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Design and Fabrication of Footstep Power Generation

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Abstract: ***The demand of energy is increasing day by day, but the source availability is less to achieve the demand. The ultimate solution to deal with such problems is to implement the alternate sources of energy. Humans are using the renewable energy from quite long time such as solar, wind, geothermal etc. but still we could not full our demand of power needs. Because of that we have to generate electricity through every possible way. The objective of this project is to produce power through footsteps as a source of alternate energy that we can obtain while walking or standing on to the certain arrangements like footpath, stairs, platforms and these systems can be installed especially in the highly populated areas. In this project, the force energy is produced by human foot step and it is converted into electrical energy by means of rack and pinion mechanism which is attached to dynamo. It is an electrical device which generates electricity. We are supposed to study the method of foot step power generation i.e. rack & pinion arrangement and to modify the system. Keywords: Footpath, stairs, platforms, dynamo, footstep power generation system.***

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

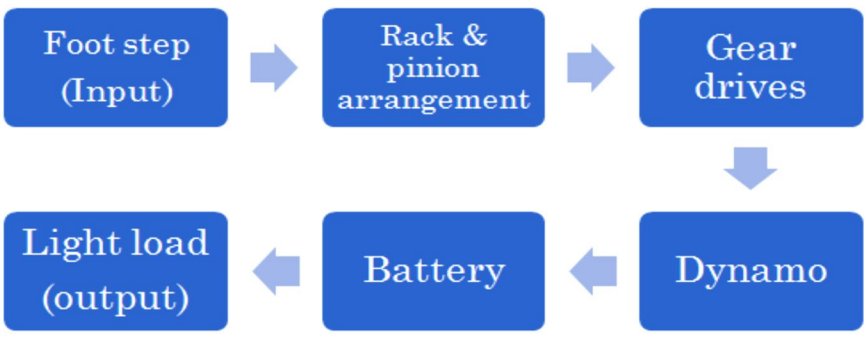
I. INTRODUCTION

In this project, we are generating electrical power as source of alternative energy that can be obtain while walking or standing onto the certain arrangements like footpath, stairs, platforms. When a person walks, there is energy loss to the road. This energy can be tapped and converted in usable form such in electrical form. In this setup mechanical energy is converted into electrical energy using a dynamo. Here the linear motion of rack is converted into the rotational motion, which converted into rotational motion of the shaft of dynamo and generates electricity. This set up requires very basic mechanical components such as gear, shaft bearing. There are also some electrical components such as battery, dynamo etc. The spring, rack & pinion arrangement is fixed below the upper plate of system. Spring system is used for return mechanism of upper plate after release of load. Pinion is supported by the shaft. The dynamo is rotated with the help of Rack and pinion arrangement.

A. Problem Identification

There are many places where there is no electricity, so we are producing power through footstep. As we know the availability of conventional energy sources are declining, there is need to find alternate energy sources. Almost all the state electricity departments in our country are unable to supply the power according to the demand. The power produced by these companies is not sufficient even for domestic utilities, in such critical situation it is very difficult to divert the energy for public needs. Much of energy is being wasted and exhausted, like when a person walks, there is energy loss to the road in the form of force energy, so we can make it possible to use that energy in making a great invention.

B. Block Diagram

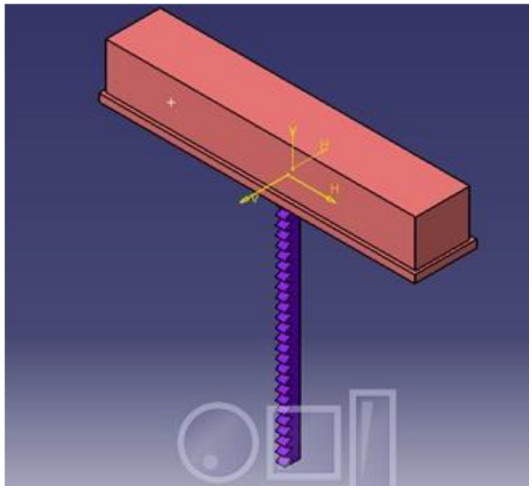


Components in the System

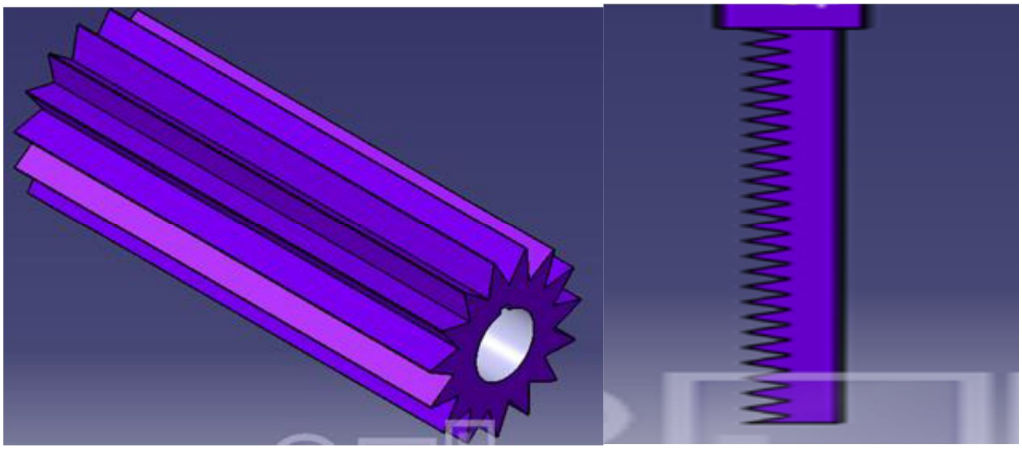
1) *Footstep*

a) *Top Assembly:* Top Plate assembly is assembly of components like angle frame made of mild steel material and which is used as platform.

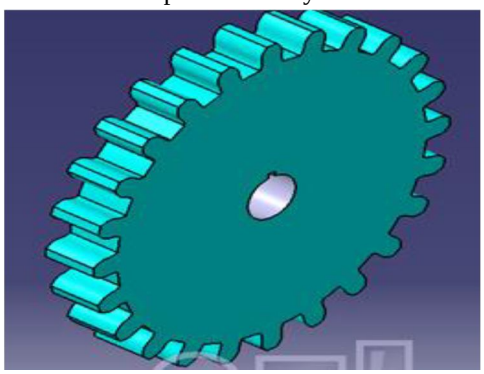
b) *Frame:* Frame is a housing in which numbers of components are assembled .strength of the frame is essential parameter in design to sustain the load of moving persons and weights of the components.



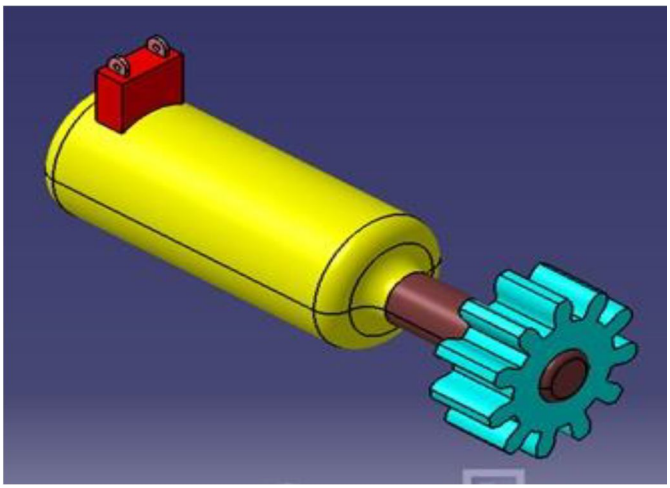
2) *Rack and Pinion:* A rack and pinion is a type of linear actuator that comprises a pair of gears which convert rotational motion into linear motion into linear motion. The circular pinion engages teeth on a linear gear bar-the rack. Rotational motion applied to the pinion will cause the rack to move to the side, up to the limit of its travel. In a rack railway, the rotation of a pinion mounted on a locomotive or a railcar engages a rack between the rails and pulls a train along a steep slope.



3) *Gear Drives:* The shaft along with pinion is supported by end bearings. A gear is provided there also. A gear is coupled to the shaft. The gear wheel which is provided in shaft is coupled to the Dynamo.



4) *Dynamo:* A Dynamo is a device that converts mechanical energy into electrical energy. It uses wire coils that rotate and creates magnetic field. This action converts the mechanical energy of the rotation into electric current. It is an electric generator that creates direct current using commutator.



5) *Spring:* It is an elastic body whose function is to distort when loaded and to recover its original shape when load is removed. It absorbs or control energy either due to shock or due to vibrations.

C. Working Principle

In the general design of footstep power generation, we are using rack and pinion arrangement which is fixed below the step. The spring is used to return the step in the original position by releasing the load. The rack is coupled to the footstep as the rack moves downward the pinion will start rotating. In this case, the dynamo is used as power generating device, which is attached to the gear drive so has the gear rotates the dynamo will start rotating and the current will generate in device.

D. Steps Involved in Working

The working procedure is explained in step-by-step manner-

1) *Step 1:* When force is applied on the plate by virtue on stamping on the plate the force spring gets compressed.
2) *Step 2:* Due to this the rack moves vertically down.
3) *Step 3:* The pinion meshed with the rack gear results in rotational motion of the pinion gear.
4) *Step 4:* For one full compression of spring, the pinion moves in one direction, when the force applied on the plate released the pinion reverses and moves another direction.
5) *Step 5:* The driven gear with large P.C.D. will rotate as a result of motion of pinion.
6) *Step 6:* The dynamo attached to the gear will start rotating as the gear rotate.
7) *Step 7:* Now, due to rotation of dynamo shaft, the electricity will get produce.
8) *Step 8:* Now this electrical energy is stored in battery for further uses.

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II. DESIGN CALCULATION

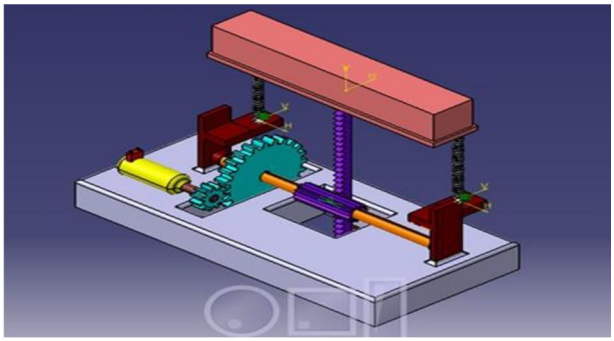
CATIA software plays a vital role in deigning, modelling and analysing the parts before manufacturing. From design calculation stresses are below than yield strength of materials, so the design is safe.

1) Force=70 kg × 4=280×9.81=2746.8 N
2) Mass of a man=70 kg

A. Discussion

Result for output voltage Generation during performance of the unit. A small foot step power generation unit has been implemented in real time and tested with various load conditions. During the experimentation it is observed that weight cannot be kept constant for number of footsteps. This unit is designed for a person of 70 kg. The output can be increase further by putting number of steps along the places and connected together. It is observed that the system produced output for average minimum weight of 60 kg. The foot step power generation unit produces the load range above 490 N.

B. CATIA Model



III. POWER OUTPUT

To determine the output power, it is essential to determine the force applied on the model.
Force = m × g
Work done = Force × Displacement
Power = Work done ÷ Second
Let the weight applied by body is 70 kg. Then the weight applied by body is 70 kg then the maximum displacement of the spring can be noted as 0.24m.
Force = 70×9.81 = 686.7
Work done = 686.7×0.24 = 164.8
Power generated = 0.27466
Per hour = 0.27466×3600 = 988.8 watts

IV. RESULT &ANALYSIS

While the Crowd Farm Wouldn't work in the home, a single human step generates only enough power to light 15-watt light bulb for one second. It could really draw some power from a crowd producing thousands of steps. A small foot step power generation unit has been implemented in real time and tested with various load conditions. During the experimentation it is observed that weight cannot be kept constant for number of footsteps. During performance single footstep does not produce desirable output. This unit is designed for a person of 70 kg. The output can be increase further by putting number of steps along the places and connected together.

A. Future Scope

This project work can further be modified on following basis-

1) Finite element analysis can be carried out for different spring material for high deflection with in control limit of shear stress and stiffness.
2) Lower stiffness value springs can be used for better working of the project on lower heights.
3) Energy generation capacity of the unit can be increased by using higher weight of the flywheel. Four or more DC generators are used in combination to increase the current so as charge battery efficiently.

V. CONCLUSION

This technique produces the electric power without dirtying our surrounding. The energy wasted through walking by human is used in this frame-work. Since in this project of power generation there is not any fuel input requirement for the generation of electrical power. 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 model.

Mechanism like rack and pinion is integrated to produce desired output. The project work "Power generation by footstep" is designed and developed successfully. A proto type module is constructed with lower rating of devices and results are found to be satisfactory. As it is demo module it cannot be used for real applications, but the concept is near to the real working system, to make it more realistic, higher rating power generator with suitable gear mechanism is essential to produce more energy. One important advantage of producing energy through this method that does not pollute the environment.

Summery- During execution of the project a method of transferring the displacement by means of Rack and pinion is successfully installed. Project is defined for average weight of the person of 70 kg, the positive output generation is observed in between of 60 to 70 kg.

A. Advantages

1) Power generation is simply walking on step.
2) No fuel input.
3) Does not pollute environment.
4) It can be easily maintained.
5) It is reliable.
6) The battery is used to store the power for further use.

B. Application

1) Foot step power generation can be used in emergency power failure situations.
2) Metros, Rural Applications
3) Street lighting, Bus station lighting
4) Colleges, Schools
5) Cinema theatres
6) Shopping complex

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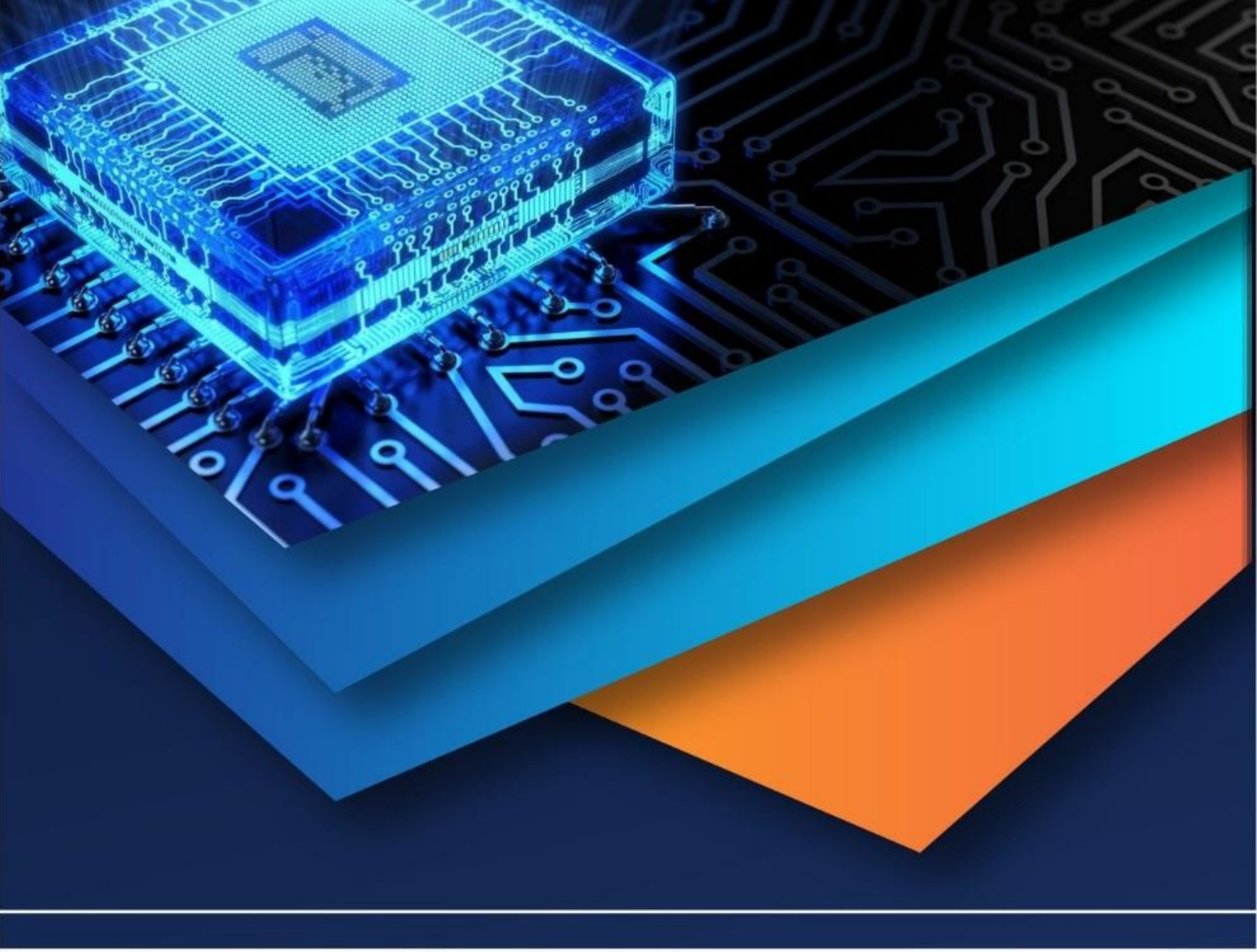

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