

# ADVANCED FOOT STEP POWER GENERATION SYSTEM

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**ABSTRACT:** Power generation and its use is one of the issues. Now-a-days numbers of power sources are present, non-renewable & renewable, but still we can't overcome our power needs. Among these human population is one of the resources. In this project we are doing generation of power by walking or running. Power can be generated by walking on the stairs. The generated power will be stored and then we can use it for domestic purpose. This system can be installed at homes, schools, colleges, where the people move around the clock. When people walk on the steps or that of platform, power is generated by using weight of person. The control mechanism carries piezoelectric sensor, this mechanical energy applied on the crystal into electrical energy. When there is some vibrations, stress or straining force exert by foot on flat platform. It can be used for charging devices e.g. laptop, mobile, etc.

**Index Terms:** Power utilization, Power generation, piezoelectric material, energy utilization.

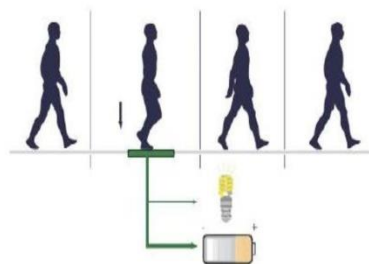
## I. INTRODUCTION

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 are 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. Using the principle called piezoelectric effect.

Piezoelectric effect is the effect in which mechanical vibrations. Pressure or strain applied to piezoelectric material is converted into electrical form. This project gives idea about how energy is used on stepping on stairs. The use of stairs in every building is increasing day by day even small building has some floors when we are stepping amount of this wasted energy is utilized and converted to electricity by Piezoelectric effect. Piezoelectric effect is the effect of specific materials to generate an electric charge in response to applied mechanical stress.

## II POWER GENERATION USING FOOT STEP METHOD

In this electric power is generated as non-conventional method. Thus the generation of power is by walking or running on foot step. At this time non-conventional energy is very important. This system introduces power generation using non-conventional energy which does not need any input to generate electrical output. In this conversion of force energy into electrical energy takes place.



**Fig 1: Schematic representation of the working model**

### A Working

Key concept of working of this system is capturing unused energy from surrounding any system and converting it into electrical energy. The piezoelectric placed under insulating material like hard rubber and pressure created by foot step and water

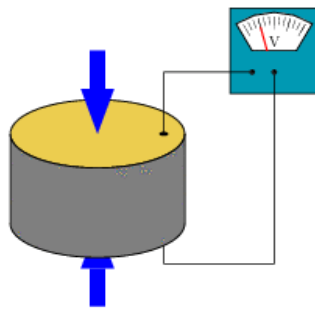
fall pressure will produce electrical energy which can be stored and used for domestic purpose. The property of Piezoelectric Material is to generate electricity when we apply pressure. It has two axis, mechanical axis & electrical axis. When we apply pressure in mechanical axis, it generates power in its electrical axis. Piezo means the generation of the electrical polarization of a material as a response to mechanical strain. This phenomenon is known as direct effect or generator effect and is applied fundamentally in the manufacture of sensors (mobile phone vibrators, lighters, etc.). In these cases piezoelectric materials, also used in actuators, undergo an inverse or motor effect, i.e. a mechanical deformation due to the application of an electrical signal.

#### B Commercial Utility:

- (i) Along the central crossing between London's Olympic stadium and the recently opened Westfield Stratford City mall 20 tiles will be scattered within estimated footfall of 30 million people in the first year.
- (ii) In front of ticket counters and every time a passenger steps on the mats, special flooring tiles were installed and they trigger a small vibration that can be stored as energy.
- (iii) We can implement this system in the floor area of stairs, schools and colleges where thousands of students are studying.

### III FOOT STEP POWER GENERATION USING PIEZOELECTRIC TRANSDUCER

Electricity has become lifeline for human population. Demand of electricity is increasing day by day. Some technology needs high amount of electrical power to perform various operations. As we know electricity is generated by some sources like water, wind etc. To generate the electricity from these resources, development of big plants or big mills is needed having high maintenance cost. As the use of energy is increases, no of energy resources are generated and wasted. If the wastage of energy is rapidly increases then one day will come at that time we will face totally absence of energy.



**Fig 2: Basic Piezo transducer**

This technology is based on principle of piezoelectric effect which has ability to build up electrical charge from pressure and strain applied to them. Piezoelectric ceramics belongs to the group of ferroelectric materials. These materials are the crystals and they do not need electric field being applied. Piezoelectric ceramics like  $\text{PbTiO}_3$ ,  $\text{PbZrO}_3$ , PVDF and PZT. Most commonly available piezoelectric materials are PZT and PVDF.

#### A. Study of connections-

To give better voltage and current three PZT are connected in series .A force sensor and voltmeter is connected to this series combination. As varying forces are applied on this connection and corresponding voltages are noted. Voltage and current generated across the series connection is measured. The voltage and current generated across the parallel connection is measured. From series connection obtained current is poor and from parallel connection obtained voltage is poor. To overcome this problem rectifier in series-parallel connection issued.

#### B. Working-

Piezoelectric material converts pressure into electrical energy. The pressure can be either from weight of moving vehicles or from the weight of people walking on it. The produced output is in the variable form .so bridge circuit is used to convert variable voltage into linear voltage and it is stored in rechargeable battery. Two possible connections were tested-parallel and series connections for producing 40v output. The voltage produce across the time can be displayed on LCD.

A piezo tile capable of generating 40v. The weight applied on tile and corresponding produced voltage is referred and linear relations found.

### IV POWER HARVESTING BY USING HUMAN FOOT STEP

In this paper use of piezoelectric crystal is to generate electric output from surrounding vibration. Piezoelectric materials have crystalline structure. They can convert mechanical energy into electrical energy and vice versa. The produced electrical

energy from piezoelectric crystal is very low in the order of 2-3 volts and is stored in battery to charge controller, since it is not possible to charge 12v battery through crystal output. To increase the voltage, the boost converter circuit is used. The level of voltage ranges 12v and it is stored in 12v battery.

#### A. Piezoelectric effect-

They also use piezoelectric crystal. The piezoelectric crystal exhibit the piezoelectric effect. This piezoelectric effect having two properties. First one is the direct piezoelectric effect which means that material has ability to convert mechanical strain into electrical charge. Second one is the converse effect, in which the applied electrical potential converted into mechanical strain energy. That means material used as power harvesting medium.

#### B. Working-

This system arranged for the requirement of taking 230v AC from 12v DC input. After this a voltage regulator 7805 feeds the microcontroller which is used to control the LCD display and other components presented. This input signal given to DC to battery to store the produced energy. Then the 12v is given to another voltage regulator 7805 for 5v output to the loads. This stored energy then utilized by the loads connected like LED's, USB devices. The LCD display will gives the voltage generated for every footstep and the footstep count.

### V POWERGENERATION

Today the major problem which is discussed rapidly energy crisis and ideal solution for this is adaptive renewable energy resources. Among all the energy sources like solar energy tidal energy, human population is also abundant energy resource that has not been yet normally in used. Using this resource expected amount of energy can be generated thus it may be ideal to generate the electricity from human population.

When people walk on the floor then electricity is generated due to weight of person as this system utilizes the parameter pressure to generate energy. This generated energy is stored in the batteries. This system will generate efficient outcome if installed in populated area. Implementation of this project will turn into boon in generation of electricity from the pressure byfootsteps.

The places in India where we can implement this system are roads, railway stations, bus stands where millions of people move round the clock. When people walk on the floor their body weight compresses the setup which piezoelectric transducer compresses and generates electrical energy and then it is stored in the battery.

#### A. Principle

The principle of the working of this system is conversion of pressure from foot steps into electrical output. The amount of electrical output depends upon the pressure by the weight of person walking on the floor.

#### B. Construction and Working

The system consists of blocks that depress slightly under pressure of human steps and which will depress the piezo transducer setup placed immediately after it inside the system. This consists of piezo sensors bottom platform and compressible top platform. System also consists of weighting platform, voltage regulators, microprocessor, LEDs, LCD display and diodes.

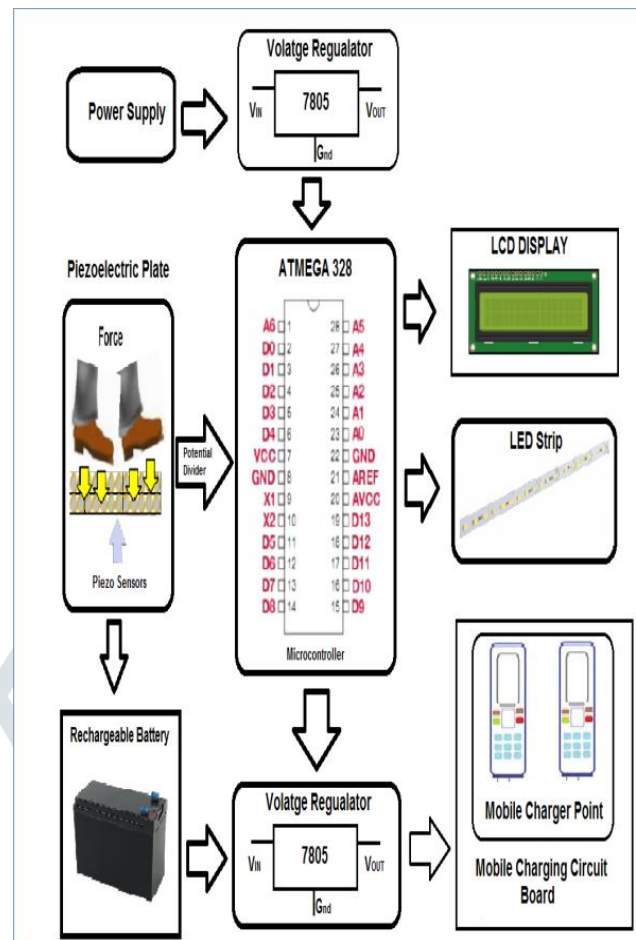
When people walk on the floor, the piezo electric transducers converts mechanical pressure into the voltage directly as the property of a piezo electric transducer is that to produce electrical output at its terminals and then the electric current and power is obtained.

This process depends on the factor, the weight as a function of pressure. When the pressure is applied through a foot step, ninety-five percent of the pressure applied is converted into energy in this method.

### VI PROTOYPESYSTEM

#### FOOT STEP POWER GENERATION USING PIEZOELECTRIC MATERIAL

The piezoelectric material converts the pressure, stress applied to the material into electrical energy. The source of stress is from the weight of the people stepping on the stairs. As the output voltage from a single piezo-film was extremely low, thus combination of few piezoelectric is used. Two types' possible connections can be done parallel connections and series connections. The output of the piezoelectric material is not a regulated one, so variable to linear voltage converter circuit rectifier is used and then it can be pass through regulator in order to regulate. The output of the voltage regulator is given to the unidirectional current controller. Unidirectional current controller means it allows flow of current in only one direction.



**Fig 3: Block diagram of the whole system**

Mostly used unidirectional current controller devices are as follows:

1. Diode- we already know that it allows an electrical current in one direction. It acts like a switch. A specific diode converts AC into pulsating DC hence sometimes it also called as rectifier.
2. Thyristor-A thyristor is four layer semiconductors that are often used for handling large amount of power. While a Thyristor can be turned on or off, it can also regulate power using something called phase angle control.
3. Atmega328- A microcontroller Atmega328 is used in this system to control the devices connected in the circuit. It controls the LCD display by means of displaying the output voltage generated and the number of footsteps counted on the piezoelectric transducer platform. Also the LED strip and USB port is connected to the microcontroller to glow the LED and to supply the power to the loads through USB.

The output voltage from this piezoelectric is then stored in a battery. LCD display is used for displaying generated voltage. For this purpose microcontroller Atmega328 is used. The microcontrollers consist of crystal oscillator and which is used for its operation. The output of the microcontroller is then given to the LCD which then displays the voltage levels.

From this system we are generating energy by human footsteps using the piezoelectric effect. Piezoelectric effect is the effect which converts mechanical stress, strain, pressure into electrical energy. This idea not only overcome the energy crises problem but also helps to maintain the eco- friendly environment for generating energy.

## VII CONCLUSION

A piezo tile capable of generating 40V has been devised. Comparison between various piezo electric material shows that PZT is superior in characteristics. Also, by comparison it was found that series- parallel combination connection is more suitable. The weight applied on the tile and corresponding voltage generated is studied and they are found to have linear relation. It is especially suited for implementation in crowded areas. This can be used in street lighting without use of long power lines. It can also be used as charging ports, lighting in buildings.

### A. Future Scope:

Utilization of wasted energy is very much relevant and important for highly populated countries in future.

#### 1. Flooring Tiles-

Japan has already started experimenting the use of piezoelectric effect for energy generation. They implement piezoelectric effect on the stairs of the bus. Thus every time passenger steps on the tiles; they trigger a small vibration that can be stored as energy. The flooring tiles are made up of rubber which can absorb the vibration. This vibration generates when running or walking on it. Under these tiles piezoelectric material are placed. When the movement is felt by the material they can generate the electricity. This generated energy is simultaneously stored into the battery. Generated electricity we can use the lightning of lamp or street light. Energy is generated by step of one human being is too less but if number of steps increases ultimately energy production also increases

#### 2. Dance floors-

Europe is another one of the country which started experimenting use of piezoelectric crystal for energy generation in night clubs. Floor is compressed by the dancer's feet and piezoelectric materials makes contact and generate electricity. Generated electricity is nothing but 2-20 watt. It depends on impact of the dancer's feet. If constant compression of piezoelectric crystal causes a huge amount of energy.

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