

A Low-Cost Foot Step Power Generation Using Piezoelectric Sensors



L. Shiva Kumar, Vijaya Bhasker Reddy, G. Ramya, K. Ajay Reddy, and Y. Pavani

Abstract Electrical energy is important and had been demand improved in the course of the world. Conventional approach of producing energy has a direct impact on environment; a lot of electricity is wasted and exhausted with the aid of humans. So, that energy is utilized and converting kinetic energy to electrical electricity as the stress exerted by way of foot step and by using the usage of transducers is essentially referred to as foot step power generation system. There exists range of power harvesting strategies through piezoelectric powered sensors. This mission would be mounted in crowded locations so when a human walks on a certain arrangement that unused energy which is in the form of stress or force is transformed to electrical energy. The stress is exerted by using human weight on piezoelectric powered sensors device and successfully generates energy to run the AC or DC loads. So, using prosed system we can generate power and give charge for lightening systems.

Keywords Electricity generation · Piezo-sensor · Foot step strain

1 Introduction

Electricity is one of the many times used power, and it is growing alongside the population. Conventional electricity has been demanded a critical technique of producing energy and has a direct effect on environment. The alternative method of producing electrical energy with availability of different quantity of techniques by using which electrical energy can be produced[1–8], out of such approaches generating foot step power can be an wonderful approach of generate electrical Electricity. The object in this invention is to use the growing of human population and give high impact

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on in growing the electricity while lowering the poor impact on environment. This makes use of electricity additionally that do no longer rely on matter on the local weather condition. Human electricity transducers have been in existence since the time immemorial in the form of walking, going for walks, etc.

Electricity is most used resource in many instances. Now-a-days demand for utilization of power is increasing and which is lifeline for most of the people in their daily life. Due to this, variety of electricity assets are generated and wasted. Generation of electricity can be done from assets like wind, water, biomass, waves, solar, etc., to generate the electrical energy from those set of sources improvement of electric energy massive flora is wanted, having excessive preservation charges. Some different power sources are additionally high-priced and purpose cause pollution. They are now not cheap to frequent people. Current scenario electricity becomes to be a necessary asset for all the human being; hence, it is required that wasted strength have to be utilized. Taking walks is the most frequent undertaking completed through human being. While taking walks through pedestrian, electricity is wasted in the form of charge motion to the surface. And this kind of power can be transformed into electrical energy; the same can be used for various applications like street lights, operating small hand-held electrical devices, etc.

Using the precept is referred to as piezoelectric effect. Piezoelectric effect is the impact in which mechanical vibrations are converted in to electric energy. Pressure or pressure utilized to piezoelectric fabric is transformed into electrical form.

Modern technological know-how has led to improvement of machines to enhance use of human energy in extra environment friendly manner. The conversion of strength that exhausted and wasted while on foot or running is done using sensors. The power is transformed to electrical energy. This is the present-day fashion in electrical strength producing, and it is attaining from people foot step. When man or woman utilized strain on the platform related with sensors their physique weight compresses the setup of device and cutting-edge is produced and saved in battery. The voltage will increase as a consequence alongside the weight will increase and strain utilized on the piezoelectric powered sensors (Fig. 1).

Fig. 1 Foot step power generation using steps [9]



2 Literature Survey

R. Meier, N. Kelly et al. proposed a mechanism of power generation through piezoelectric technique in shoe, which is a limited work and did not mention applications for the same [10].

R. K. Datta and S. Rahman et al. discussed about foot step electricity generation using micro-generator system, even though it's a low cost but not up to the mark as require power generation which is designed based on a simple op-amp [11].

T. R. Deshmukh et al. discussed about a paper deals with plan and modeling of components of the model of a system those foot step energy technology system the usage of 3D modeling software program. This procedure consists quantity of simple setup that is mounted below the strolling or standing platform.

A. D. Triono et al., "Utilization of Pedestrian Movement-based power generation using piezo-sensor for side walk" design becomes little expensive where a special attraction is required [12].

A. Bhaumik et al., Task machine chips away at the standard of changing over the direct movement in light of the fact that to tension of strides into pivoting movement via rack and pinion gear plan. This component comes up short in case there is any frequency of variable burden prompts adjusting kind issues power isn't created for the term of return development of rack. Sasank Shekhar Pandas paper is principally founded on driving rod, fly wheel, and stuff plan. This sort of strides power age machine is qualified to be introduced in jam-packed spots and country regions [13]. Along these lines, this is an awesome innovation to outfit pleasant response to control related issues to minimal expense degree. This will be the most legitimate abilities of giving energy to the spots that incorporates hardships of transmission.

T. Sarala et al. express those piezoelectric substances having glasslike structure. They can change over mechanical energy in the electrical energy as well as the other way around. The delivered electrical energy from piezoelectric precious stone is extremely low in the request for 2–3 V and is saved in battery to charge regulator, taking into account that it is presently not plausible to charge 12v battery through gem yield [14].

To intensify the voltage, the lift converter circuit is utilized. Examination between different piezoelectric controlled texture proposes that PZT is unrivaled in qualities. Likewise, by examination it used to be found that series-equal blend association is more reasonable. The weight applied on the tile and comparing voltage produced is considered, and they are detectable to have direct connection. It is predominantly alluring for execution in jam-packed regions. Jose Ananth Vino express the project that utilization of simple power instrument which incorporate rack and assessment meeting and chain drive component. The change of the tension or strain energy into electrical energy is discussed [1–3]. The power age is exceptionally high yet. The underlying expense of this framework is high. There is no need of energy from the mains, and this framework is eco amicable. It is exceptionally advantageous at the

jam-packed spots and on all streets and as appropriately as all assortment of stride which is utilized to produce the power. Upkeep and oil is expected opportunity to time as a by product of the experiment. Power is not generally created during return movement of rack.

3 Proposed System

First of all, we need to maintain piezoelectric sensors on crowded areas or places. Piezoelectric tile converts stress into electrical energy. The strain can be both from weight of moving motors or from the weight of human beings taking walks on it. The produced output is in the variable form. So bridge rectifier circuit is used to convert variable voltage into linear voltage. An AC filter is used to filter out this output voltage, and it is saved in rechargeable battery. We are using Arduino Uno. Arduino is open supply digital prototyping platform based totally on flexible, handy to use hardware and software. When gadget is on it shows a message on LCD and then it is a primarily based safety device lets in solely approved humans to use this system.

The energy harvesting circuit consists of piezo-sensor transducers positioned on a tile. At the point when a unique pressing factor is applied on them [15], voltage across the piezo-transducer is created. The field of piezoelectric sensor is not steady so we use bridge rectifier to change over the variable into a direct voltage. Around 8–12v from this piezo-transducer bank is created. Bridge rectifier is given to capacitor of 2000uF followed by SPDT switch. The voltage is produced when pressure is applied on piezoelectric sensors. That is voltage is conveyed to battery, and here the battery utilized is lead acid battery, 12v. The voltage divider setup brings the voltage down to the microcontroller as we can't took care of 12v straightforwardly to the capacitor so it used to partition the voltage. Diode impedes the flow moving from capacitor to piezoelectric sensor. Pointer segment incorporates LED to show the force age. Inverter changes 12v DC over to 230v AC. After perusing the battery, voltage and the voltage created from the piezoelectric transducer are shown on 16 * 2 LCD. The microcontroller ATMEGA-328P is interfaced with LCD for programming display reason (Fig. 2).

- The amount of mechanical stress of individuals on the floor acquired sensor plate convert in to electrical energy.
- The rural energy to run AC to DC
- It does not contain any pollution.

The relation between electrical voltage and mechanical force is proportional to each other.

As per Hook's Law in $F = - kx$.

x —displacement of springs.

F —resulting force vector.

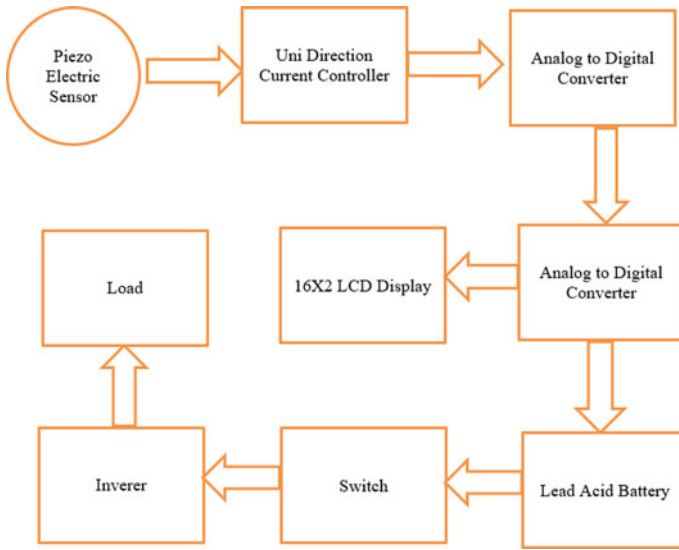


Fig. 2 Block diagram of system

k —spring constant, a constant that depends on the substrate material.

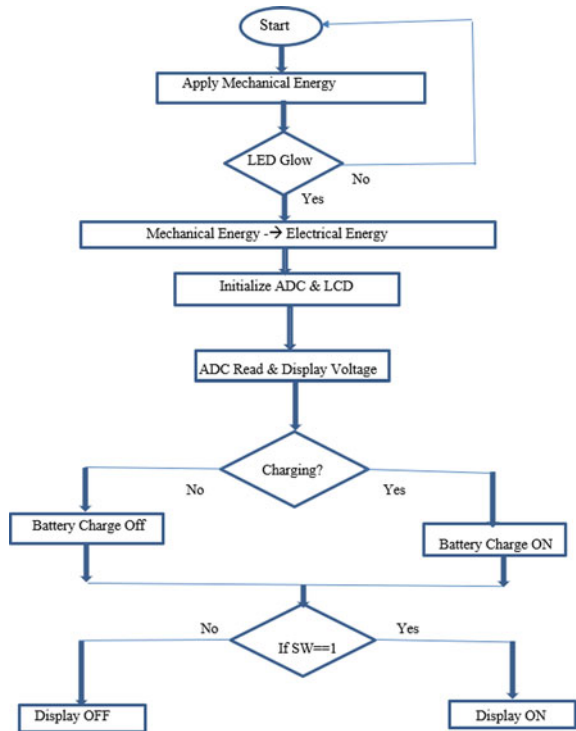
The principle of working of proposed system is primarily based on the piezoelectric sensor plates. For the implementation of this system, we regulate the tile plates above and beneath the sensors and movable spring. The process of non-conventional energy using foot step is changing the acquired mechanical power into equivalent electrical power. Foot step board is consisting of piezoelectric sensors; when strain is applied on the sensors, the sensors will convert mechanical power into electrical energy. The electrical electricity will be storing in the 12v rechargeable battery related to inverter; we are using conventional battery charging unit also for giving supply to the circuitry. The inverter is used to convert the 12 V DC to 230 V AC voltage that is used to run the loads; by the use of this AC voltage, we can function the AC loads.

A flowchart is simply graphical representation of system. Flowchart in Fig. 3 shows the steps in sequential order; generation foot step power through piezoelectric sensor plate process is explained in graphical diagram to reduce the environment pollution using renewable energy.

3.1 Hardware Description

- Piezoelectric sensors
- Led bulb
- Unidirectional current controller
- Lead Acid Battery

Fig. 3 Working flow of system



- Voltage sampler
- Analog to digital converter
- Arduino Uno
- Inverter
- Switch
- 16 * 2 LCD.

3.2 Software Description

- Arduino IDE
- Embedded C Programming.

4 Results and Discussion

An electric power harvesting system based on piezoelectricity principle is developed and implemented here for electrical energy generation and voltage is obtained from the pedestrian walk pressure applied, the status of voltage is displayed with the help

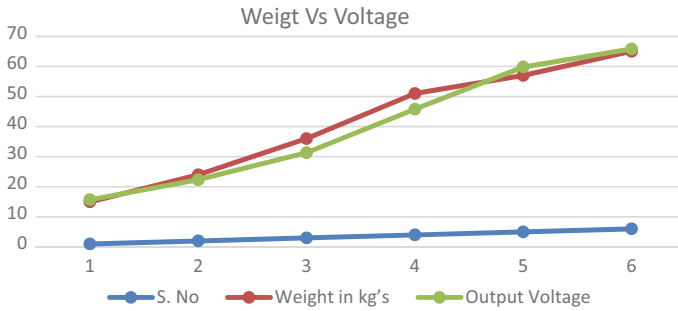


Fig. 6 Graph weight versus voltage

Table 1 Voltage for different weight

S. No.	Weight in kg's	Output voltage
1	15	15.71
2	24	22.34
3	36	31.33
4	51	45.78
5	56	58.84
6	65	66.33

need to convert the same into DC source). We have linked the wires into a multi-meter to measure the voltage. We have utilized some stress on the surface of sensor plate and seen the output electrical voltage on meter readings. The amount of output electrical voltage varies with the amount of strain experienced on the sensor plate. For different phases of experimental setup, we increase the quantity of piezo-sensor plates and followed the equal accompanied foot-steps (connected the piezo-sensor plates, multimeter, bridge rectifier and wires) to observe how the quantity of produced electrical-voltage would varies and verify the results (Fig. 6; Table 1).

5 Conclusion

A non-conventional, non-polluting energy is achieved when applying a force on piezoelectric sensors. As a result, installation of proposed model in a place where more amount of crowd like malls and entries, where large numbers of people can step on, which in turn would generate more power, thus using this power generated for charging of a connected battery for lighting purpose.

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