Foot Step Power Generation

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Abstract -*Man has needed and used energy at an increasing rate for the sustenance and wellbeing since time immemorial. 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 paper 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.

Key Words:**Renewable Energy, Foot step, Electricity, Generator.**

1. INTRODUCTION

For an alternate method to generate electricity there are number of methods by which electricity can be produced, out if such methods 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 energy to the road surface in the form of impact, vibration, soundetc. Due to the transfer of his weight on to the road surface, through foot falls on the ground during every step. This energy can be tapped and converted in the usable form such as in electrical form. This device, if embedded in the footpath, can convert foot impact energy into electrical form.

Human-powered transport has been in existence since time immemorial in the form of walking, running and swimming. However modern technology has led to machines to enhance the use of human-power in more efficient manner. In this context, pedal power is an excellent source of energy and has been in use since the nineteenth century making use of the most powerful muscles in the body. Ninety-five percent of the exertion put into pedal power is converted into energy. However, human kinetic energy can be useful in a number of ways but it can also be used to generate electricity based on different approaches and many organizations are already implementing human powered technologies to generate electricity to power small electronic appliances.

1.1 Objective

- To generate the electricity through the human foot
- To provide electricity in rural area
- To promote the non-conventional energy source
- To save conventional energy sources
- To store the electricity for further use
- To produce electricity at cheapest cost
- To produce electricity while rack moves in upward direction.

1.2 Working Principle

- The basic working principle of our project is based on the spring force that is used to convert mechanicalinto the electrical energy.
- This electrical energy will be stored in the 12V rechargeable battery connected to inverter.
- This inverter is used to convert the 12 Volt D.C to the 230 Volt A.C. This 230 Volt A.C voltage is used to activate the loads

Fig.1: Final Model

1.3 Working Model of the system

The working of the Foot Step Electric Converter (FSEC) is demonstrated:

I. When force is applied on the plate by standing on plate the spring gets compressed.
II. The rack here moves vertically down.
III. The pinion meshed with the rack gear results in circular motion of the pinion gear.
IV. For one full compression the pinion moves 1 full circle.
V. When the force is released from the plate pinion reverses and moves another circle and cause rotation of gear pairs.
VI. The generator attached to the last gear hence results in the dc power generation.

The power generated by the foot step generator can be stored in an energy storing device. The output of the generator was fed to a 12 V lead acid battery, through an ac-dc converter bridge. Initially, the battery was completely discharged. Then, the FSEC was operated by applying foot load and energy was stored in the battery. A 100 W, 230V bulb was connected to the battery through an inverter. The arrangement is shown in figure.4.

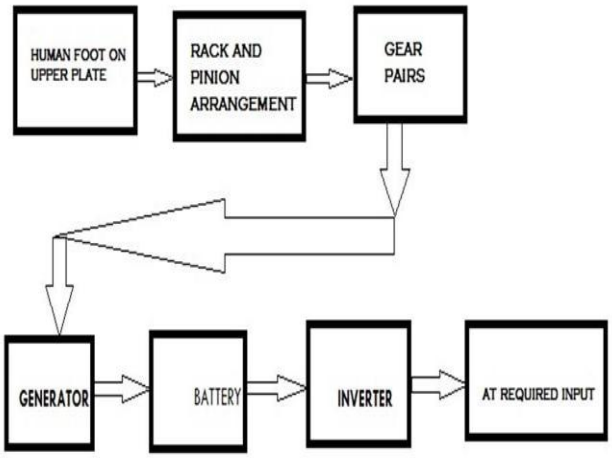

Fig.2: Block Diagram

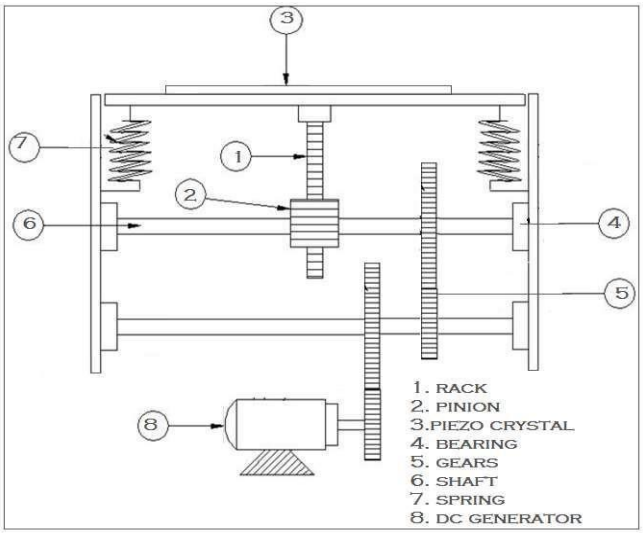

Fig.3: Line Diagram of Foot Step Power Generation

This is the line diagram of foot step power generator. It describes different components of the system in proper manner. In which rack moves downward as human weight applied which cause rotation of pinion on first shaft. A big gear is mounted with pinion on shaft one which is attached to the small gear of shaft two. Another big gear is mounted with small gear on shaft two which is in contact with gear of dc generator.

1.4 Need for the system

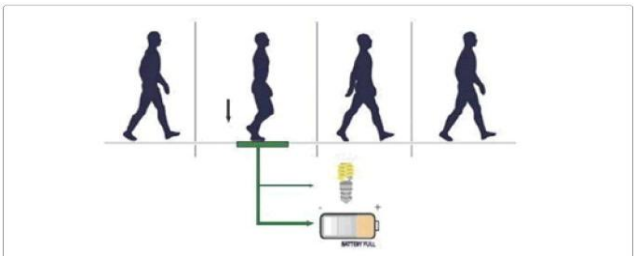

Fig.4: Need for the system

- 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 and China where the roads, railway stations, bus stands, temples, etc. are all over crowded and millions of people move around the clock. This whole human/bioenergy being wasted if can be made possible for utilization it will be great invention and crowd energy farms will be very useful energy sources in crowded countries. Walking across a "Crowd Farm," floor, then, will be a fun for idle people who can improve their health by exercising in such farms with earning. The electrical energy generated at such farms will be useful for nearby applications.
- The utilization of waste energy of foot power with human motion is very important for highly populated countries.

- India and China where the roads, railway stations, temples, etc. are all over crowded and millions of people move around the clock.

2. LITERATURE REVIEW

According to **T.R.Deshmukh** described along with design and modeling of parts of the model of the foot step power generation system using 3d modeling software. This process consists number of simple setups that is installed under the walking or standing platform. Project system works on the principle of converting the linear motion because to pressure of footsteps into rotating motion by rack and pinion arrangement. This mechanism fails if there is any occurrence of variable load leads to balancing type problems Power is not generated during return movement of rack. [1]

Vipin Kumar Yadav1, Vivek Kumar Yadav1, Rajat Kumar1, Ajay Yadav, [2]In this research paper authors used the equipment with following specification: Motor Voltage:10 volt Type: D.C. Generator, RPM:1000 rpm, Gear 1-Mild Steel, No. of teeth:59(big gear),No. of teeth:36(small gear),Type: Spur Gear, No. of gear used:2 Spring 1-Load bearing capacity:60-90 kg, Mild Steel, Total displacement:5 inch, Bearing 1- Type: Ball bearing, Bearing no.N35,Shaft 1- Diameter: 15 mm- Material: Mild steel author concluded that with these method energy conversion is simple efficient and pollution free.

From the viewpoint of **Shiraz Afzal, and FarrukhHafeez,**[3]this paper is all about generating electricity when people walk on the Floor 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 1MegaWattAs a fact only 11% of renewable energy contributes to our primary energy. If this project is deployed, then not only we can overcome the energy crises problem but this also contributes to create a healthy global environmental change. In this project a gear system is attached with flywheel which causes to rotate the dynamo as the tile on the deck is pressed The power that is created is saved in the batteries in addition we will be able to monitor and control the amount of electricity generated When an individual passes it push the tile on the ground surface which turn the shaft beneath the tile, turn is limited by clutch bearing which is underpinned by holders. Primary shaft is rotate approx. twice by a single tile push ..The movement of the prevailing shaft turn thegearbox shaft which builds it 15 times (1:15) then its movement is smoothen by the help of fly wheel which temporary store the movement, which is convey to the DC generator (it generates 12V 40 amp at 1000 rpm).

From the perspective of **Sasankshekhar Panda** has described the based on crank shaft; fly wheel, and gear arrangement. This type of footsteps power generation system is eligible to be installed in crowded places and rural areas. Thus, this is a very good technology to provide effective solution to power related problems to affordable extent. This will be the most acceptable means of providing power to the places that involves difficulties of transmission. Maintenance and lubrication is required time to time. [4]

Jose AnanthVino described the simple drive mechanism which include rack and pinion assembly and chain drive mechanism. The conversion of the pressure or force energy in to electrical energy. The power generation is very high but the initial cost of this system is high. There is no need of power from the mains and this system is eco-friendly. It is very useful at the crowded places and on all roads and as well as all kind of foot step which is used to generate the electricity. Maintenance and lubrication is required time to time. Power is not generated during return movement of rack. [5]

3. COMPONENTS OF THE SYSTEM

Rack and pinion: A rack and pinion gears system is composed of two gears. The normal round gear is the pinion gear and the straight or flat gear is the rack. A rack and pinion are types of linear actuator that comprises a pair of gears which convert rotational motion into linear motion. The circular pinion engages teeth on a linear "gear" bar which is called the “rack“.

Fig.5: Rack and Pinion

Gears: A gear is a rotating machine part having cut teeth which mesh with another toothed part to transmit torque. Geared devices can change the speed, torque, and direction of a power source. Gears almost always produce

a change in torque, creating a mechanical advantage, through their gear ratio, and thus may be considered a simple machine.

Assuming no slipping of the two surfaces, the following kinematic relationship exists for their linear velocity:

$$v = \omega ArA = \omega BrB$$

$$= 2\pi NArA = 2\pi NBrB$$

Or $\frac{\omega A}{\omega B} = \frac{NA}{NB} = \frac{rB}{rA}$

Where N = angular velocity (rpm)

□ = angular velocity (rad/s)

r = radius of gear

Subscripts 'A' and 'B' represent gear A and B respectively.

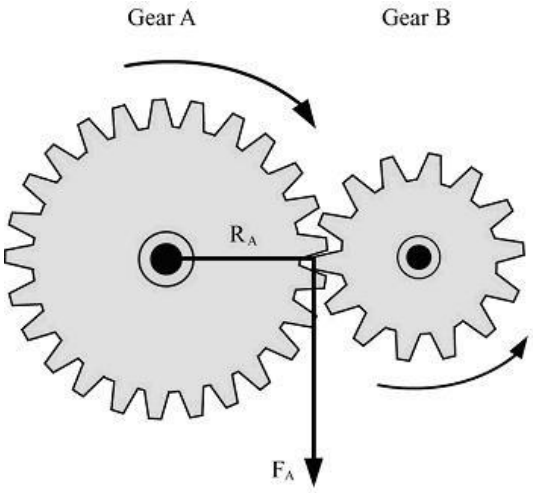

Fig.6: Gears

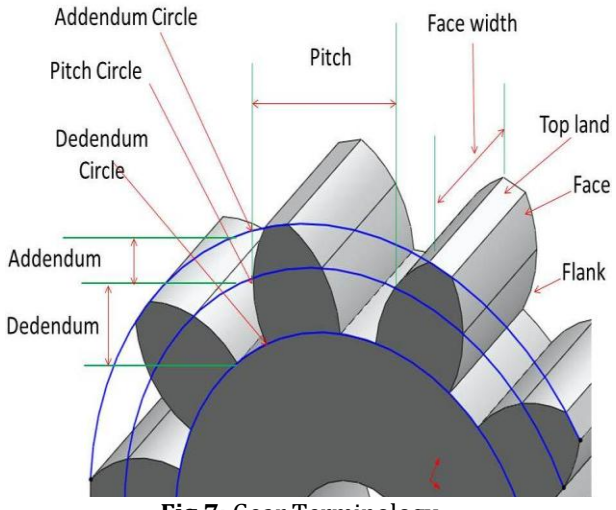

Fig.7: Gear Terminology

Table 1: Specification of Gears

Parameters	Driver Gear	Driven Gear
No. of Teeth	56	23
Module	1.5	1.75
Pressure angle (degree)	20	20
Shaft angle (degree)	90	90
Pitch Diameter	84	40.25
Addendum	1.5	1.75
Dedendum	2	2.1

Springs: A coil spring, also known as a helical spring, is a mechanical device which is typically used to store energy and subsequently release it, to absorb shock, or to maintain a force between contacting surfaces. They are made of an elastic material formed into the shape of a helix which returns to its natural length when unloaded.

Fig.8: Helical Springs

Ball bearing: A ball bearing is a type of rolling-element bearing that uses balls to maintain the separation between the bearing races. The purpose of a ball bearing is to reduce rotational friction and support radial and axial loads.

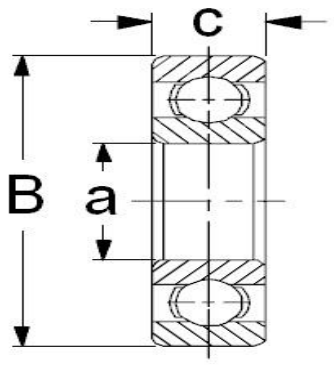

Fig.9: Dimension of Bearing

Fig.10: Ball bearing

Dynamo: Dynamo is an electrical generator. This dynamo produces direct current with the use of a commutator. the dynamo uses rotating coils of wire and magnetic fields to convert mechanical rotation into a pulsing direct electric current.

The commutator is needed to produce direct current. When a loop of wire rotates in a magnetic field, the magnetic flux through it, and thus the potential induced in it, reverses with each half turn, generating an alternating current.

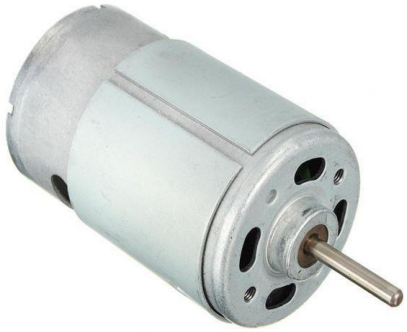

Fig.11: Dynamo

Battery: In our paper we are using secondary type battery. It is rechargeable type. A battery is one or more electrochemical cells, which store chemical energy and make it available as electric current. There are two types of batteries, primary (disposable) and secondary (rechargeable), both of which convert chemical energy to electrical energy.

Fig.12: Battery

Inverter: An inverter is an electrical device that converts direct current (DC) to alternating current (AC); the converted AC can be at any required voltage and frequency with the use of appropriate transformers, switching, and control circuits.

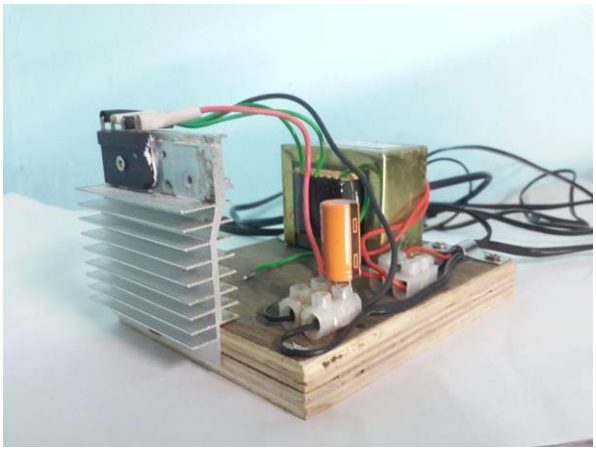

Fig.13: Inverter

4. EXPERIMENTAL INVESTIGATION

4.1. TECHNICAL ANALYSIS

CHARGING TIME

The entire energy that is produced when the load is applied on the footsteps is stored in a storage device called BATTERY. So, it is taken as important criteria to determine the charging time taken by the battery. In this project the battery is used with the battery rating of 1.3AH (ampere hour).

Charging Time=Battery Rating/Charging Current

BATTERY BACKUP TIME

Battery Backup Time=Battery Ratting/Load Applied

THEORITICAL POWER OUTPUT

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

Power= Work done/Sec

Let the weight applied by the body is 20kgs, then the maximum displacement of the spring can be noted as 0.05m

Force =20 x 9.81=196.2N

Work done =196.2 x 0.05

i.e., work done = 9.81

Power=0.981\60

i.e., power =0.1635

Power generated per an hour = 0.1635 x 3600 = **588.6Watts**

PRACTICAL POWER OUTPUT

Power can be calculated in terms of obtained voltage and current when the load is applied on the footsteps. The readings are noted by using the Multimeter.

Power = Voltage x Current

Here, when the foot is depressed due to the applied load on the footsteps the calculated power is as follows.

For one step of 20kg of load applied on the footsteps, the generated voltage is 2.6V and the average current produced is 12milliamps.

Power = 2.6 x 0.012 = 0.0312

Power generated per hour is0.0312 x 3600 = 112.3Watts.

Thus, the obtained power for continuous load applied on the footsteps for one hour is **112.3Watts.**

4.2. Advantages

- Power generation is simply walking on step.
- No need of fuel input.
- This is a non-conventional system.
- Self-generation - no external power required.
- Compact yet highly sensitive.
- Battery is used to store the generated power.
- Reliable, Economical, Eco-Friendly.
- Extremely wide dynamic range, almost free of noise.

4.3. Disadvantages

- Only applicable for the particular places.
- Initial cost of this arrangement is high.
- Output affected by temperature variation.
- Care should be taken for batteries.

4.4. Applications

- Foot step generated power can be used for agricultural, home applications, street lighting.
- Foot step power generation can be used in emergency power failure situations.
- Metros, Rural Applications etc.
- It can be used as a source for D.C applications
- It is also used in universities
- It can use in emergency power failure situations like hospitals.

5. CONCLUSION

The project "POWER GENERATION USING FOOT STEP" is successfully tested and implemented which is the best economical, affordable energy solution to common people.

This can be used for many applications in rural areas where power availability is less or totally absence. Since India is an developing country where energy management is a big challenge for huge population. By using this project, we can drive D.C loads

It is especially suited for implementation in crowded areas. This can be used in street lighting without use of long power lines. It can also be used as charging ports, lighting of pavement side buildings.

As a fact only 11% of renewable energy contributes to our primary energy. If this project is deployed then not only, we can overcome the energy crises problem but this also contributes to create a healthy global environmental change.

- Smart system.
- Produces 2000W of electricity
- Durable.
- Have a life of approx. 5 yrs.

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