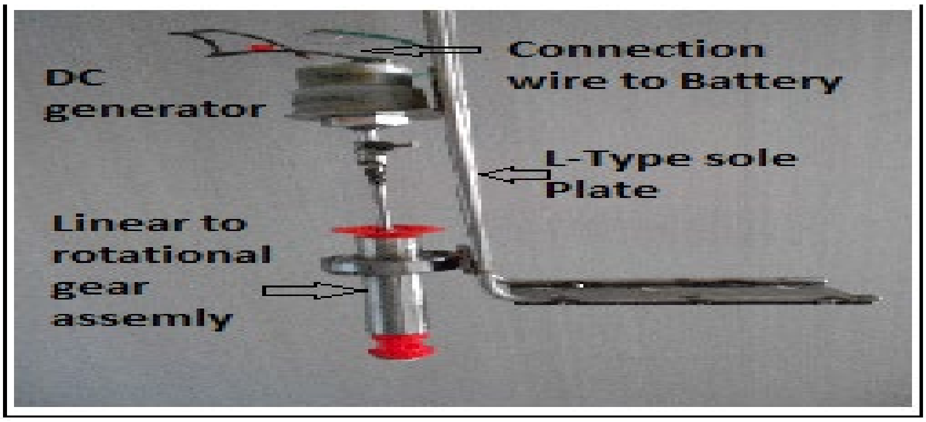

Fig 3 prototype of Portable generator

Table1. Components and Material Specifications

Sr.No.	Component	Details
1.	Base and upper excel	*Mild steel*
2.	Fixed Cylindrical pipes	*MS steel*
3.	Moving shaft	*MS pipes*
4.	Springs	*Alloy Steel Wire*
5.	Spur gear	*Cast iron,*
6.	DC generator	*Electric equipment*
7.	Supporting frame	*Mild steel*

4. Data collection

OUTPUT POWER CALCULATION

Let us consider,
The mass of a Human body is = 60 Kg (Approximately)Height of stud is = 4cm
∴Work done = Force x Distance
Here,
Force = Weight of the Body
= 60 Kg x 9.81
= 588.6 N
Distance traveled by the body = Height of the spring
= 4 cm
= 0.04 m
∴Output power = Work done/Sec
= (588.6x 0.04)/60
= 0.39 Watts (For One pushing force)

5. Result and Discussion

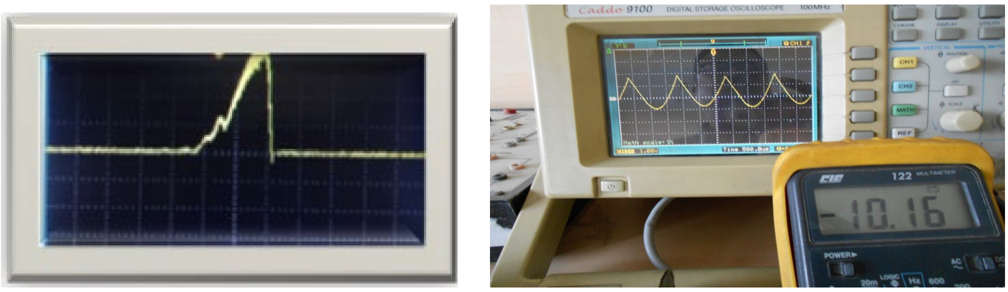

Figure4. Output voltage signal from prototype of Portable generator

As shown in Fig 4: the above graph this shows the Voltage induced in a slow walking or normal walking speed. Here we analyze that the Digital storage oscilloscope output clearly indicates that the voltage around 10 volts is generated and can be increase with more powerful generator

ADVANTAGES OF THIS PORTABLE GENERATOR

This process depends on human resources which is available in plenty in our country which makes our country a favorableplace for this project.

1) Power generation is simply walking on the step.
2) Power also generated by running or exercising on the step.
3) Battery is used to store the generated power for further Application.
4) This is a Non-conventional system
5) No need fuel input.
6) It can be used at any time when it necessary
7) Low cost level.
8) Reduces transmission losses.
9) Wide areas of application.
10) Easy maintenance because of less moving parts.
11) Highly efficient in more crowded places.
12) Depending upon the power generator and number of them,power output is very high
13) Promising technology for solving power crisis to anaffordable extent
14) Maintenance cost is low.
15) Conversion of mechanical energy into electrical energy iseasy.

6. Conclusion

This research of portable power generation generates the power without any conventional fuel input Thus, it can also be concluded that this mode of power generation system is eco- friendly, i.e., no pollution is caused during the generation of power using this type of generator . Hence due to such advantages, this system can be used for many applications and due to light weight can be easily assemble with shoes without any hesitation. With this system; we can easily reduce our dependency on the conventional sources of energy and can be used for emergency situation. The prototype is successfully tested and given the result up to the mark The research work designed and developed the portable power generator successfully, for the demonstration purpose a proto type module is constructed with lower ratings of devices, & results are found to be satisfactory. This system can further modified with latest trend and technology for the robust and economical aspect this concept falls under the subject of non-conventional energy resources, when it is implemented practically, depending up on the size & cost , this power can be utilized for many applications.

References

Shenck N., Paradiso J., "*Energy Scavenging with Shoe-Mounted Piezo-Electrics"*, IEEE Micro, vol. 21(3), pp. 30–42, 2001.

Hosaka H., "*Personal electric power generation technology for portable information equip- mention", Micro Mechatronics - Journal of the Horological Institute of Japan*, vol. 47(3), pp. 38-46, 2003.

Amirtharajah R., Collier J., Siebert J., Zhou B. and Chandrakasan A., "*DSPs for Energy Harvesting Sensors: Applications and Architectures", IEEE Pervasive Computing*, vol. 4(3), pp. 72-79, 2005.

Kagetsu Y., Osaki Y., Hosaka H., Sasaki K., Itao K., "*Research on automatic power generator using self-exciting rotation", Micro Mechatronics - Journal of the Homological Institute of Japan*, vol. 48(4),

Bhosale P.A., Shinde Mr.Harshal, Tahade Mr.Rohit, Valani Mr. Meet, Wallalwar Mr.Rohan, (2017) "*Design of Foot Step Power Energy Generation Machine", International Conference on Ideas, Impact and Innovation in Mechanical Engineering* (ICIIIME 2017), ISSN: 2321-8169 /943 – 948, Volume: 5 Issue: 6

Hayshida J., *Unobtrusive integration of magnetic generator systems into common footwear. MIT Department of mechanical engineering*, pp. 98-104, 2000.

Dhimar Mrs. Krupal, Patel Krishna, Patel Zeel, Pindiwala Nisha, (2017) *FOOTSTEP POWER GENERATION SYSTEM International Research Journal of Engineering and* Technology Volume: 04 Issue: 04 | Apr -2017.

M. Iswarya, G. R. P. Lakshmi, (2017) "*Generation of Electricity by Using Speed Breakers", IEEE International Conference on Power, Control, Signals and InstrumentationEngineering,* IEEE 2017.

Khaligh A., *"Kinetic Energy Harvesting Using Piezoelectric And Electromagnetic Technologies —State of the Art" IEEE Transactions on Industrial Electronics,* vol. 57(3), pp. 850-860, 2010.

Yaglioglu O, "*Modeling and Design Considerations for a Micro- Hydraulic Piezoelectric Power Generator," master's thesis, Dept. Electrical Eng. and Computer Science, Massachusetts Inst. of Technology.* 2002.

Chapman P., Raju M., "*Designing power systems to meet energy harvesting needs", TechOnline* India, vol. 8(42), 2008.

Paradiso A, Starner T., "*Energy Scavenging for Mobile and Wireless Electronics", IEEE Pervasive Computing,* vol. 4(1), pp. 18-27, 2005.

Abhishek N, Shivasharana Yalag, (2016) "*Power Generation by Foot Steps Using Rack and Pinion Arrangement", International Journal of Engineering Research and Advanced Technology, volume* 02 Issue 01, pp 2454-6135 2016.

Kymissis J., Kendall C., Paradiso J., Gershenfeld N., *"Parasitic power harvesting in shoes", In IEEE Intl. Symp. On Wearable computers,* vol. 24, pp. 132-139, 1998.

Bonisoli, E., Repetto, M.,Manca, N., and Gasparini, *A. Electro-mechanical and electronic integrated harvester for shoes application.* IEEE/ASME, pp. 1921–1932. (2017).

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