Industrial Engineering Journal
ISSN: 0970-2555
Volume : 53, Issue 1, No. 1, January : 2024

HARNESSING EVERY STEP: THE PROMISING FUTURE OF FOOTSTEP POWER GENERATION

Amit Kumar, Sr. Lecturer, Dept. of Mechanical Engg. IIMT College of Polytechnic, Greater Noida
Email- amit3456_gn@iimtindia.net
Pawan Kumar, HOD,Dept. of Mechanical Engg. IIMT College of Polytechnic, Greater Noida
Email- hodmeppoly_gn@iimtindia.net
Vikash Kumar Gautam, Assistant Professor Dept of civil Engg. IIMT COP Greater Noida
Email- dyhodcivilpoly_gn@iimtindia.net

Abstract:
This design is concentrated on generating electrical power by means of a non-conventional system just by walking on the steps. Our study is substantially using the non conventional energy coffers. Energy generation using steps requires without energy input to induce electrical energy. In this design we're generating electrical energy by using rack and pinion arrangement along with alternator and chain drive medium, by using this medium which converts Force into electrical energy, and this medium consists of chain drives, rack & pinion, battery and alternator. In the quest for sustainable and renewable energy sources, researchers and innovators are exploring unconventional avenues to generate power. One such promising and innovative concept gaining attention is Footstep Power Generation, a technology that converts the kinetic energy generated by footsteps into electrical energy. This approach not only addresses the growing energy demand but also promotes eco-friendly practices and harnesses the untapped potential of human movement.

Key words: Foot step power generation, rack and pinion, alternator, battery and chain drive.

Introduction:
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 mobility of its masses will turn into boon in generating electricity from its footsteps. In India, places like roads, railway stations, bus stands, are all over crowded and millions of people move round the clock. As a result large amount of power can be obtained with the use of this promising technology. This process involves number of simple setup that are installed under the walking platform. When people walk on this platform their body weight compresses the setup which rotates a dynamo or Sanyo coil and current produced is stored in dry battery. To reduce the external compression, a responsive subflooring system is installed. And while the power producing platform is over crowded with moving population, energy is produced at larger levels. Greater movement of people will generate more energy. Footstep Power Generation operates on a simple yet ingenious principle – converting the mechanical energy generated by the impact of footsteps into usable electrical energy. This process typically involves the use of piezoelectric materials, which generate an electric charge in response to mechanical stress. These materials are embedded in flooring systems, walkways, or special floor tiles, creating a sustainable energy harvesting infrastructure.

Power Generation By Foot Steps Using Rack And Pinion Arrangemen: 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 overcrowded a The movement of the prevailing shaft turn the gearbox shaft which builds it 15 times 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).
"POWER GENERATION FROM STEPS" by Ramesh Raja R, This research paper attempts to show how energy can be tapped and

They 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. 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.
"Electricity Generation from Footsteps; A Regenerative
Energy Resource" by Tom Jose V*, Binoy Boban*, Sijo M In these research paper author manufactured a model made from stainless steel, recycled car tires and recycled aluminum, also includes a lamp embedded in the pavement that lights up every time a step is converted into energy (using only 5 percent of the generated energy).The average square of pavement produces about 2.1 watts of electricity. According to author, any one square of pavement in a high-foot traffic area can see 50,000 steps a day. Based on this data, only five units of pavement can be enough to keep the lights on at a bus stop all night.
Component And Assembly: The footstep arrangement is used to generate the electric power. arrangement is used to generate the electrical power in order to compensate the electric power demand. The complete fabricated model picture of Foot Step is shown. The upper plate is mounted on two springs; the weight impact is converted into electrical power with proper control unit. The spring and rack & pinion arrangement is fixed below the foot step which is mounted on base. Spring system is used for return mechanism of upper plate after release of load. 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. The dynamo capacity used here is12V.
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. The dynamo capacity used here is12V. From the dynamo the wires are taken. These wires are connected to a LEDs, to show the output power. The generator is used here is 12Volt permanent magnet DC generator. The terminal of DC generator is connected to lightning LED. Working Block Diagram In the first step the footstep is directly connected to the Rack & pinion arrangement. To the pinion shaft dynamo is provided and LEDs are coupled to it. Thus, Mechanical energy is converted in to Electrical energy. With the help of block diagram as show in the block diagram the working procedure is explained in step by step manner. In this project we are converting Mechanical energy into Electrical energy. We are trying to utilize the wasted energy in a useful way. By using Rack and Pinion arrangement we are converting to and fro motion of the steps into rotational motion of the dynamo. In first foot step we are using rack and pinion arrangement directly to rotate the dynamo.

The Working Of The Project:
The General design of the foot step power generation is given. In this arrangement we are using two steps. The rack & pinion, spring arrangement is fixed below the steps. We are using four springs foe each step. The spring is used to return the step-in 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 same direction for the forward and reverse direction of rotational movement of the larger sprocket. It running at same speed also The upper plate is mounted on two springs; the weight impact is converted into electrical power with proper control unit.
The spring and rack & pinion arrangement is fixed below the foot step which is mounted on base. Spring system is used for return mechanism of upper plate after release of load. The shaft along with pinion is supported by end bearings the complete diagram of the footstep power generation is given

below. Only one step is inclined in certain small angle which is used to generate the power. The pushing power is converted into electrical energy by proper driving arrangement.

The main phenomenon on which the working of this project is based is that rack and pinion assemble converts the linear motion into rotary motion and vice versa also. The pinion is of finite diameter and gives circular motion when the rack of infinite diameter comes in contact with pinion and gives linear or translator motion for proper contact between both rack and pinion the should have equal module. The shafts of rack and pinion remains parallel during their motion. The complete and real image of this project and mechanism is shown in given below. The impact load is put on surface on the step. 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 the top of the plate, the spring come 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 absorbed in the spring and the rack move downward its original position. When the spring is compressed due to impact of weight on plate, the energy absorbed in the spring and the rack move downward direction vertically and the rack is in contact with pinion. So, pinion rotates in anti-clock wise direction. The pinion shaft is directly coupled with dynamo (generator). So, dynamo generates electricity. When the spring expends releasing the energy stored inside it, the rack moves in upward direction vertically and the rack is in contact with pinion. So, pinion rotates in clock wise direction. The pinion shaft is directly coupled with dynamo. So, dynamo generates electricity again. If we want to store the electrical energy for future use, we connect the dynamo to the invertors which store the energy in the form of D.C. in the battery.

Result & discussion

Let us consider,

The mass of a body = 68 Kg (Approximately)

Height of spring = 9 cm

∴Work done = Force x Distance

Here,

Force = Weight of the Body

= 68 Kg x 9.81

= 667.08 N

Distance traveled by the body = Height of the spring

= 9 cm

= 0.09 m

∴Output power = Work done/Sec

= (667.08 x 0.09)/60

= 1.00062 Watts

(For One pushing force)

Flooring System: When the mechanical setup is used as it is, every single setup will compress separately and give an awkward feeling while walking over that. To prevent this, a flooring system is installed over the mechanical setup. The purpose of installing this flooring system is to provide required compression and at the same time to prevent the people to feel uncomfortable when walking over it. As every block over the setup is connected to one another using hinge arrangement, the compression will not be felt as the weight of the person walking over that will be distributed. But the pressure required to compress the setup will area,

be conveyed as the person's weight acts on the particular setonly depending upon the average weight over a locomotive

the strength and number of hinges are used. For the area where average weight is more, the numbers of the hinges are increased. This along with the primary spring provides the required compression for the setup. This hinge arrangement distributes the weight of the person and prevents them from feeling the compression. But about 95% of the pressure applied due to the weight is conveyed for the compression.

Key Components of Footstep Power Generation

Piezoelectric Materials: Materials like piezoelectric crystals or polymers are strategically placed in areas with high foot traffic. When pressure is applied through footsteps, these materials generate a voltage, creating an electric charge.

Energy Harvesting Modules: Energy harvesting modules capture and convert the generated voltage into a usable form of electricity. These modules are integrated into the flooring system and can be connected to a power storage system or directly to the electrical grid.

Flooring Infrastructure: FPG can be incorporated into existing infrastructure, such as sidewalks, shopping malls, airports, and public transportation hubs. Alternatively, special floor tiles with embedded piezoelectric materials can be installed in high-traffic areas.

Benefits of Footstep Power Generation:

Renewable and Sustainable: FPG harnesses human motion, a readily available and renewable resource, making it a sustainable and eco-friendly energy solution.

Off-Grid Power Generation: Footstep Power Generation provides an opportunity for off-grid power generation, especially in public spaces with high foot traffic, contributing to energy self-sufficiency.

Low Environmental Impact: Unlike some conventional energy sources, FPG has a minimal environmental impact. It does not produce greenhouse gas emissions or require extensive infrastructure development.

Promotion of Physical Activity: Implementing FPG in public spaces encourages physical activity by turning walking into a dual-purpose activity, promoting both health and energy efficiency.

Conclusion:

Footstep power generation represents a fascinating intersection of technology, sustainability, and human activity. As advancements continue and challenges are addressed, this innovative approach has the potential to play a significant role in diversifying the global energy mix, offering a cleaner and more sustainable future powered, in part, by the steps we take every day.A piezoelectric pipe is able of generating further voltage when longer the time taken. The longer the time taken means further step/ force are applied on the pipe. The direct relation is set up between the voltage generated and the time taken. This piezoelectric are specifically suitable for the perpetration in the crowded area similar as pavement road, train ticket counter, stairs and dance bottom. The piezoelectric pipe is also suited for the exercise pipe similar as for skipping or on the routine. The power that's generated from this piezoelectric pipe can be used to power up the light road, light along the stairs and also low power appliances.

REFERENCES:

1. https://www.researchgate.net/publication/339802422_Study_on_footstep_power_generation_using_piezoelectric_tile
2. https://www.researchgate.net/publication/334330165_FOOT_STEP_POWER_GENERATION
3. https://www.ijraset.com/research-paper/footstep-power-generation-using-piezoelectric-sensor
4. https://www.jetir.org/view?paper=JETIRC006180
5. https://www.academia.edu/36352945/275_Foot_Step_Power_Generation_System