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DESIGN AND FABRICATION OF FOOTSTEP POWER GENERATION SYSTEM

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ABSTRACT

We need energy for every day today work of our life. There are many conventional methods of energy generation but these are depleting very Fastly hence non-conventional energy system is very essential at this time to our nation. So, an alternate method of non-conventional energy generation.

In this paper generating electrical power as non-conventional method by simply walking or running on foot step. Here Dynamo motor is used for converting mechanical energy into electrical energy. The voltage generated by this sensor is stored in battery which will be later on transmitted wirelessly to charge the mobiles. Generating electrical energy by means of a non- conventional method just by walking on the footsteps. Non-conventional system for energies is very much required at this time. Energy generation using footsteps requires no any fuel input to generate electricity.

Proper functioning such that it converts Force into electrical energy, the mechanism consists of Dynamo Motor, Diode, Capacitors, LED lights, Resistor and battery. We have discussed its various alternate applications with extension also. The power generation is much worthy but it has little initial cost-effective factors.

In This idea we show in public area many public walks on road and if we place there my project then when public walk on road that time our project generates electricity because our project is Generate electricity by Pressure or Foot Power, We add on road our project so when any one walk on road that time he press the our project and when our project press that time under in project dynamo move and generate electricity and that electricity we store in battery and that store battery power we use anywhere in real live , so this is our project idea and we can use in real life .

Keywords: Power Generation, Power Storing, Wireless Power Transceiver, Charging.

1 INTRODUCTION

To design a system that generates voltage by the humane footsteps force. Using non-conventional sources and stores it for usage. The system will have Dynamo motor that will convert the mechanical energy into electrical energy. It will fully depend on the human footsteps pressure and convert it into useful power.

Energy is nothing but the ability to do the work. In day-to-day life, Electricity is most commonly used energy resource. Now-a-days energy demand is increasing and which is life-line for people. Due to this number of energy resources are generated and wasted. Electricity can be generated from resources like water, wind etc. to generate the electricity from these resources development of big plants is needed having high maintenance cost. Some other energy resources are also costly and cause pollution. They are not affordable to common people. Electricity has become important resources for human being hence, it is needed that wasted energy must have to utilize, walking is the most common activity done by human being while walking energy is wasted in the form of vibration to the surface. And this wasted energy can be converted into electricity.

As the availability of conventional energy declines, there is need to find alternate energy sources. All most all the state electricity departments in our country, they are unable to supply the power according to the demand. The power produced by these companies is not even sufficient for domestic utilities; in such critical situation it is very difficult to divert the energy for other public needs. There by an alternative source must be discovered, many people propose for solar energy, but it is going to be a costliest affair, moreover availability of solar energy is poor particularly in rainy & winter seasons, as a result it is not dependable. Hence an alternative cheapest method must be determined for few applications; consequently, this project work has been taken up, which is aimed to generate electricity from footsteps mechanism.

Out of the many alternative energy resources, this technology described in this paper report is the ultimate source of all known forms of energy. It is clear, safe, and free, does not pollute the environment and thus will be an extremely viable alternative in the days to come. As there is a tremendous

increase in the crowd, the load applied on the footsteps by the people, it generates nonstop energy, which can be stored and utilized to energize the street lights. Here the concept is to convert the mechanical energy in to electric energy. 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 derived this by eating plants or animals, which he hunted. 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.

2. Literature Review

(1) "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.

(2) Harvesting kinetic energy of footsteps on specially designed floor tiles Daifallah Dala beih; Batool Haws; Sawsan Muhtaseb

This paper introduces an exploratory model for utilizing the kinetic energy of footsteps. The model consists of three wood layers. The bottom and top layer having the same dimensions are connected through springs. The use of springs makes walking on the tile flexible. The middle layer is installed with the 35 Piezoelectric units connected in series/parallel connection. A practical examination was performed at the University of Jordan to compute the expected energy generation if commercial tiles are lodged**.**

(3)"Maximum energy harvesting from electromagnetic micro generators by footsteps using photo sensor R. Manasa Veena ; B. Harika Reddy ; S.M. Shyni".

The root aim of this project is to harvest utmost energy from electromagnetic microgenerators. Most electromagnetic generators use the process of electromagnetic induction while some of these use renewable energy sources such as water power and wind power to create the initial mechanical energy. This project uses the principle of electromagnetic induction and converts the pressure energy into the electrical energy. The control mechanism carries the copper coil and bar magnetic to generate voltage, and a rechargeable battery is used to store this generated voltage. The idea is to utilize the unused energy released by footsteps at populated places such as roads, railway stations, temples and bus stops

(4)"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 approx. twice by a single tile push. The movement of the prevailing shaft turn the gearbox 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).

(6)" Sarat Kumar Sahoo ``FOOT STEP POWER GENERATION" Volume 7, Issue 2, March-April 2016, pp. 187

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. Hence due to such advantages, this system can be embedded at any of the public places like railway platforms, busy footpaths, malls etc. Implementing this system, we can easily reduce our dependency on the conventional sources of energy, thus can be considered beneficial from that point of view .

(7)"Shiraz Afzal, Farrukhhafeez, ``Power Generation Footstep" Volume 3, Issue 4, April-2014 "

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. 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.

SanketBorkar, AnkitTripathi, AmitChandrikapure, ``Design and Fabrication of Foot Step Power Generator" IJIRT Volume 4 Issue 10 March 2020

In this project electrical power is generated using non-conventional method by simply running on the foot step. eg. Railway stations. 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 output of electrical power. This project is made using simple drive mechanism such as rack and pinion assembly. For this project the conversion of the forced mechanical energy into electrical energy. The control mechanism carries the rack and pinion, D.C generator, battery. This project is implemented to all foot step. 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 efficiency systems for generating electricity which can be easily installed in many regions.

Tom Jose V, BinoyBoban, Sijo M T, ``Electricity

Generation from Footsteps; A Regenerative Energy Resource" Volume 3, Issue 3, March 2023

A slab of concrete harnesses kinetic energy whenever it is stepped on. This energy, created by 5 millimeters of flex in the material, is then either stored by lithium polymer batteries contained within the slabs or transmitted immediately to streetlights or other electronics located close by. The current model, made from Wood, stainless steel.

2.1 Objectives

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 Dynamo motor we are converting to and flo motion of the steps into rotational motion of the dynamo. In first foot step we are using link arrangement directly to rotate the dynamo. But in second step we are using gear mechanism to obtain better efficiency. Through Dynamo the rotational energy is converted into electrical energy. The output power is expected to be 5V in prototype.

Depending upon the above Literature Survey of different papers we have decided to moved forward to take this project in practical means. For this purpose, we have aimed to construct a prototype for footstep power generation system.

3. Experimental Methodology

3.1 Introduction

The footstep arrangement is used to generate the electric power. Now a day's power demand is increased, so the footstep arrangement is used to generate the electrical power in order to compensate the electric power demand. In this arrangement the mechanical energy is converted into electrical energy.

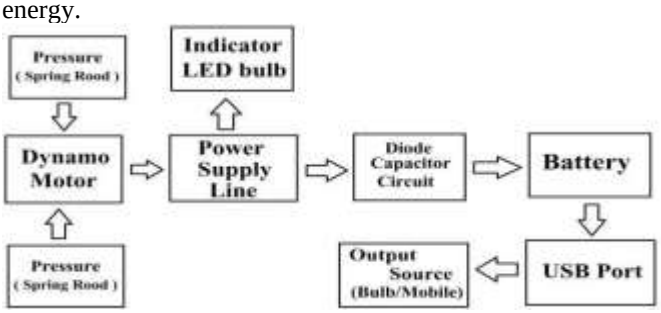

Fig.3.1. Block Diagram of The Proposed Project

3.2 Components Used

The footstep arrangement is used to generate the electric power. Now a day's power demand is increased, so the footstep arrangement is used to generate the electrical power in order to compensate the electric power demand. In this arrangement the mechanical energy is converted into electrical energy. This section is constructed by of rubber or other material which is placed within the surface areas. This section is mainly placed in the crowed areas. This footstep arrangement is attached with spring section.

3.3 **Footstep section components**

- Dynamo motor
- Capacitors
- Resistors
- Diodes
- Springs
- Foot-step
- Line filter
- LEDs
- Shaft
- Battery

3.3.1 Dynamo Motor:

A dynamo motor is an electrical machine that converts mechanical energy into electrical energy. It is also known as a generator or alternator.

Principle of Operation:

The dynamo motor works on the principle of electromagnetic induction, which states that an electric current is generated in a conductor when it is exposed to a changing magnetic field.

Key Components:

1. Magnet: A permanent magnet or electromagnet that provides the magnetic field.
2. Coil: A conductor coil that rotates within the magnetic field.
3. Rotor: The rotating part of the dynamo motor that carries the coil.
4. Stator: The stationary part of the dynamo motor that carries the magnet.

3.3.2 Capacitor:

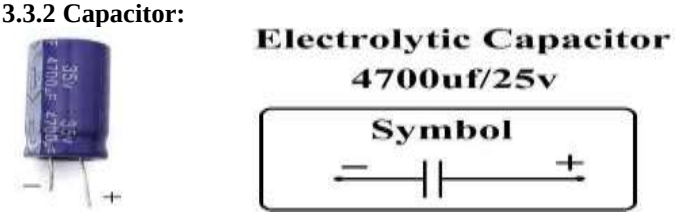

Fig.3.2. Electrolytic Capacitor

A voltage applied across the conductors creates an electrical field in the capacitor, which stores energy. A capacitor operates like a battery in that, if a potential difference is applied across it that can cause a charge greater than its "present" charge, it will be charged up**.**

3.3.3 USB Port:

Fig.3.3 USB Port

USB ports can be a convenient and practical way to utilize the energy generated by a footstep power generation system:

Purpose:

1. Charging devices: USB ports can be used to charge mobile devices, such as smartphones, tablets, or smartwatches.
2. Powering devices: USB ports can power devices that require a stable DC voltage, such as LED lights, sensors, or small motors.

3.3.4 BATTERY:

Fig.3.4. Rechargeable Battery

Here's an overview of battery usage in a footstep power generation system:

Battery Type:

1. Rechargeable Batteries: Nickel-Cadmium (Ni-Cd), Nickel-Metal Hydride (NiMH), or Lithium-Ion (Li-ion) batteries are suitable for energy storage.

2. Deep Cycle Batteries: Designed for frequent charging and discharging, deep cycle batteries are ideal for footstep power generation systems.

Battery Characteristics:

1. Capacity: Measured in Ampere-hours (Ah), capacity determines how much energy the battery can store.
2. Voltage: Typically, 12V or 24V, voltage affects the system's overall efficiency and compatibility.
3. Self-Discharge: Batteries lose charge over time; selecting batteries with low self-discharge rates is crucial.

Battery Management System (BMS):

1. Overcharge Protection: Prevents battery damage from overcharging.
2. Over-Discharge Protection: Prevents battery damage from deep discharging.
3. Voltage Regulation: Maintains a stable output voltage.
4. State of Charge (SOC) Monitoring: Tracks battery capacity and state of charge.

Battery Charging and Discharging:

1. Charging: The battery is charged by the footstep power generation system.
2. Discharging: The battery supplies power to the load (e.g., LED lights, USB devices).

4. Implementing A Footstep Power Generation

Implementing a footstep power generation project involves several steps:

Step 1: Design and Planning:

1. Determine the application: Identify the intended use of the generated power (e.g., charging mobile devices, powering LED lights).
2. Choose a location: Select a location with high foot traffic (e.g., shopping malls, train stations, airports).
3. Design the system: Create a detailed design of the system, including the dynamo motor, energy storage, and power conditioning components.

Step 2: Component Selection and Procurement:

1. Dynamo motor: Select a suitable dynamo motor that can generate the required power.
2. Energy storage: Choose a suitable energy storage component (e.g., batteries, capacitors).
3. Power conditioning: Select power conditioning components (e.g., voltage regulators, rectifiers).
4. USB ports and connectors: Procure USB ports and connectors for charging devices.

Step 3: System Assembly and Installation:

1. Assemble the system: Assemble the system components, including the dynamo motor, energy storage, and power conditioning components.
2. Install the system: Install the system in the chosen location, ensuring secure and stable mounting. Connect the USB ports: Connect the USB ports to the system, allowing for device charging.

Step 4: Testing and Commissioning:

1. Test the system: Test the system to ensure it is generating power and charging devices correctly.
2. Commission the system: Commission the system, making any necessary adjustments to optimize performance.

Step 5: Maintenance and Upkeep:

1. Regular maintenance: Regularly inspect and maintain the system to ensure optimal performance.
2. Troubleshooting: Troubleshoot any issues that arise, making repairs as needed.

Key Considerations:

1. Safety: Ensure the system is safe for users and does not pose a tripping hazard.
2. Efficiency: Optimize the system for maximum energy efficiency.

Durability: Use durable components and construction to ensure a long system lifespan.

Fig.4.1. Circuit Diagram of Foot Step Power Generation System

4.1 Proposed Project

First when pressure come then dynamo move and power go to power supply wire and that power go to area first indication LED Bulb for showing electricity generating and second go to diode so that power after cross diode cannot return for dynamo and after that power go to capacitor and capacitor give that power for battery charging then we connected to battery USB Port and by that USB Port we charge mobile and glow the bulb.

Key Considerations:

1. Voltage and current ratings: Ensure that all components can handle the expected voltage and current.
2. Power efficiency: Optimize the circuit to minimize energy losses.
3. Safety features: Implement safety features, such as overcurrent protection and short-circuit protection.

Design Requirements

Here's a step-by-step guide to designing a footstep power generation system:

Step 1: Define the Design Requirements

1. Power output: Determine the required power output (e.g., 5V, 1A).

2. Foot traffic: Estimate the average foot traffic per hour.
3. System size: Determine the available space for the system.
4. Budget: Establish a budget for the project.

Step 2: Choose the Dynamo Motor

1. Type: Select a suitable dynamo motor type (e.g., piezoelectric, electromagnetic).
2. Power rating: Choose a motor with a suitable power rating.
3. Efficiency: Opt for a motor with high efficiency.

Step 3: Design the Energy Harvesting System:

1. Mechanical design: Design the mechanical system to convert foot pressure into mechanical energy.
2. Energy storage: Choose a suitable energy storage component (e.g., batteries, capacitors).

Step 4: Design the Power Conditioning System:

1. Voltage regulation: Design a voltage regulator to stabilize the output voltage.
2. Rectification: Choose a suitable rectifier to convert AC to DC.
3. Filtering: Design a filter to remove unwanted frequencies.

Step 5: Design the USB Port and Connector:

1. USB port type: Choose a suitable USB port type (e.g., USB-A, USB-C).
2. Connector type: Select a suitable connector type (e.g., USB-B, USB-Micro).

Step 6: Design the System Housing and Mounting:

1. Housing material: Choose a suitable material for the system housing (e.g., plastic, metal).
2. Mounting system: Design a secure and stable mounting system.

Step 7: Test and Refine the Design

1. Prototype testing: Test the prototype to identify areas for improvement.
2. Design refinement: Refine the design based on test results.

Key Design Considerations:

1. Efficiency: Optimize the system for maximum energy efficiency.
2. Safety: Ensure the system is safe for users and does not pose a tripping hazard.
3. Durability: Use durable components and construction to ensure a long system lifespan.

Fig 4.2 Fabricated Model

Table 4.1. Results from the amplifying circuit

Force	Load	Voltage	Current	Power
735.75N (75kg)	**2.5 ohms (phone)**	**5V**	**2mA**	**0.01W**
735.75N (75kg)	**1K ohms**	**5V**	**5mA**	**0.025W**
735.75N (75kg)	**100 Ohms**	**5V**	**17mA**	**0.085W**
735.75 (75kg)	**10 Ohms**	**5V**	**18mA**	**0.09W**

5. RESULTS and DISCUSSIONS

Here's a sample results and discussion section for a footstep power generation

Results:

Electrical Performance:

1. Voltage Output: The system generated a maximum voltage of 5.5V.
2. Current Output: The system generated a maximum current of 1.2A.
3. Power Output: The system generated a maximum power of 6.6W.

Energy Harvesting Efficiency:

1. Efficiency: The system achieved an energy harvesting efficiency of 25%.
2. Energy Storage: The capacitor bank stored up to 50% of the generated energy
3. Charging Efficiency: The system achieved a charging efficiency of 80%

Discussion:

Electrical Performance:

1. Voltage Regulation: The voltage regulator effectively regulated the output voltage.
2. Current Limiting: The current limiting circuit prevented excessive current flow.

Energy Harvesting Efficiency:

1. Dynamo Motor Efficiency: The dynamo motor efficiency was lower than expected, affecting overall efficiency.
2. Energy Storage: The capacitor bank stored a significant amount of energy, improving overall efficiency.

Charging Performance:

1. Charging Speed: The charging speed was slower than expected, due to the limited power output.
2. Charging Efficiency: The charging efficiency was higher than expected, indicating effective energy transfer.

Conclusion

The footstep power generation system demonstrated promising results, with a maximum power output of 6.6W and an energy harvesting efficiency of 25%. While there is room for improvement, the system shows potential for charging mobile devices and other small electronics.

Future Work:

1. Optimize Dynamo Motor: Improve dynamo motor efficiency to increase overall efficiency.
2. Enhance Energy Storage: Upgrade the capacitor bank to increase energy storage capacity.
3. Improve Charging Speed: Optimize the charging circuit to increase charging speed.

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