

Generation of power from footsteps on staircase

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ABSTRACT

We are using fossil fuels which has recognized as a major cause of climate change but after some year fossil fuels will be overed. So we need to turn increasingly to alternative energy source as an answer to the economical, environmental and social problems links to fossil fuel use. Alternative energy resources are broadly defined as energy source that do not cross the limit of net emission of carbon dioxide and avoid atmospheric impacts. . We are using fossil fuels which has recognized as a major cause of climate change but after some year fossil fuels will over. The most common activity in our day to day life is walking. While walking, the person loses energy to the surface in the form of tremble. This energy can be tapped and transmuted to electrical form. In this project, we aim to design and test a simple device which converts the kinetic energy of footsteps into electrical energy. The device was efficiently designed, fabricated and tested. The objectives of my project are design of a staircase to produce electricity from footsteps, fabrication of the designed staircase and analysis of the system for better performance. The vitality can be used by simply setting a unit "Stride Power Generation System". By putting the framework in a country building or in spots like railroad station, so much vitality can be caught. This devoured vitality can be utilized for the lights on the rustic territory or the packed spots like railroad stations, universities and so forth.

Keywords: Footstep, Staircase , LED , Generator , Battery

1. Introduction

As per T.R.Deshmukh paper manages sketch and displaying of parts of the model of the stride power creating framework utilizing 3D demonstrating programming team. This procedure comprise number of simple design that is introduced under the strolling or standing stage. Venture framework deals with the guideline of changing over the direct pace on the grounds that to weight of strides into rotating movement by rack and pinion course of action. This system comes up short if there is any event of variable burden prompts adjusting type issues. Power isn't creating during return development of rack [1]. Sasank shekhar Panda's paper studied footstep power generation based that depends on wrench shaft; fly wheel, and apparatus course of action. This kind of strides power delivering framework are passable to be introduced in packed spots and country territories. This is a generally excellent innovation to give productive answer for power related issues to reasonable degree. This will be the most permissible methods for giving current to the spots that incorporates troubles of transmission. Upkeep and grease is expected time to time [2]. Miss. Mathane studied Piezoelectric footstep power generation based components that having crystalline development. They can change mechanical vitality in the electrical vitality and the other way around. The age of electrical vitality from piezoelectric precious stone is extremely low in the request for 2-3 volts and is put away in battery to charge controller, since it is unimaginable to expect to charge 12v battery through gem yield. To rise the voltage, the lift transformer circuit is utilized. distinction between different piezo electric material demonstrates that PZT is unrivaled in qualities. Additionally, by parallelism it was discovered that arrangement parallel blend association is progressively proper. The weight connected on the tile and comparing

voltage created is examined and they are found to have direct association. It is particularly appropriate for usage in jam-packed territories [3]. Jose Ananth Vino express that undertaking utilizing straightforward drive system which incorporate rack and pinion get together and chain drive component. The change of the power or weight vitality in to electrical vitality. The power creation is high however the underlying expense of this framework is high. There is no need of intensity from the mains and this framework is eco-accommodating. It is extremely compelling at the packed spots and on all streets and just as all sort of stride which is utilized to deliver the power. Support and grease is expected time to time. Power isn't created during return development of rack [4]. C. Nithiyesh Kumar and so on are examined three techniques for stride control production called piezoelectric strategy, rack and pinion strategy and fuel cylinder technique nearly and found that the rack and pinion instrument is increasingly powerful with moderate expense of activity and support [5]. Md. Azhar and so studied footstep power generation based that forth utilized managed 5V control, 500mA power supply. Extension type full wave rectifier is utilized to change the air conditioner yield of auxiliary of 230/12V advance down transformer. A rack and pinion are a kind of straight actuator including a couple of apparatuses which change cyclic pace into direct pace. The "pinion" connects with teeth on the rack. In this paper, since the power creation utilizing stride get its vitality prerequisites from Non-inexhaustible wellspring of vitality. There is no need of vitality from outside sources (mains) and there is less contamination in this asset of vitality. It is powerful to the spots like all streets and just as all sort of stride which is utilized to create the non-customary vitality like power [6]. Joydev Ghosh and so forth utilized 80 volts and 40 mA from one loop have

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been delivered from a model as first revelation. The subsequent disclosure gives 95 volts and 50 mA from one curl and this delivered vitality can be utilized to light LED exhibit and to pursue DC fan amending the AC or can charge batteries. For high proficiency in the axel of the subsequent rigging, they fitted a solid magnet vertically, with the goal that when the apparatus will rotate because of human body weight the magnet likewise spin. The magnet is set in a circle type copper curl. At the point when the magnet begin rotating as indicated by the Faraday's law of electromagnetic enlistment, there will be initiated emf in the loop [7]. Vipin Kumar Yadav and so forth utilized materials with following particular: Motor Voltage : 10 volt Type: D.C. Generator , No. of teeth : 59 (big gear) , No. of teeth : 36(small gear) , Type : Spur Gear , No. of apparatus used : 2 , RPM:1000 rpm , Gear 1-Mild Steel , Spring 1-Load bearing capacity : 6090 kg , Mild Steel , Total displacement : 5 inch , Bearing 1Type : Ball bearing, Bearing no.N35 , Shaft 1-Diameter : 15 mm-Material: Mild steel creator inferred that with these strategy vitality change is basic powerful and contamination free [8]. Shiraz Afzal and so forth express about creating power when individuals stroll on the Floor in the event that we are skilled to structure a power delivering floor that can create 100W on only 12 stages, at that point for 120 stages we can create 1000 Watt and on the off chance that we introduce such sort of 100 stories with this framework, at that point it can deliver 1MegaWattAs a reality just 11% of sustainable power source adds to our essential power. On the off chance that this venture is sent, at that point not just we can conquer the vitality emergencies matter however this additionally adds to make a sound worldwide barometrical change. In this paper a rigging framework is appended with flywheel which causes to turn the dynamo as the tile on the deck is pushed. The power that is constructed is spared in the batteries what's more we will be skilled to screen and manage the measure of power produced When an individual passes it push the tile on the ground surface which session the pole underneath the tile, turn is restricted by grasp bearing which is supported by holders. Essential shaft is rotate approx. twice by a solitary tile push. The pace of the overall shaft session the gearbox shaft which manufactures it multiple times (1:15) at that point its pace is smoothen by the assistance of fly wheel which between time store the development, which is convey to the DC generator (it creates 12V 40 amp at 1000 rpm) [9]. Ramesh Raja R and so on endeavors to demonstrate how power can be tapped and utilized at a by and large utilized floor steps. The utilization of ventures in each structure is rising step by step, since even every little structure has a few stories. An enormous amount of intensity is squandered when we are venturing on the floors by the scattering of warmth and grating, each time a man ventures up utilizing stairs. There is extraordinary plausibility of tapping this power and creating power by making each staircase as a vitality age unit. The created power can be put away by batteries, and it will be led for insulting the structure [10]. Tom Jose V and so on are manufactured

a model produced using treated steel, reused vehicle tires and reused Aluminum, likewise includes a light inserted in the asphalt that lights up each time a stage is changed into power (utilizing just 5 percent of the created power). The normal square of asphalt produces about 2.1 watts of power. Also, as indicated by creator, any one square of trail in a high-pedestrian activity zone can see 50,000 stages per day. In view of this information, just five units of asphalt can be adequate to rest the lights on at a transport stop throughout the night [11]. M. W. White has said that during human strolling there is an impermanent foot strike between the impact point and ground. The effect strain from foot strike arrives at twice times an individual's body weight. The translocation that a heel goes in the vertical channel during walk is subject on the property of the shoe. For a cushioned running shoe, the vertical translocation of the foot strike is about 1 cm. The realistic capacity to collect is subject on the effect strain and the vertical translocation of foot strike, just as the strolling recurrence. For instance, a 68kg man strolling at 2 stages for each second, the base vitality possible to gather is likely 13.3 W. It tends to be seen that there is extensive mechanical vitality from foot strike pace accessible to search [12]. Sibabrata Mohanty and so on expressed different sorts to create electrical power from strides. Power would create by strides of group on the floor. Piezo plate plan is put underneath the floor. There will be sheet covering the piezo plate and furthermore spring will be there for vibration strain on piezo. The piezo plate will be in lumps in the floor. This plate will deliver vitality in the sort of electric flow. The electric vitality creation can be conceivable through mechanical arrangement like flywheel and apparatus wheel, rack and Pinion and chain sprocket arrangement. The yield creation in rack and pinion, flywheel and rigging wheel arrangement is in one channel as it were. i.e during forward pace of human advance [13] Aleena Paul K and so on studied the piezoelectric footstep power generation based material makes an interpretation of the weight connected to it into electrical power. The asset of pressure can be either from the heaviness of the voyaging vehicles or from the heaviness of the individuals strolling over it. The yield of the piezoelectric segment is definitely not a relentless one. An extension circuit is utilized to change this variable voltage into a straight one. An AC swell channel is utilized to puzzle out any further vacillations in the yield. The yield dc voltage is then formed in a battery powered battery. As the vitality yield from a solitary piezo-film was incredibly low, combination of few Piezo movies was asked. There are two potential associations that were tried - parallel and arrangement associations. The parallel association did not indicate significant ascent in the voltage yield. With arrangement association, outer piezo film brings about ascent of voltage yield however not in straight extent. So here an association of both parallel and arrangement association is selected for producing 40V voltage yield with high current thickness. From battery arrangements are given to join dc load. An inverter is joined to battery to give arrangement to join AC load. The voltage produced over the tile can be seen in a LCD. For this

thought process microcontroller PIC16F873A is utilized. The microcontroller utilizes a precious stone oscillator for its activity [14]. XIE Longhan etc stated a novel mechanism based on dual oscillating Mode is planned to harvest the kinetic energy from footstep pace. The harvester contains two oscillating sub mechanisms one is spring mass oscillator to soak the vibration from external impetus, i.e. the footstep pace, and the other is cantilever beam with tip mass for evolving the vibration. Theoretic analysis shows that the dual oscillating mechanism can be more efficiently harness the foot step pace. The energy transformation sub mechanism is based on the electromagnetic induction, where the wire coils permanent at the tip end of the cantilever beam serves as the slider and permanent magnets and yoke create the alternating magnetic field. Simulation displays that the harvester, with total mass 70 g, can generate about 100 mW of electricity at the walking speed of 2 steps per second [15]. Alla Chandra Sekhar1 and so studied footstep power generation based that have point of this undertaking is to grow much cleaner cost effective way of intensity age process, which in goes cuts down the a dangerous atmospheric deviation just as decline the vitality deficiencies In this paper they are creating electrical vitality as non-traditional procedure by essentially strolling or running on the stride. Nonordinary vitality framework is significant as of now to our country. Nonconventional vitality utilizing stride is changing mechanical power into the electrical power. In this venture, they utilized electromagnetic acceptance guideline. In this paper the weight vitality is changed into electrical vitality. The checking procedure conveys the copper loop and bar attractive which is utilized to deliver voltage, a battery-powered battery is utilized to assemble this created voltage [16]. In the previous project some are studied for analysis the importance and some are fabrication of the foot step power generation. But they did not studied or work for balance.in this project I want to make a footstep arrangement that have balanced properly as a result it can frequently used in the staircase.

2.Methodology

The footstep moves the top plate downward as a result the piston moves downward. Thus, the crankshaft rotates and the motion is transferred to the generator via the pulley belt mechanism. The movement of the generator lightens the LED. The top plate restores its original position after the left-off of the footstep by the effect of the flywheel and the two springs. The two bearings are welded and their function is to supports the crankshaft. Required components are

- 1.Piston
2. Wrist pin
- 3.Connecting rod
- 4.Crank shaft
5. Flywheel
6. Bearing
7. Helical spring
8. Support rod
9. LED.

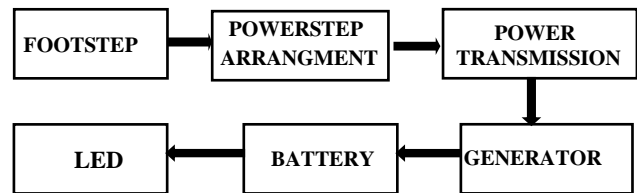


Fig 1 : Flow Diagram

2.1 Piston : The force of the footsteps of the piston is acted upon the top plate. Its motive is to convert force from footsteps to the crankshaft though a connecting rod, This function is reversed and force is moving from the crankshaft is casted from steel for better fatigue and strength longevity, The connecting rod is connected to the piston by a wrist pin. This pin is attached within the piston. The pin itself is of hardened steel and is permanent in the piston.to the piston for the motive of relocation of the piston by a decent pair of springs.



Fig.2 : Piston after forming

2.2 Wrist pin : Wrist pin connects with the piston via connecting rod. Usually, the wrist pin, which is a counterfeit short rod made of a steel alloy of huge strength and hardness, is a pivot or journal.

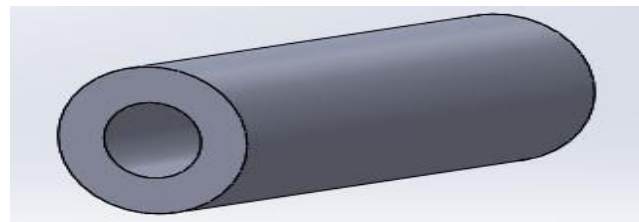


Fig. 3 : wrist pin

2.3 Connecting rod : The connecting rod associate the piston to the crankshaft. Together with the crankshaft, they form a simple mechanism that converts linear pace into revolving motion. The connecting rod is form of steel for the ability to imbibe high impact and high execution. The small end attaches to the wrist pin. The big end attached to crankshaft.

2.4 Crank Shaft : The crankshaft is the part that deciphers responding straight cylinder pace into whirl. To changing the responding movement into spin, the crankshaft has "wrench tosses" or "crankpins", surpassing bearing surfaces whose pivot is balanced from that of the wrench, to which the

"huge finishes" of the interfacing pole associate. The associating pole is structure by steel for the capacity to ingest high effect and high execution. It commonly joins a flywheel to diminish the throb trademark.

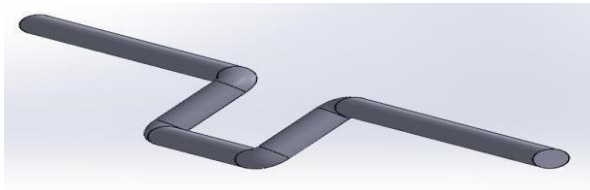


Fig 5 : Crankshaft

2.5 Flywheel : A flywheel is a spinning mechanical component that is utilized to accumulate rotational power. Flywheels have a cabalistic snapshot of dormancy and in this manner oppose change to rotational speed. A tolerable flywheel was fabricated from steel and associated with one finish of the crankshaft.

2.6 Bearings : A heading is a machine segment that propel relative movement between moving parts to just the deliberate movement. Direction are arranged extensively as per the sort of activity, the motions sanctioned, or to the channel of the loads (forces) imposed to the parts. To place the crankshaft a pair of roller bearings was used.

2.7 Springs : A pair of helical springs was used to support the top plate, [fig 6](#). These two springs increase slightly the top plate above the horizontal level when there is no force on the top plate. Then, both springs store the top plate to its previous position after lifting the applied force of the footstep.

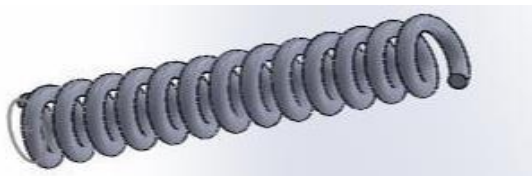


Fig 6 : Spring

2.8 Top Plate : The flat metal top plate takes the forces of the footsteps. It is made of steel. It has a length of 400 mm, width of 300 mm and thickness of 15 mm. A pair of helical springs is supported the top plate at one end and hinged to the main frame at the other end.

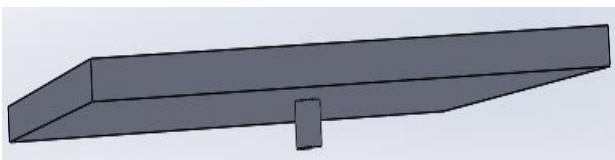


Fig 7 : Sketch of top frame

2.9 Main frame : All the mechanical and electrical components contain in the main frame. It is made of welded steel bars. Transparent plastic plates are cover the frame for observation of the operation.

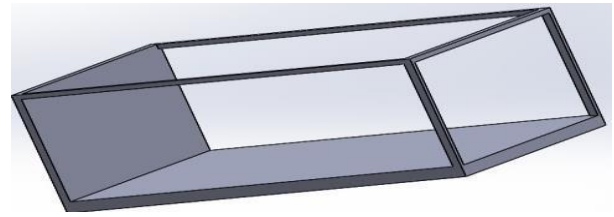


Fig. 8 : Sketch of main frame

2.10 Support rod : The rod is made of steel. A pair of support rods is placed at the free end of the top plate. The fixation of the helical spring done by support rods. Also, it limits the movement of the top plate.

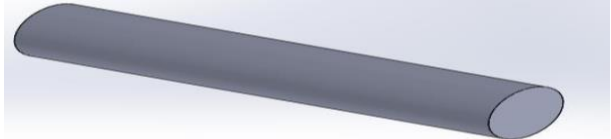


Fig 9 : Support rod

2.11 Central support : The central support carries a chamber for the piston. The central support dimensions are shown in [Fig 10](#).



Fig 10 : Central support

2.12 Generator : A 12 V output suitable DC generator was used. The motion is converted from the crankshaft to the generator via two pulleys and belt. The two pulleys diameter ratio are 4:1. This means that the generator rotational speed is four times that of the crankshaft. The generator is joint to a LED to demonstrate the activities of the mechanism.

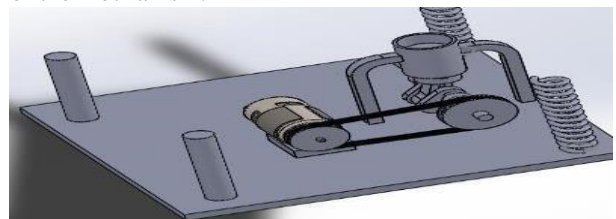


Fig 11 : Generator and pulley mechanism

3. Experimental Setup

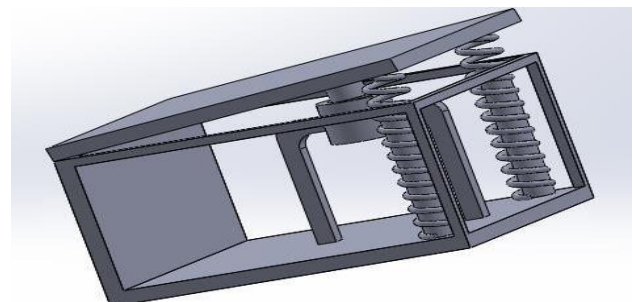


Fig 12 : Experimental Setup (right view)

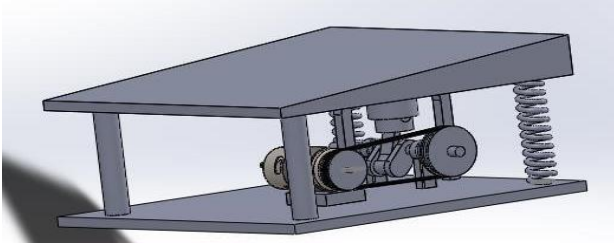


Fig 13: Experimental view (left view)

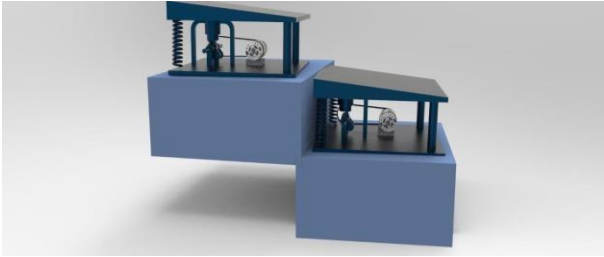


Fig 14 : Complete view

4. Fabricated Project

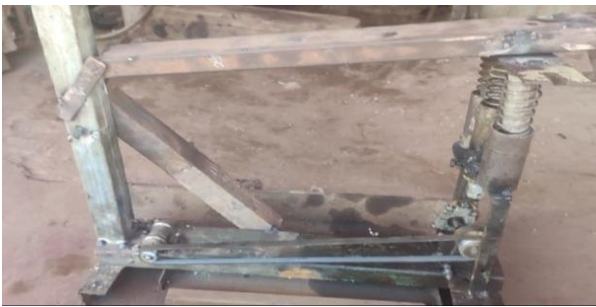


Fig 15 : Fabricated project

5. Data Collection and analysis

5.1 Driver and driven pulley specification

- Diameter of driver pulley = 4 cm
- Diameter of driven pulley = 1 cm
- Distance between two pulley center = 10 cm

5.2 Spring specification

- Total length = 17 cm
- Number of turns = 20
- Inner Diameter = 3.5cm
- Outer Diameter = 3.8 cm

5.3 Frame dimension

- Area of upper and lower plates= 25cm × 25cm
- Height of the frame= 15cm

5.4 Dynamo

- 12V 300 rpm Terminals Speed Reducing Power Geared Motor
- Model: 370GA25
- Rated Voltage: 12V

5.5 Necessary equation for calculation

Speed ratio = $D1/D2=N1/N2=T1/T2$ Power = $T\omega$

Torque $T = Fb$

$$\text{Angular Speed } \omega = 2\pi N$$

$$\text{Belt length , } L = \pi/2 (D1 + D2) + \frac{(D2-D1)^2}{4} + 2$$

$$\text{Belt Speed, } V = \frac{2*N*D2}{60}$$

5.6 Pulley speed ratio

Diameter of driver pulley , $D1 = 4$ cm

Diameter of driven pully $D2 = 1$ cm

Speed Ratio = $D1/D2 = 4$

5.7 Data collection and calculation

Distance of connecting rod to pulley = 0.98cm = 0.0098 m

Resistance of the generator = 29 ohm

Trial no	1	2	3	4	5
Weight	55	69	75	81	88
Rpm (Pulley D1)	8	11	13	16	19
Rpm , N (Pulley D2)	32	44	52	64	76
F = mg	539	676.2	735	793.5	862.4
$\omega = 2\pi N/60$	3.351	4.608	5.445	6.702	7.958
$T = r * F$ = $0.0098 * F$	5.2822	6.6268	7.203	7.7763	8.4515
$P = T * \omega$ = $T * 2\pi N$	17.7	30.54	39.26	52.12	67.26
V	2.1	2.9	3.5	4.19	4.8
I= V/R	0.072A	0.1A	0.121A	0.144A	0.166A

6. Result and discussion :

When person walk or stand on this platform their body weight compresses the setup system which suppose to rotate a dynamo and current produced is stored in dry battery. And when the power producing platform is over crowded with moving population, energy is produced is high. From the data table we can see that I have taken 5 trial with different weight. Forces were different because of the weight variation. We also get different rpm for pulley D1 and D2. Voltage and current both have been increased with the increment of applied force. Advantages of my project are listed below.

- This is a non-conventional system
- This process depends on human resource which is available plenty in our country which makes our country a suitable place for this project
- Promising technology for evolving power crisis to an affordable extent
- Simple design and construction
- Easy maintenance

- No labor required
- Clean and unlimited source of energy
- It is environmental and human friendly
- Apart from the human applied force it doesn't need any external energy
- Independence of brightness or weather factors like solar panels, wind turbines, hydro power generation
- Significant reduction of higher costs for the existing methodologies to generate current.
- Highly efficient in more crowded places

6. Conclusion

In concluding the words of our project, since the power generation using foot step gets its energy requirements from the nonrenewable sources of energy. There is no need of power from the mains and there is less pollution in this source of energy. It is very useful to the places like all roads and as well as all kind of stair case which is used to generate the nonconventional energy like electricity. It is able to extend this project by using same arrangement and construct in the footsteps/speed breakers so as to increase the rate of power production rate. These project has some limitations . They are

- 1.Capacity of power generation is dependent on the density of passing person
- 2.The top plate is slightly inclined above the horizontal level
- 3.The device is relatively heavy because of using steel for the main frame

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NOMENCLATURE

- S : Speed, rpm
H : Height of the frame, cm
P : power, w
R : Resistance of generator , ohm
V : Voltage, V
D : Diameter , cm