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Foot Step Electric Power Generation

Mohd. Faizan, Himanshu Singh, Harsh Pandey

Abstract: The reduction in energy demand by portable electronics has rekindled interest in the use of renewable energy sources in the built environment. This technological study focuses on a sophisticated piezoelectric material energy harvesting method. Piezoelectric materials can be used to convert mechanical energy, such as environmental vibrations, into electrical energy, which can then be stored and used to power other devices. When mechanical stress is applied to a piezoelectric material, it creates an electrical charge. However, when an electric field is introduced, mechanical deformation occurs. The electrical density generated on the piezo can be stored in a rechargeable battery for later use. Piezoelectric materials offer a wide range of applications in real life. Following are some of the latest applications. Following are some of the latest applications. Alternative forms of energy are currently needed in travel terminals such as airports and railways around the world. Keeping prices low, maintaining friendly and productive relations with neighbors and ensuring a healthy environment for future generations requires cleaner and more sustainable electricity. Piezoelectric devices installed in the terminals make it possible to recover the kinetic energy of pedestrian traffic. That energy can then be used to balance some of the electricity needed to power the lighting systems. Low power electrical appliances have become more common in recent years. Technologies are widely used to make our daily lives easier. The idea of looking for an alternative renewable energy for the human environment has piqued our curiosity, as the energy consumption of these portable electronic devices has increased. I am trying to create a piezoelectric generator in this project. It can generate energy from the vibration and pressure found in the second sentence (like people walking). This study describes the use of piezoelectric materials to capture the energy of walking people, creating and harvesting vibrational energy. This approach can also be applied to massive vibration sources found in nature. This project is also the first step towards a piezoelectric energy harvesting model that is both cost-effective and easy to install.

Keywords: Piezoelectric material, battery, external pressure, led, microcontroller.

I. INTRODUCTION

There are several alternative ways to generate electricity, and one of these methods, cascade power generation, can be an efficient way to generate electricity. Walking is the most common form of human activity. When a person walks, he loses energy to the road surface in the form of impact, vibration, sound, etc., because his weight is transferred to the road surface by the impact of his feet on the ground. This energy can be captured and transformed into something useful, like electricity. The kick energy can be transformed into electrical energy by placing this gadget on the track. Ninety-five percent of pedal power is converted into energy. Pedal power is a simple, cheap and convenient source of energy that can be used for many tasks. Human kinetic energy, on the other hand, can be used in many different ways, including different methods of generating electricity, and several organizations are already using human powered technologies to generate electricity to power small electronic devices [5]. For densely populated nations like India and China, where human mobility is a gift for electricity generation in their wake, the suggestion to harness the waste energy of human movement to generate electricity is particularly vital and crucial. Indian roads, railway stations and bus stands are crowded with millions of people traveling around the clock. Therefore, this promising technology can be used to generate large amounts of power. During this process, various small assemblies are installed under the walkway.[8]

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II. OBJECTIVE

The main goal would be to study footprint strategies and successfully compare all power generation methods. The importance of this system modelling and electrical equipment integration would be most important [1]. The obtained parameters and design values (results) help realize the design through hardware.

A. Study of Piezo Material

Piezoelectric materials include piezoelectric ceramics in their class. Crystals that are polar in the absence of an electric field are known as ferroelectric materials. Several piezo ceramics, including $PbTiO3$, $PbZrO3$, PVDF, and PZT, exhibit the piezoelectric effect. The main component of the project is the piezoelectric material. The right choice of piezo material is of utmost importance. To this end, an analysis was made of the two most common piezoelectric materials - PZT and PVDF to determine the most suitable material. The selection criterion was better output voltage for different pressures. To understand the capacity corresponding to different applied forces, the V-I characteristics of each material, PZT and PVDF, were plotted [1]. The piezoelectric material to be evaluated is placed on the piezoelectric sensor for this purpose. Both are linked to voltmeters and ammeters, respectively, to measure voltage and current.

Voltage readings corresponding to the various applied forces are shown when different forces are applied to the piezo material. Different voltage and current values from the piezo test material are recorded for each such force sensor voltage reading. PZT has a voltage of roughly 2 V, while PVDF has a value of roughly 0.4 V. Hence, we may say that PZT offers superior power over PVDF.

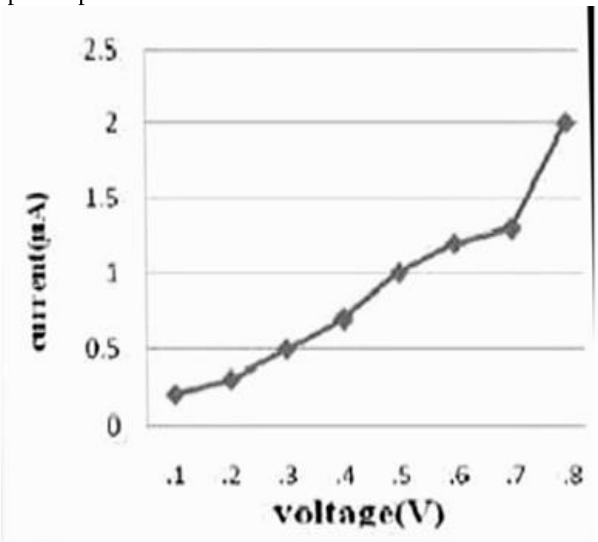

Fig -1: V-I Characteristic for PZT

Similar connections are created for parallel and series-parallel connections, and the curves are as depicted in the images. The diagram shows that the series connection voltage is good but the received current is bad, the parallel connection current is good but the voltage is bad. But this problem is solved by series parallel connection where good voltage and current can be obtained [5].

III. SYSTEM DESCRIPTION AND WORKING

The piezoelectric sensor serves as the foundation for this project's basic operation. We modify the wooden plates above and below the sensors and movable springs to put this into practice [3]. Through the use of unconventional energy, mechanical energy is transformed into electrical energy by walking. Foot step board is made up of 16 parallel-connected piezoelectric sensors [10]. The sensors will change mechanical energy into electrical energy when pressure is applied to them. The 12 volt rechargeable battery linked to the inverter will store this electrical energy. Also, we use a typical battery charging machine to deliver power to the circuits. Using this inverter, 12 V DC is changed into 230 V AC. This voltage is 230 volts AC.

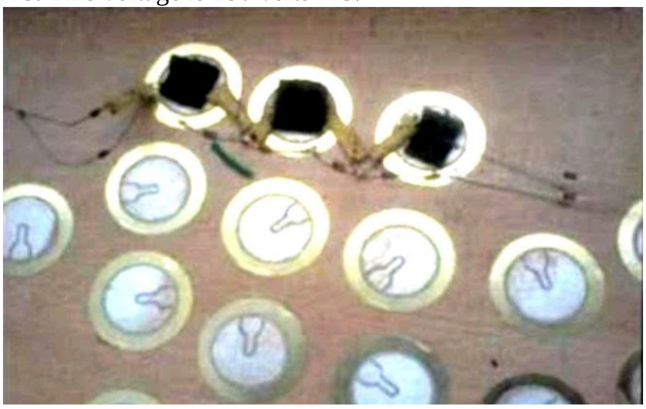

Fig -2: PZT in series connection

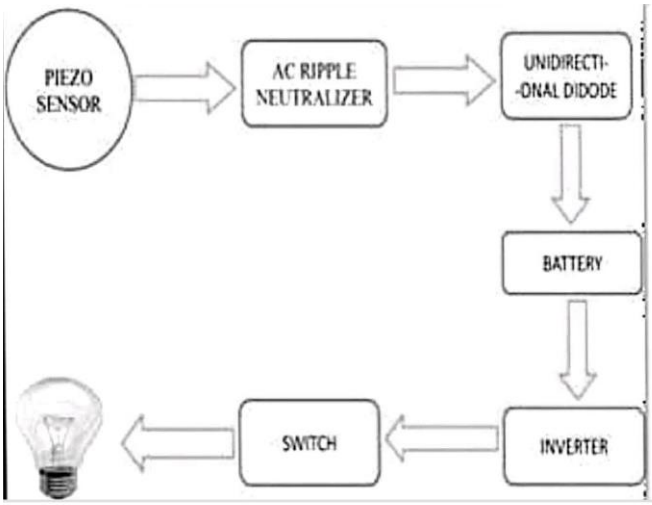

Fig -3: Block diagram of footstep generator

IV. ENERGY GENERATION MODEL USING FOOTSTEPS

The foot is shown touching the top plate in the right-side image without applying any weight, demonstrating how the Foot Stop Electric Converter (FSEC) works. When the body's entire weight is shifted on the top plate, the foot may be seen on the left side of the photograph. When a foot load is applied, a 6 W, 12 V bulb attached to the alternator's output flashes to show the electric output. The device is made to produce a full-power pulse when activated by a person who weighs close to 60 kg. Using an oscilloscope, an experimental voltage vs. time plot was produced [11]. The load (a resistor) and voltage data were used to create a standard plot of power vs. time. An energy storage device may be used to store the electricity produced by the foot step generator. An AC-DC converter bridge was used to connect the generator's output to a 12 V lead acid battery. The battery was first totally drained. The FSEC was then run by exerting foot pressure while energy was stored in the battery. The battery was attached to a 100 W, 230V bulb through an inverter. The duration of lighting, the bulb for number of footsteps and corresponding energy stored.

Fig-4: Footstep Power Generation System

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V. ENERGY STORING TABLE

The power produced by the leg generator can be stored in an energy storage device. The generator output was fed to a 12V lead-acid battery via an AC converter bridge. At first the battery was completely empty. The FSEC was then used with leg loads and the energy stored in the battery. A 100 W, 230 V light bulb was connected to the battery via the inverter. The arrangement is shown in Figure 6. The duration of illumination, the number of steps and the corresponding stored energy are shown in Table 1. The piezoelectric material converts the pressure applied to it into electrical energy. The source of pressure can be either the weight of moving vehicles or the weight of people walking over it [9]. The performance of piezoelectric material is not uniform. So a bridge circuit is used to convert this variable voltage to linear. Again, an AC ripple filter is used to filter out additional fluctuations in the output. The output DC voltage is then stored in the rechargeable battery. Since the power of a single piezo membrane was very small, a combination of several piezo membranes was investigated. Two possible connections were tried - parallel and series. The parallel connection did not show a significant voltage increase. In a series connection, an additional piezo membrane increases the output voltage, but not in a linear relationship. So here a combination of both parallel and series connection is used to produce 0 V voltage with high current density. One of the batteries is reserved to connect the DC load [7]. The inverter is connected to the battery to connect the AC load. The voltage produced on the board is displayed on the LCD screen.[2]

VI. MAXIMUM VOLTAGE GENERATED

A charge is generated over a piezo material when a force is applied to it. We can thus infer that it is a perfect capacitor. Hence, it can be subjected to all equations regulating capacitors. Three piezo materials are series-connected to a single board in this project. [2] Ten of these parallel series connections are connected. Hence, the equivalent capacitance of three piezoelectric plates connected in series changes: As a result, the unique voltages of each piezoelectric plate are added to create the grid voltage generated in a series connection. One piezo plate's output voltage is 11 V. So, V= 11+11+11 = 33 V. [4]

Table -1: Energy Storage Chart

S. No	No. of Foot Steps	Duration of lighting a 100W, 230V bulb(S)	Total Energy(J)	Energy/step(J)
1	100	2	300	1.3
2	250	5	550	2.0
3	500	13	1300	2.1
4	750	21	2000	2.4

VII. PIEZOELECTRIC SENSOR

A piezoelectric sensor is a machine that converts pressure, acceleration, voltage, or force into an electrical signal using the piezoelectric effect. Piezoelectric sensors have demonstrated their versatility as instruments for measuring a range of processes. Despite its widespread use in quality control, process management, and research and development, the piezoelectric effect was not used for industrial sensing until the 1950s. Since then, usage of this measurement principle has grown, and it may now be regarded as an established technology with high levels of intrinsic reliability [6]. It has been successfully utilized in a number of applications, including nuclear power equipment, aerospace, medical equipment, and touchpads for mobile phones. In the creation of internal combustion engines, piezoelectric components are employed in the automotive sector to monitor combustion. The sensors are either incorporated into the ignition/burner plug or they are put directly into the chrome holes in the cylinder head. A number of inherent benefits have directly contributed to the growth of piezoelectric technology. Several piezoelectric materials have large elasticity moduli that can exceed 106 N/m2 and are equivalent to many metals. Despite the fact that piezoelectric sensors are electromechanical systems that react to compression, there is essentially no deflection of the sensor parts. Therefore, piezoelectric sensors so durable, they have a very high natural frequency and excellent linearity over a wide range. In addition, piezoelectric technology is not sensitive to electromagnetic fields and radiation, which allows measurements to be made in harsh conditions. Some of the materials used (especially gallium phosphate or tourmaline) have extreme stability even at high temperatures, allowing sensors to operate up to 1000 °C. In addition to the piezoelectric effect, tourmaline also has piezoelectricity. It is the capacity to produce an electrical signal in response to changes in crystal temperature. Also frequent in piezo ceramic materials is this phenomenon. The inability to perform totally static measurements is one drawback of piezoelectric sensors. A specific number of charges are generated in the piezoelectric material as a result of the static force. Imperfect insulating materials and low internal sensor resistance cause continual electron leakage and signal deterioration when used with traditional readout circuits [6,7,8].

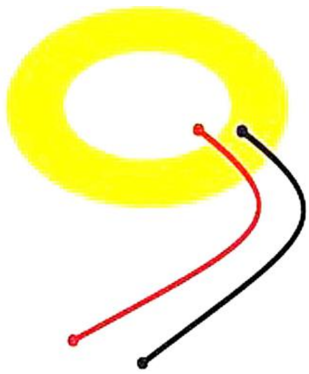

Fig -5: Piezoelectric Sensor

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VIII. BATTERY CONNECTION

Lead-acid batteries are usually available in 2V, 6V or 12V blocks. In most cases, many batteries must be connected in parallel and/or in series to produce the required operating voltage and battery capacity for the solar inverter. [7]

IX. MICROCONTROLLER

Using graduated force, this project generates voltage. The proposed technology generates electricity effectively. This project is very useful in public places such as bus stops, theatres, stations, shopping malls, etc. Thus, these systems are placed in public places where people walk and must ride the system to go through the entrance or to exist. Then, with each action, these systems might produce tension. In order to do this, force, pressure, and acceleration are transformed into electrical impulses and measured by a piezoelectric sensor. In order to assess power, this system uses a voltmeter, LED lights, a weight system, and a battery. [7]

1). whenever force is applied on piezoelectric sensor, then the force is converted into electrical energy.
2). In that movement, the output voltage is stored in the battery.
3). The output voltage which is generated from the sensor is used to drive DC loads.
4). Here we are using AT89S52 to display the amount of battery get charged.

This project makes use of the AT89S52 microcontroller, which has features like 8K ROM, 256 RAM, 3 Timers, 32 I/O pins, 1 Serial interface, and 8 Interrupt sources. When we step on a piezoelectric sensor, an AT89S52 microcontroller displays how much battery power is generated.

X. PRACTICAL ARRANGEMENTS AND RESULTS

The successfully tested and implemented project "POTENTO GENERAT)ON US)NG FOOT STEP" is the best economic and affordable energy solution for the common man. It can be used in many applications in rural areas with little or no access to electricity. India is a developing country where energy management is a major challenge for a huge population. Using this project, we can control both AC and DC loads depending on the force applied to the piezoelectric sensor. A piezo plate capable of producing a voltage of 0 V is proposed. A comparison of different piezoelectric materials shows that PZT has better properties. For comparison, a series-parallel connection was also found to be more suitable. The weight applied to the plate and the corresponding generated stress are investigated and found to have a linear relationship.[5]

Fig -6: Series and Parallel Connection Arrangement

It is particularly suitable for use in congested areas. It can be used for street lighting without long power lines. It can also be used as charging ports, lighting up buildings along the sidewalk. In actuality, just 11% of our energy comes from renewable sources. If this project is carried out, we will not only be able to solve the energy crisis problem but also contribute to a positive shift in the world's environmental conditions.[2]

A clever mechanism generates 1500 W of electricity. A durable's lifespan is roughly 4 years. It is particularly suitable for use in congested areas. It can be used for street lighting without long power lines. It can also be used as charging ports to light up buildings on the sidewalk. In fact, only 11% of renewable energy is our primary energy. If this project is implemented, we can not only overcome the problem of energy crisis, but also help create healthy global environmental changes.

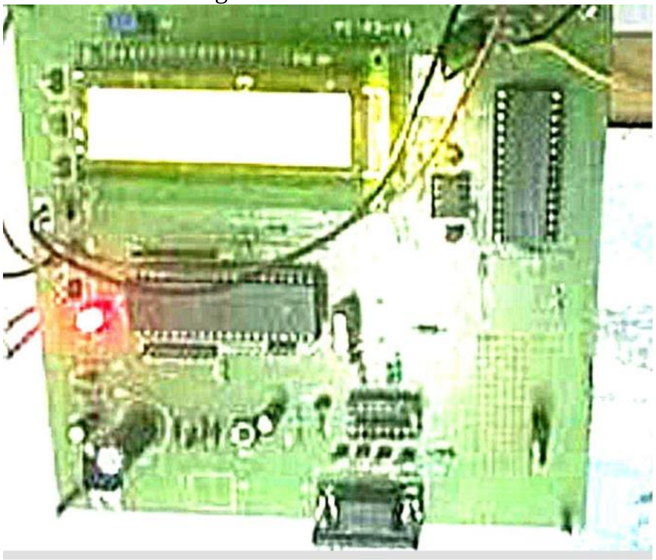

Fig -7: Force application generates force which charges battery

The electricity produced in such facilities is useful in nearby applications. This technology would facilitate the creation of new urban landscapes, sports arenas with stands, music halls, theatres, nightclubs and meeting places for large demonstrations, demonstrations and parties, train stations, bus stops, metro stations, airports, etc., which use human movement for power Generation. [10]

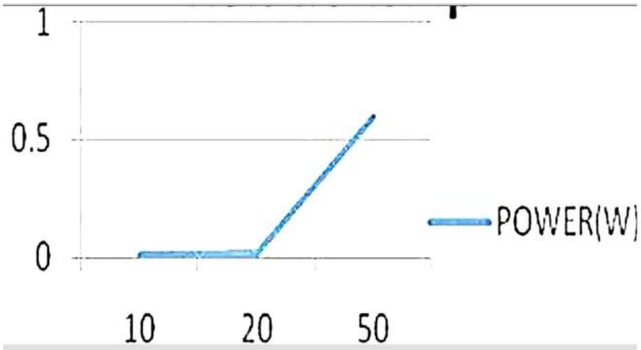

Fig -8: Weight versus power relationship

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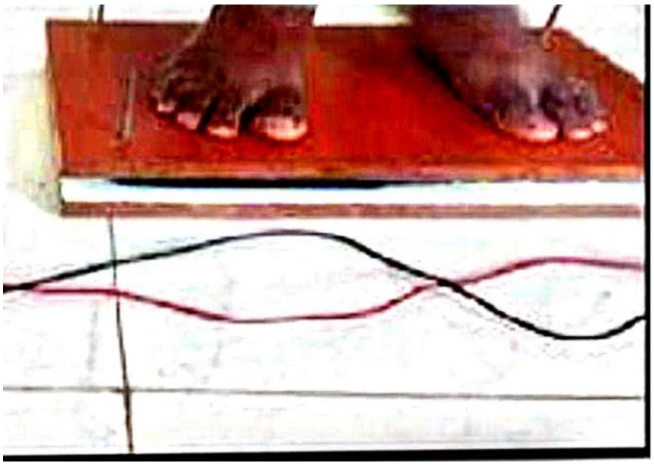

Fig -9: A 19V indicator showing by this arrangement

XI. CONCLUSIONS

The fundamental benchmarking and design criteria utilized in the approaches used to produce energy utilizing the step are relatively simple to comprehend from this review. Only the electrical component of the approach is essential. As a result, the system is simple to use and keep up. As a result, for a system to be used throughout an urban region, more design factors should be taken into account. One of the issues is the creation and usage of energy. There are many renewable and non-renewable energy sources available today, yet we still cannot produce more energy than we require. One of the resources is the population of people. Walking down the stairs will give you energy. The generated energy is then stored for later use in the home. This system can be put in places where people travel around the clock, such as residences, schools, and universities. People's weight generates the force when they step on a boom or platform. The mechanical energy that is delivered to the glass as electrical energy passes through a piezoelectric sensor on the actuator. On a level surface, vibration happens when pressure or effort is exerted to the foot. "Build and create an automatic toll booth based on microcontroller, RFID technology, and load cell (piezoelectric sensor)" to save time and money at the toll booth. The primary focus of this article is automation, as implied by the title "Automated Payment." The term "automation, then, simply refers to the technological replacement of human processes. It refers to what a person is doing right now in relation to a task that a machine is performing. Let's take a quick look at the evolution of paid concerts before continuing. Hence, all manual control over paid websites existed before the 1990s. [6]

DECLARATION

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Ethical Approval and Consent to Participate	No, the article does not require ethical approval and consent to participate with evidence.
Availability of Data and Material/ Data Access Statement	Yes, it is relevant. Availability of Data and Material are mentioned in the references section.
Authors Contributions	A distinction is made between five types of contributions: Conceived and designed the analysis; Collected the data; Contributed data or analysis tools; Performed the analysis; Wrote the paper. In this paper the contribution of Mr. Mohd.Faizan is collection of data and analysis of the tool and performance of the machine. The contribution of Mr. Himanshu Singh is writing the Paper, Designing the proposed Model and also Finding the research gap. The contribution of Mr. Harsh Pandey is in assembly of Product and Data collection. The Final approval of the version to be published is done by Mr. Mohd.Faizan.At the end we are very thankful to him for his guidance.

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