



ISSN: 0975-833X

Available online at <http://www.journalcra.com>

INTERNATIONAL JOURNAL  
OF CURRENT RESEARCH

International Journal of Current Research  
Vol. 15, Issue, 04, pp.24425-24429, April, 2023  
DOI: <https://doi.org/10.24941/ijcr.45196.04.2023>

## RESEARCH ARTICLE

### DESIGN AND FABRICATION OF FOOTSTEP POWER GENERATION

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#### ARTICLE INFO

##### Article History:

Received 19<sup>th</sup> January, 2023  
Received in revised form  
15<sup>th</sup> February, 2023  
Accepted 26<sup>th</sup> March, 2023  
Published online 30<sup>th</sup> April, 2023

##### Key words:

Footsteps, Conventional Energy, Non-conventional energy system, D.C. Generator, Rack & Pinion, Chain.

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Citation: Hithesh Sai Nadh, G., Girish, K., Bhargav Teja, P., Dinesh, P., Subrahmanyam, M.R.S. and Kumar Babu, P. 2023. "Design and fabrication of footstep power generation". *International Journal of Current Research*, 15, (04), 24425-24429.

#### ABSTRACT

Nowadays energy and power are the one of the basic necessities regarding this modern world. In this project we are generating electrical power as a non-conventional method by walking on the footsteps. Non-conventional energy system is very essential at this time to developing nations like India, China etc. Non-conventional energy using footsteps needs no fuel input power to generate the output. In this project we are generating electrical power as non-conventional method by simply walking or running on the footsteps. Non-conventional energy system is very essential at this time to our nation. Nonconventional energy using foot step needs no fuel input power to generate the electrical power. In this project the simple drive mechanism such as rack and pinion assembly and chain drive mechanism is used for generating power by utilization of force which is obtained during the walking on steps is converted in to electrical energy with the help of mechanical systems. The generated power is stored by means of battery and this is used for activating the connected loads. This is one of the compact and efficient systems for generating electricity which can be easily installed in many regions.

## INTRODUCTION

Proposal for the utilization of waste energy of foot power with human locomotion is very much relevant and important. Man has needed and used energy at an increasing rate for his sustenance and well-being ever since he came on the earth a few million years ago. Primitive man required energy primarily in the form of food. He derived this by eating plants or animals, which he hunted. Subsequently he discovered fire and his energy needs increased as he started to make use of wood and other bio mass to supply the energy needs for cooking as well as for keeping himself warm. With the passage of time, man started to cultivate land for agriculture. He added a new dimension to the use of energy by domesticating and training animals to work for him. With further demand for energy, man began to use the wind for sailing ships and for driving windmills, and the force of falling water to turn water for sailing ships and for driving windmills, and the force of falling water to turn water wheels man has needed and used energy at an increasing rate for his sustenance and wellbeing ever since he came on the earth a few million years ago. Primitive man required energy primarily in the form of food. He derived this by eating plants or animals, which he hunted. Subsequently he discovered fire and his energy needs increased as he started to make use of wood and other biomass to supply the energy needs for cooking as well as for keeping himself warm.

With the passage of time, man started to cultivate land for agriculture. He added a new dimension to the use of energy by domesticating and training animals to work for him. With further demand for energy, man began to use the wind for sailing ships and for driving windmills, and the force of falling water to turn water for sailing ships and for driving windmills, and the force of falling water to turn water wheels. Till this time, it would not be wrong to say that the sun was supplying all the energy needs of man either directly or indirectly and that man was using only renewable sources of energy. In this project the weight which acts on the foot step is used to generate electrical energy. When a person walks Over the foot step, a force acts on the step. One can simply be amazed by knowing how much energy a person can have just by walking on the floor with normal speed. Whenever a person walks, manages to lose energy towards the floor by means Excess weight to the floor. That energy may be used and converted into electrical energy. The Mechanical energy (weight) is converted into electrical energy using drive mechanism, in this case rack and pinion. Generated energy can be stored in Batteries. Then the output of the battery is used to lighten the lamps in the room. Proposal for the utilization of waste energy of foot power with human locomotion is very much relevant and important. Man has needed and used energy at an increasing rate for his sustenance and well-being ever since he came on the earth a few million years ago. Primitive man required energy primarily in the form of food.

He derived this by Eating plants or animals, which he hunted. Subsequently he discovered fire and his energy needs increased as he started to make use of wood and other biomass to supply the energy needs for cooking as well as for keeping himself Warm. With the passage of time, man started to cultivate land for agriculture. He added a new dimension to the use of Energy by domesticating and training animals to work for him. With further demand for energy, man began to use the Wind for sailing ships and for driving windmills, and the force of falling water to turn water for sailing ships and for Driving windmills, and the force of falling water to turn water wheels. Till this time, it would not be wrong to say that the sun was supplying all the energy needs of man either directly or indirectly and that man was using only renewable Sources of energy. This process involves number of simple setup that is installed under the walking platform. When People walk on this platform their body weight compresses the setup which rotates a dynamo and current is produced. The power producing platform is an overcrowded area with a moving population; energy is produced at larger levels. Greater movement of people will generate more energy. This whole human energy being wasted if can be made Possible for utilization it will be great invention and power producing platform will be very useful energy sources in crowded countries.

## BACKGROUND

Many researchers have worked on the conversion of dynamic energy into electrical energy by human locomotion Jeff krupenkin and Ashley Taylor proposed a new technique which is called reverse electro wetting in which the motion of liquid on dielectric material is coated. The conductive substrate will create electrical energy, if there is any vibration on the above platform due to human locomotion that will be caused to produce electrical energy. One of the scientists of Hull University worked on transferring the motion of man into electrical energy. so many experiments had been performed by this person in Japan also to harness the energy from footsteps.

## LITERATURE REVIEW

“Power Generation in Automobile Suspension System” by C. Nithiyesh Kumar, K.Gowtham, M.Manikandan, P.Bharathkanna, T. Manoj Kumar In this research paper author studied three methods of foot step power generation namely piezoelectric method, rack and pinion method and fuel piston method comparatively and found that the rack and pinion mechanism is more efficient with moderate cost of operation and maintenance.

“Generation of Electrical Energy from Foot Step Using Rack and Pinion Mechanism” by Md.Azhar, Zitender Raj purohit, Abdul Saif, Nalla Abhinay, P.Sai Chandu In this research paper authors used regulated 5V power, 500mA power supply. Bridge type full wave rectifier is used to rectify the ac output of secondary of 230/12V step down transformer. A rack and pinion is a type of linear actuator including a pair of gears which convert rotational motion into linear motion. The “pinion” engages teeth on the rack. In this paper, the power generation using footsteps gets its energy requirements from Non-renewable sources of energy. There is no need for power from external sources (mains) and there is less pollution in this source of energy. It is very useful to places like all roads and as well as all kinds of foot steps which are used to generate non-conventional energy like electricity.

“Electrical Power Generation Using Foot Step for Urban Area Energy Applications” by Joydev Ghosh, Amit Saha, Samir Basak, Supratim Sen. In this research paper authors used 80 volts and 40 MA from one coil have been generated from a prototype model as first invention. The second invention provides 95 volts and 50 MA from one coil and this generated power can be used to light LED arrays and to run DC fans after rectifying the AC or can charge batteries. For high efficiency in the axle of the second gear, they fitted a strong magnet vertically, so that when the gear rotates due to human body weight the magnet also rotates.

The magnet is placed in a loop type copper coil. When the magnet starts rotating according to Faraday's law of electromagnetic induction, there will be induced emf in the coil.

“Power generation through step” by Vipin Kumar Yadav1, Vivek Kumar Yadav1, Rajat Kumar1, Ajay Yadav In these research paper authors used 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.

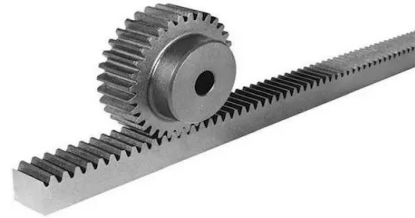
“Power Generation Footstep” by Shiraz Afzal, Farrukh hafeez This paper is all about generating electricity when people walk on the Floor if we are able to design a power generating floor that can produce 100W on just 12 steps, then for 120 steps we can produce 1000 Watt and if we install such type of 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 215approx... Twice by a single tile push. The movement of the prevailing shaft turns the gearbox shaft which builds it 15 times (1:15) then its movement is smoothen by the help of a flywheel which temporarily stores the movement, which is conveyed to the DC generator (it generates 12V 40 amp at 1000 rpm).

“POWER GENERATION FROM STEPS ” by Ramesh Raja R, Sherin Mathew This research paper attempts to show how energy can be tapped and used at a commonly used floor step. The usage of steps in every building is increasing day by day, since even every small building has some floors. A large amount of energy is wasted when we are stepping on the floors by the dissipation of heat and friction, every time a man steps up using stairs. There is great possibility of tapping this energy and generating power by making every staircase as a power generation unit. The generated power can be stored by batteries, and it will be used for slighting the building.

## SURVEY & ANALYSIS

“Power Generation Using Foot Step”: In this project we are generating electrical power as a non-conventional method by simply running on the train in the foot step. Non-conventional energy system is very essential at this time to our nation. on-conventional energy using foot step needs no fuel input power to generate the output of the electrical power. This project using simple drive mechanism such as rock and pinion assemble and chain drive mechanism. For this project the conversion of the force energy in to electrical energy. The control mechanism carries the rack & pinion, D.C generator, battery and inverter control. We have discussed the various applications and further extension also. So this project is implemented to all foot step, the power generation is very high. The initial cost of this arrangement is high. There are some methods to generate electrical energy from the footsteps. Such as Gear wheel and flywheel are methods to generate electrical power. This method works on the principle and in it mechanical parts are used because this is placed where there are so many people and the energy is produced by their movements on the floor. Generation of power is done by footsteps from the crowd on floor and piezo plate scheme is used below the floor, then there will be sheet which covers the piezo plate and also spring will be there for vibrating force on piezo sensor.

- To arrange the electrical components and equipment properly to convert the mechanical energy into electrical energy
- After arranging the electrical system in proper manner that will transfer mechanical energy into electrical energy
- Then spring is attached to piezo with the help of Sheet in this manner spring arrangement is done, spring is used to vibrate the piezo by force then power will be generated
- After that voltage which is produced through the steps can be rectified and after battery charges circuit, the DC voltage will be stored in the 12-volt battery of lead acid
- Further this battery will be attached with an inverter. Designing of inverter is such a way which converts the battery voltage that is 12 volt DC into 220v AC
- Finally, the AC voltage can be used in many appliances like charging the laptop battery as well as to charge the handset; it may also be used to lightening up energy saver.
- If we need more power in this method then use more steps for more energy. Also the ability of battery and inverter should be increased, then output will be increased.



**12V DYNAMO MOTOR:** 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 rotary converter. Today, the simpler alternator dominates large scale power generation, for efficiency, reliability and cost reasons.



## ASPECTS

The main features of power generation through footsteps by piezoelectric are that the power generated by transforming mechanical energy into electrical by movement of people on the floor where piezo plate is placed. Piezo electric power system is safe and secure to use. It is a totally risk free method. This system will not produce any problem and discomfort for people. Foot step power generation through piezoelectric processes has electrical and mechanical parts but it hasn't so many losses. This system has low cost if the system is damaged so no issue the cost of equipment is very low This system also has the ability to store the electrical power in the batteries. Foot step power generation system is a cheap , reliable and efficient method.

## COMPONENTS

**SQUARE TUBE:** Rectangular and square HSS are also commonly called tube steel or box sections. Circular HSS are sometimes mistakenly called steel pipe, although true steel pipe is actually dimensioned and classed differently from HSS. Square tubes are generally used for maintenance and structural purposes.



**SPUR GEAR:** Spur gears or straight-cut gears are the simplest type of gear. They consist of a cylinder or disk with teeth projecting radially. Viewing the gear at 90 degrees from the shaft length (side on) the tooth faces are straight and aligned parallel to the axis of rotation.



**RACK & PINION:** A rack and pinion is 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.

**SPRING COIL:** A coil 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. Under tension or compression, the material (wire) of a coil spring undergoes torsion.

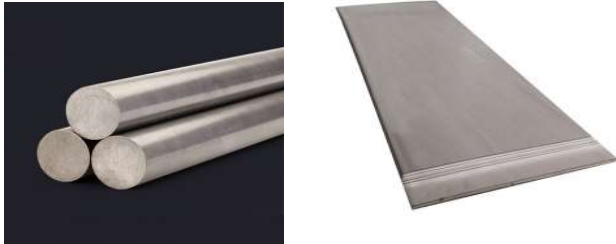


**MULTIMETER:** A multimeter is a measuring instrument that can measure multiple electrical properties. A typical multimeter can measure voltage, resistance, and current, in which case it is also known as a volt-ohm-milliammeter (VOM), as the unit is equipped with voltmeter, ammeter, and ohmmeter functionality. Some feature the measurement of additional properties such as temperature and volume.



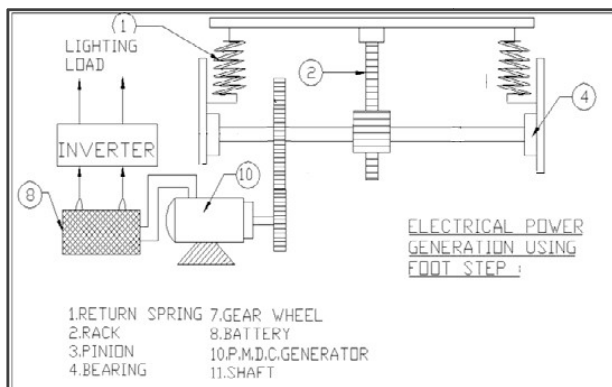
**1 INCH- ROD & SHEET:** The rod, perch, or pole (sometimes also lug) is a surveyor's tool[1] and unit of length of various historical definitions, often between 3 and 8 meters. In modern US customary units it is defined as 16+1/2 US survey feet, equal to exactly 1/320 of a surveyor's mile, or a quarter of a surveyor's chain (5+1/2 yards), and is approximately 5.0292 meters.

The rod is useful as a unit of length because whole number multiples of it can form one acre of square measure (area). The 'perfect acre'[2] is a rectangular area of 43,560 square feet, bounded by sides 660 feet (a furlong) long and 66 feet wide (220 yards by 22 yards) or, equivalently, 40 rods and 4 rods. An acre is therefore 160 square rods or 10 square chains.



## WORKING & CONSTRUCTIONS

### LINE DIAGRAM



**WORKING PRINCIPLE:** The General design of the foot step power generation. In this arrangement we are using two steps. The rack & pinion spring arrangement is fixed below the steps. We are using four springs for each step. The spring is used to return the step in the same position by releasing the load. The rack is coupled to the foot step. In the second step, the Rack is connected to the footsteps. From Rack a shaft is provided in which the larger sprocket lies.

The larger sprocket is coupled with Rack, so that it is running at the same speed of Rack. The larger sprocket is coupled to the smaller sprocket below in the other shaft with the help of chain (cycle). This larger sprocket is used to transfer the rotation force to the smaller sprocket. A gear is provided there also. The smaller sprocket is running the same direction for the forward and reverse direction of rotational movement of the larger sprocket. It runs at the same speed also.

### WORKING PROCESS

When a person moves from a foot step power generation system the plates move downward due to force applied on the plate by virtue of impressing on the plate the force spring gets compressed.

- The rack here moves vertically downward.
- When the rack moves pinion will be engaged with the rack gear resulting in circular motion of the pinion gear.
- For one full compression the pinion moves 1 half circle.
- When the force will have been removed on the plate the pinion reverses and moves another half circle.
- The dynamo attached to the pinion hence results in the sinusoidal waveform (for single dynamo).
- Then, in this result energy produced will be stored on the battery for use.

## PROJECT IMAGES



## ADVANTAGES

- Highly efficient in more crowded places.
- Depending upon the power generator and number of them, power output is very high
- This process depends on human resources which are available in plenty in our country which makes our country a favorable place for this project.
- Promising technology for solving power crises to an affordable extent.
- Low cost level.
- Simple in construction.
- Pollution free.
- Reduces transmission losses.

## APPLICATIONS

- Railway, subway stations
- Roads
- Temples
- Bus stands, air ports
- Music halls, auditoriums
- Markets

## CONCLUSION

Our work shows that in foot step power generation there is no need for fuel to generate the electrical energy. This is also an eco-friendly method for energy production, there is no huge land required to install them like other energy plants. This project can be handled in various ways to make the best use of it. There are many more extensions that can be made to this project. Generators of more load capacity can be used to get more power. Although the power generation is little less in this project. It tries to make use of the energy wasted to generate electricity. The power generation using footsteps gets its energy requirements from the Non-renewable source of energy. There is no need for power from the mains and there is less pollution in this source of energy. It is very useful in the places like railway stations, shopping complex etc. It is able to extend this project by using same arrangement and construct in the footsteps/speed breaker so that increase in the power production rate by fixing it in school, colleges, highways etc. The output power generated is 3V. Our final conclusion in this project is creative way to make use of the energy wasted in various ways. By storing output power in batteries we can utilize this for further use. By making the rack and pinion arrangement rotate in either direction the output power can be increased. When we implement this project on a large scale the overall cost of the project reduces.

## FUTURE SCOPE

The project work "Power generation by foot step" is designed and developed successfully, for the demonstration purpose a proto type module is constructed with lower ratings of devices, & results are found to be satisfactory. As it is a demo module it cannot be used for real applications, but the concept is near to the real working system, to make it more realistic, a higher rating power generator with suitable gear mechanism is essential to produce more energy. This concept falls under the subject of non-conventional energy resources, out of the many alternative energy resources one dependable source is solar energy, but it is quite the costliest affair. Therefore the cheapest alternative is to generate electricity from footsteps. This technology proven here is the ultimate inexpensive source of all known forms of energy. When it is implemented practically, depending on the size & traffic flow, each foot step may produce tens of kilowatts power every day, this power can be utilized for many applications. If we are used to this project at very busy stairs, then we produce efficient useful electrical for large purposes. One important advantage of producing energy through this technology is that it does not pollute the environment. Hence these footsteps can be altered with this technology, thereby all the street lights belonging to a particular city can be energized.

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