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Harvesting Renewable Energy by Using Human Foot Step

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ABSTRACT

Man has used tremendous amount of energy for his daily needs. Due to this a lot of energy resources have been exhausted and wasted. Proposal for the utilization of waste energy of foot power with human locomotion is very much relevant and important for highly populated countries like India where the railway station, temples etc., are overcrowded all round the clock. In this paper the force energy is produced by human footsteps and the force energy is converted into mechanical energy by rack and pinion mechanism, electricity is produced by dc generator. And this power source has many applications as in agriculture, home application and street lighting and as energy source for sensors in remote locations. This thesis is all about generating electricity when people walk on the Floor. Think about the forces you exert which is wasted when a person walks by. The idea is to convert the weight energy to electrical energy The Power generating floor intends to translate the kinetic energy to the electrical power. Energy Crisis is the main issue of world these days. The motto of this research work is to face this crisis somehow. Though it won't meet the requirement of electricity but as a matter of fact if we are able to design a power generating floor that can produce 100W on just 12 steps, then for 120 steps we can produce 1000 Watt and if we install such type of 100 floors with this system then it can produce 1MegaWatt. Which itself is an achievement to make it significant.

KEYWORDS: *Energy Resource, Human Footstep, Weight Energy, Electrical Energy*

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1. INTRODUCTION

Since the human beings came to earth a few million years ago, their needs and use of electrical energy is growing very fast for their sustenance and comfort. Embryonic man needs energy mostly in the form of diet. Over time, man began farming the land for agriculture and cultivating the land for farming. With an additional demand for energy, man began using wind for sailboats and to drive windmills but now these methods are also not completely fulfilling the demands. So, we need to look upon other nonconventional sources to acquire energy[1].

Footstep energy generation can be an effective method to generate electricity. Walking is the most common activity in human life. When a person walks, he loses some energy to road surface in the form of impact, vibration and sounds etc. due to transfer of his weight on to the road surface, through foots falls on the ground during every step result in losing kinetic energy. This kinetic energy can be tapped and converted in to useable form such as in electrical form[2].

2. LITRATURE REVIEW

Method The burning of coal, wood, diesel (generators) and so forth are used for traditional power generation method, which is continuously depleting our natural resources such as fossil fuels[3]. The demand for power rises with the increase in population. Besides, the traditional methods cause pollution and encourage deforestation (cutting of trees). Therefore, this results to consequences such as global warming, power shortage just like what we are facing in India.

Global warming indicates an average rise of the temperature in the atmosphere near the Earth's surface. The global surface temperature increased

0.74 ± 0.18 °C (1.33 ± 0.32 °F) during the 100 years ending in 2005. Since the mid-twentieth century, the temperature rises with the intensity of anthropogenic greenhouse gas. Solar variation, volcanoes, and cooling effect contributes to the entropy rise frompre-industrial age to nowadays[4].

Table 1 Papers Studied

S. no	Paper title	Author	Idea
1.	Design and analysis of a Mechanical Device to harvest energy from human footstep motion	T R Deshmukh	Converting Human Foot Pressure into Linear Motion by Rack and Pinion
2.	An Investigation on Generation of Electricity Using Foot Step	Sasank Shekhar Panda	Based on crank shaft; fly wheel, and gear arrangement
3.	Foot Step Power Generation Using Piezoelectric Material	Miss Mathane Nitashree V	Based on Piezoelectric Materials
4.	Power Generation Using Foot Step	Jose Ananth Vino.	Simple drive mechanism which includes rack and pinion assembly and chain drive mechanism
5.	Modification and implementation of foot step power generation System in weighting scale of the gym	A.R. Kotadiya, B.D. Parmar	Modified and combine existing methods of foot step power generation that are rack and pinion arrangement and piezoelectric crystals.

3. METHODOLOGY

Basically, we are designing and fabricating a foot step power generation using unidirectional mechanism prototype to overcome the problem related to Power shortage and Environmental Pollution. Our Model will be capable of generating Electricity by human foot work during downward motion of Rack and upward motion of rack. This generated electricity will be stored in Lead storage Battery that can be further used for any electric load purpose using invertor.

It is just a model to let us understand the basic idea and principle, with the help of which a prototype Floors can be fabricated accordingly with specific manipulation. So, coming on its design, Project can be seen into mainly hardware part. Hardware part contains Helical Springs, Rack and Pinion Arrangement, two main shafts, Ball Bearings, Gears, Unidirectional Gear System, Chain Drive Mechanism, two DC Motors, Multimeter, Diode, Battery, Invertor.

Here we have used Unidirectional Mechanism so that we can generate electricity when it is pressed by human foot and also when it returns in its normal position. So, this system will generate more electricity in a single human foot step.

This model is mainly consisting of hardware part only. We have made a wooden floor with help of iron blocks. This wooden floor each corner has a helical spring connected by welding process. The other end of helical spring is also connected with same type of iron blocks. In between both iron blocks all the gears and chain drive are installed.

In the lower iron block, we have installed two main shafts each end has ball bearing for their smooth rotation. In the upper iron block (Wooden floor) a Rack is welded and in same line of rack in the lower part a pinion is fitted in one shaft. When upper wooden floor will be pressed by human foot then this Rack and Pinion will move and rotate the shaft. The two shafts are connected with chain drive. Two shafts are also connected with two spur gears of same teeth and one gear has unidirectional mechanism which enables shafts rotation in both direction motion of rack and pinion. On the Second shaft two spur gears of 38 teeth is fitted which mess with two 25 teeth DC motor. DC motors can generate voltage up to 12 Volt and 300 mA current. This generated current will be stored in a 12 Volt battery. On the battery a diode is linked which only allows the one direction flow of current only from dc motor. An inverter is also connected with battery which takes AC loads. A multimeter is also installed by which we can check the battery charging status and can also directly check the voltage generated during foot step.

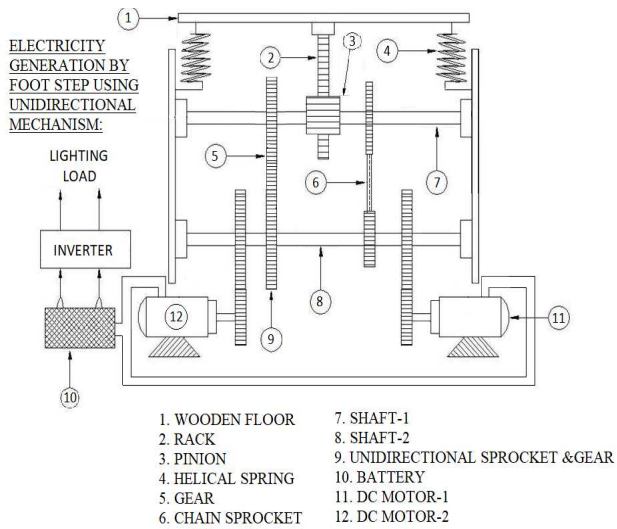


Figure 1: Block diagram of scheme of the project

4. DESIGN AND TESTING

The whole module is composed of many Mechanical, Electrical and Electronics components. Each component is specific in its work and performs dedicated function intelligently. Each component used in the module, contributes to make a complete system. The complete system consists of hardware framework. DC motor which is connected with spur gears to main shaft of model generates electricity by human footwork. That electricity can be stored in Lead Storage Battery. This stored energy can be further used in any Load work.

HARDWARE FRAMEWORK

4.1. Rack and Pinion

A **rack and pinion** are a type of linear actuator that comprises a circular gear (the pinion) engaging a linear gear (the rack), which operate to translate rotational motion into linear motion. In our model we have used Rack of 22 teeth and pinion 24 teeth.

4.2. Unidirectional Gear System

A mechanical assembly applicable to convert bidirectional motion of an input shaft into unidirectional motion of an output shaft comprising input shaft, intermediate shaft and output shaft, wherein two sets of gearing arranged one after the other, in combination with ratchet and pawl mechanisms driven in opposite directions, with two opposing ratchet wheels fitted to input shaft, each accompanied by a gearwheel driven on bearings on the same shaft with protruded flanges integral to aforesaid gear wheel, carrying spring loaded pawls on flanges to engage with accompanied ratchet wheel. The output shaft is coupled to input shaft by aforesaid gearings, so that the rotary movement performed either on clock wise or counterclockwise direction on input shaft will result unidirectional motion on output shaft.

4.3. Springs

Spring is an elastic machine element that can deflect under the application of load. When the load is removed, it regains its original position. In our model we have used four helical compression spring on the four corners of wooden floor.

4.4. Shafts

A shaft is a rotating machine element, usually circular in cross section, which is used to transmit power from one part to another, or from a machine which produces power to a machine which absorbs power. In our model we have used two shafts for rotation of dynamo. One shaft directly connected by rack and pinon arrangement with the upper wooden floor. Both shaft mesh with two spur gears and also connected with chain drive.

4.5. Chain Drive

A chain is a series of connected links which are typically made of metal. A chain may consist of two or more links.

Those designed for lifting, such as when used with a hoist; for pulling; or for securing, such as with a bicycle lock, have links that are torus shaped, which make the chain flexible in two dimensions (The fixed third dimension being a chain's length.)

4.6. Dynamo

A dynamo is an electrical generator that creates direct current using a commutator. Dynamos were the first electrical generators capable of delivering power for industry, and the foundation upon which many other later electric-power conversion devices were based, including the electric motor, the alternating-current alternator, and the converter.

Two DC Motors are used in our model to generate DC current which is further stored in battery. These DC motor can generate voltage 1.5V – 12V. 500mAmp current at maximum rpm.

4.7. Battery

Battery (electricity), an array of electrochemical cells for electricity storage, either individually linked or individually linked and housed in a single unit. An electrical battery is a combination of one or more electrochemical cells, used to convert stored chemical energy into electrical energy.

4.8. Inverter

A power inverter, or inverter, is a power electronic device or circuitry that changes direct current (DC) to alternating current (AC) The resulting AC frequency obtained depends on the particular device employed. In our model we have used 18W Mini Inverter (12V DC to 220V AC).It is a premium quality 18w mini-inverter circuit PCB board suitable for LED bulbs, CFL, Mobile charging, homemade mini-DIY inverter, etc.

Specification of 18W mini-Inverter:

- Type: Voltage converter
- Input voltage: DC 6V-12V
- Input current: 1A-2.5A
- Power output: AC220V 0.1W-18W

4.9. Multimeter

A Multimeter is an electronic instrument, every electronic technician and engineer's widely used piece of test equipment. A multimeter is mainly used to measure the three basic electrical characteristics of voltage, current, and resistance. It can also be used to test continuity between two points in an electrical circuit.

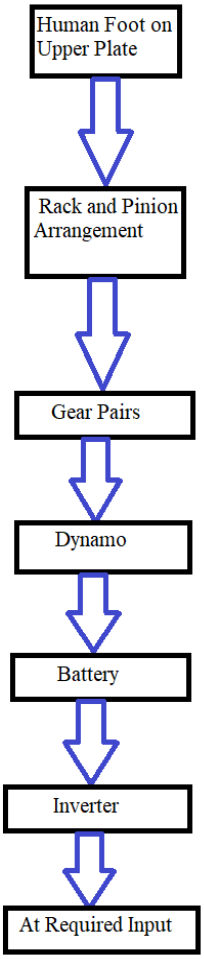


Figure 2: Flow Chart of the project

Model of Project:

Figure 3: Side view of complete Project

4.10. Testing of Project

THEORETICAL ENERGY OUTPUT:

Calculation of Energy per Step by Person A:

To determine the output power, it is essential to determine the force applied on the model. Let the force applied be calculated as,

Force=Weight of the Body= m. g

Work done =Force x Displacement

The weight applied by the Person A is 56 kg, then the

Maximum displacement of the spring can be noted as- 0.036m

Force =56 x 9.81=549.36 N

Work done per Step =549.36 x0.036 =12.63 Joule/Step

Table 2 Theoretical Energy generated per Step by Each Person

Person	Mass (Kg)	Force ()	Deflection (cm)	Theoretical Energy per Step (Joule)
A	56	549.36	2.3	12.63
B	66	647.46	2.9	18.77
C	78	765.18	3.2	24.48
D	87	853.47	3.6	30.72

EXPERIMENTAL ENERGY OUTPUT:

Calculation of Energy per Step for 100-foot counts by Person A:

Step Counts- 100

Battery Voltage before Foot Counts- 11.65 V

Battery Voltage after Foot Counts- 11.75 V

Duration of Lightning of 5-Watt bulb- 40 Seconds

Energy consumed by 5-Watt bulb by Battery- 40x5= 200 Joule

Average Energy per Step by Person A- (Energy consumed by 5-Watt bulb by Battery/Foot Counts) = 200/100= 2 Joule/ Step.

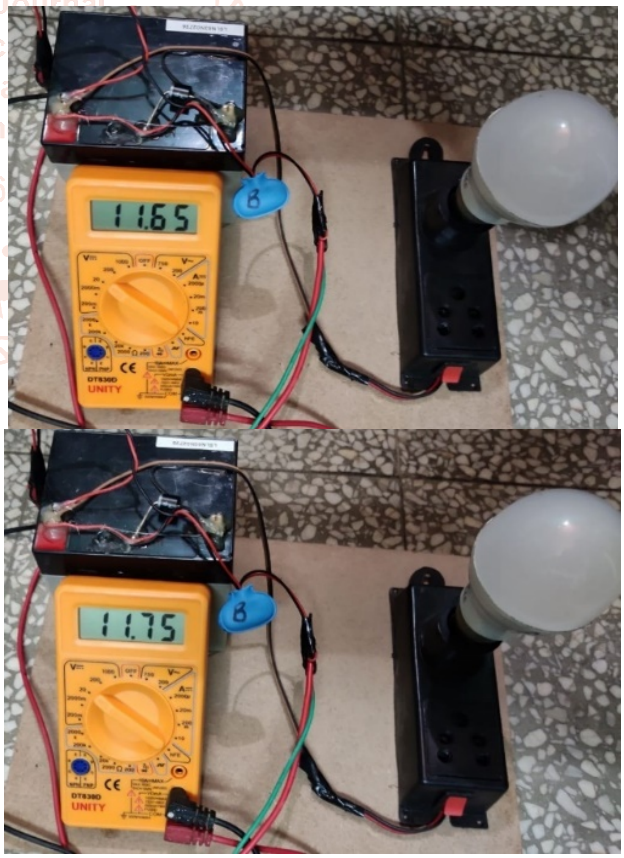


Figure 4: Battery Voltage before and after Foot Count of Person A

Calculation of energy per step for each person at different foot counts is same as shown above. Similarly, I have taken data for different step counts which are 200,300,400 respectively for each Person.

Table 3 Experimental Energy generated per Step by Person A (56 Kg)

Step Counts	Duration of Lightning of 5-Watt Bulb (Seconds)	Total Energy (Joule)	Energy per Step(J/step)
100	40	200	2
200	75	375	1.875
300	110	550	1.83
400	145	725	1.81

Table 4 Experimental Energy generated per Step by Person B (66 Kg)

Step Counts	Duration of Lightning of 5-Watt Bulb (Seconds)	Total Energy (Joule)	Energy per Step(J/step)
100	60	300	3
200	126	630	3.15
300	185	925	3.08
400	230	1150	2.875

Table 5 Experimental Energy generated per Step by Person C (78 Kg)

Step Counts	Duration of Lightning of 5-Watt Bulb (Seconds)	Total Energy (Joule)	Energy per Step(J/step)
100	80	400	4
200	155	775	3.875
300	230	1150	3.83
400	300	1500	3.75

Table 6 Experimental Energy generated per Step by Person D (87 Kg)

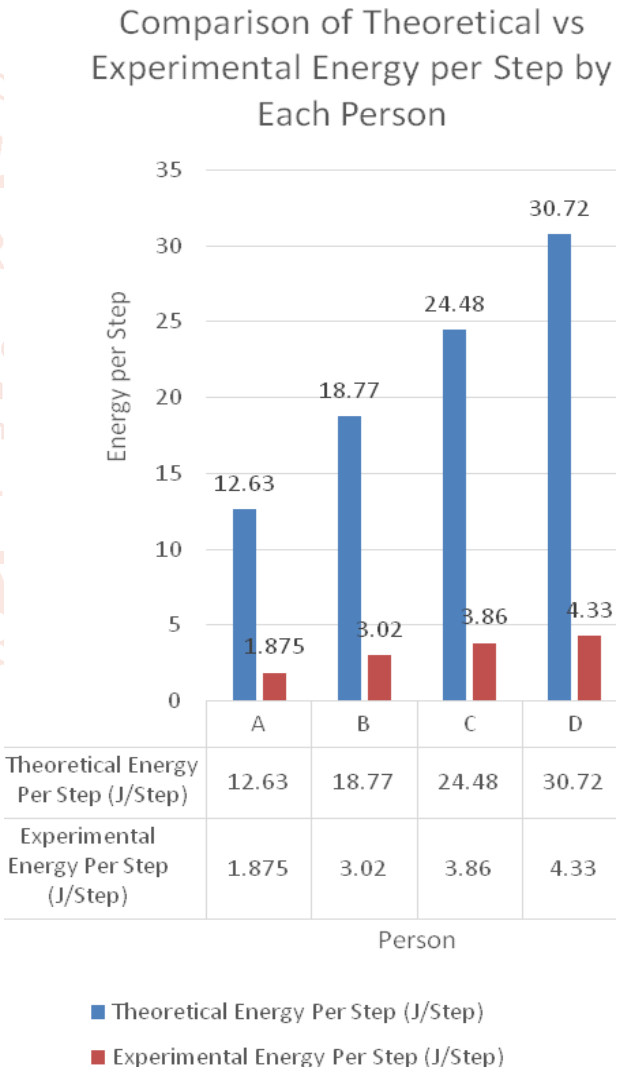
Step Counts	Duration of Lightning of 5-Watt Bulb (Seconds)	Total Energy (Joule)	Energy per Step(J/step)
100	96	480	4.8
200	170	850	4.25
300	250	1250	4.16
400	330	1650	4.125

5. RESULT AND CONCLUSION

From the above data taken during testing following results and conclusions are drawn.

1. By the below Graph of Comparison between Theoretical and Experimental Energy per Step we can calculate the average Energy harness to be about 16 percent of input energy by human foot count.
2. As the weight of person is increasing energy generated per step is also increasing.
3. As step counts are increasing energy generated per step is decreasing slightly. The main reason for the decrease in energy is frictional losses which also increases as the step counts increases.
4. From the above graph of comparison between theoretical and experimental energy produced per step we can clearly see that only on an average 16 percent of the input energy is harnessed by our project. These losses of energy are due to two main reasons:

- As there are many mechanical moving parts which have relative motion with respect to each other so this leads to increasing frictional losses.
- As there is no controller like PID to maintain the top of the project floor in horizontal direction, due to this the force applied by human foot in vertical direction is not completely get converted in rotational motion.



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