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Footstep Power Generation Using Piezoelectric Material

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Abstract: ***In the day-to-day life, the utilization of power turns of being necessary for each work. This paper focuses on designing a setup that leads to the generation of electrical energy which is going to waste when humans are walking. There are different methods used to produce energy like conventional and non-conventional methods. 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 purposes. The paper proposes a novel technique for the creation of power utilizing piezoelectric sensors kept along the footpaths which can be ready to charge the battery and ready to supply the force at whatever time of our prerequisite. The non-conventional energy system is very essential currently to our nation. Nonconventional energy using footstep is converting mechanical energy into Electrical Energy. Due to this a lot of energy resources have been exhausted and wasted. This system can be installed at homes, schools, colleges, where people move around the clock. The footstep power generation technique through piezoelectric sensors produces electrical force by changing piezoelectric force generation framework is that is sheltered and secure to utilize it does not make any issue or distress for the general population strolling through the footpath, and it is a free strategy. This project will be cost-effective and easy to be installed in populated areas like railway stations, bus stands, and shopping malls. Our project is cost-effective and easy to implement.***

Keywords: Piezoelectric sensors, Battery, Electricity, Footstep Power Generation

I. INTRODUCTION

Power assumes a critical part of being developed of the county. Power is characterized asset of physical wonder connected with the stream of charge. The process of producing electrical power from different types of energy sources is called electricity generation. Whether we realize it or not, energy is an important part of most aspects of daily life. The quantity of life and even is sustenance, depends on the availability of energy. The objective of this invention is to use them in increasing of human population and give a high impact in increasing the energy while reducing and negative effect on the environment. This utilizes power also does not depend or rely on the climate condition. In India, places like roads, railway stations, bus stands, are all overcrowded, and millions of people move round the clock. The average human footstep can take about 3000 -5000 steps a day. This footstep can generate more electricity to achieve the demand needed. Therefore, here we will explain a new technique for electricity generation. This new technique works on the law of conservation of energy “energy neither created nor destroyed it can change its form”. Footstep power generation system is designed to be especially useful at public places like railway stations, bus stands, shopping malls where a lot of people keep walking all day. The piezoelectric effect is the effect in which mechanical vibration pressure or strain applied to piezoelectric material is converted into electrical form. This project gives an 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. The piezoelectric effect is the effect of specific materials to generate an electric charge in response to applied mechanical stress.

A. Piezoelectricity

Piezoelectricity is the electric change the accumulates in certain solid materials (such as crystals, certain ceramics) in response to applied mechanical stress. This technology is based on the principle of the piezoelectric effect which has the ability to build up an electrical charge from pressure and strain applied to them. Piezoelectric ceramics belong to the group of ferroelectric materials. The most commonly available piezoelectric materials are PZT and PVDF. Piezoelectric material converts pressure into electrical energy.

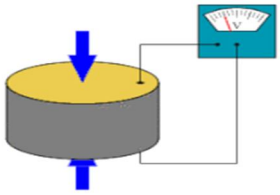

Fig. Piezoelectric Transducer

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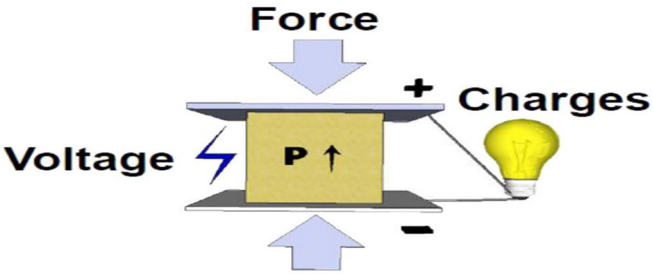
B. Piezoelectric Material

There are many materials, both natural and man-made, that exhibit a range of piezoelectric effects. Some naturally piezoelectric occurring materials include Berlinite (structurally identical to quartz), cane sugar, quartz, Rochelle salt, topaz, tourmaline, and bone (dry bone exhibits some piezoelectric properties due to the apatite crystals, and the piezoelectric effect is generally thought to act as a biological force sensor). An example of man-made piezoelectric materials includes barium titanate and lead zirconate titanate. In recent years, due to the growing environmental concern regarding toxicity in lead-containing devices and the RoHS directive followed within the European Union, there has been a push to develop lead-free piezoelectric materials. To date, this initiative to develop new lead-free piezoelectric materials has resulted in a variety of new piezoelectric materials which are more environmentally safe.

C. Implementation of Piezoelectric Materials

Due to the vibrations, a piezoelectric crystal generates electrical power. The produced output voltage is in the form of ac. Then it can be converted to dc by passing it through a rectifier circuit. The converted dc voltage can be fed into a boost converter.



They also use piezoelectric crystals. The piezoelectric crystal exhibits the piezoelectric effect. This piezoelectric effect having two properties. The first one is the direct piezoelectric effect which means that material has the ability to convert mechanical strain into electrical charge. The second one is the converse effect, in which the applied electrical potential is converted into mechanical strain energy. That means material used as power harvesting medium. This system arranged for the requirement of taking 230v AC from 12v DC input. After this a voltage regulator 7805 feds the microcontroller which is used to control the LCD display and other components present. This input signal is given to DC to the 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 is then utilized by the loads connected like LED's, USB devices. The LCD display will give the voltage generated for every footstep and the footstep count.

II. ELEMENTS FOOTSTEP POWER GENERATION UNIT

A. Piezoelectric Sensor

Piezoelectric sensors are versatile tools for the measurement of various processes. They are used for quality assurance, process control, and for research and development in many industries. Pierre Curie discovered the piezoelectric effect in 1880, but only in the 1950s did manufacturers begin to use the piezoelectric effect in industrial sensing applications. Since then, this measuring principle has been increasingly used and has become a mature technology with excellent inherent reliability.

Fig. Piezoelectric Sensor

B. Unidirectional Current Controller

As the name indicates this circuit allows only one direction current. following some devices which are used as unidirectional current controller.

1) Diode

2) Thyristors

The output voltage from this piezoelectric is then stored in a battery. The LCD display is used for displaying generated voltage. For this purpose, microcontroller Atmega328 is used. The microcontrollers consist of a 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. The piezoelectric effect is the effect that covers mechanical stress, stain, pressure into electrical energy. This idea not only overcomes the energy crisis problem but also helps to maintain an eco-friendly environment for generating energy.

III. POWERGENERATION

Today the major problem which is discussed rapidly energy crisis and the ideal solution for this is adaptive renewable energy resources. Among all the energy sources like solar energy tidal energy, the human population is also an abundant energy resource that has not been yet normally used. Using this resource expected amount of energy can be generated thus it may be ideal to generate electricity from the human population. When people walk on the floor then electricity is generated due to the weight of the person as this system utilizes the parameter pressure to generate energy. This generated energy is stored in the batteries. This system will generate efficient outcomes if installed in a populated area. Implementation of this project will turn into a boon in the generation of electricity from the pressure by footsteps. 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 in which the 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 the conversion of pressure from footsteps into electrical output. The amount of electrical output depends upon the pressure by the weight of a person walking on the floor.

B. Working

The system consists of blocks that depress slightly under the 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. The system also consists of a weighing platform, voltage regulators, microprocessor, LEDs, LCD display, and diodes. When people walk on the floor, the piezoelectric transducers convert mechanical pressure into the voltage directly as the property of a piezoelectric 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 footstep, ninety-five percent of the pressure applied is converted into energy in this method.

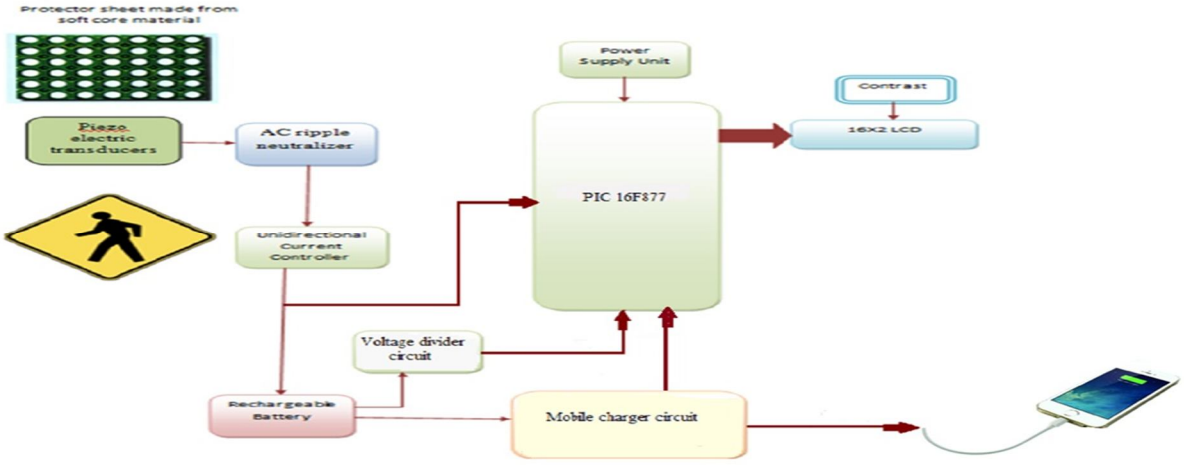


Fig: Block Diagram of the whole system

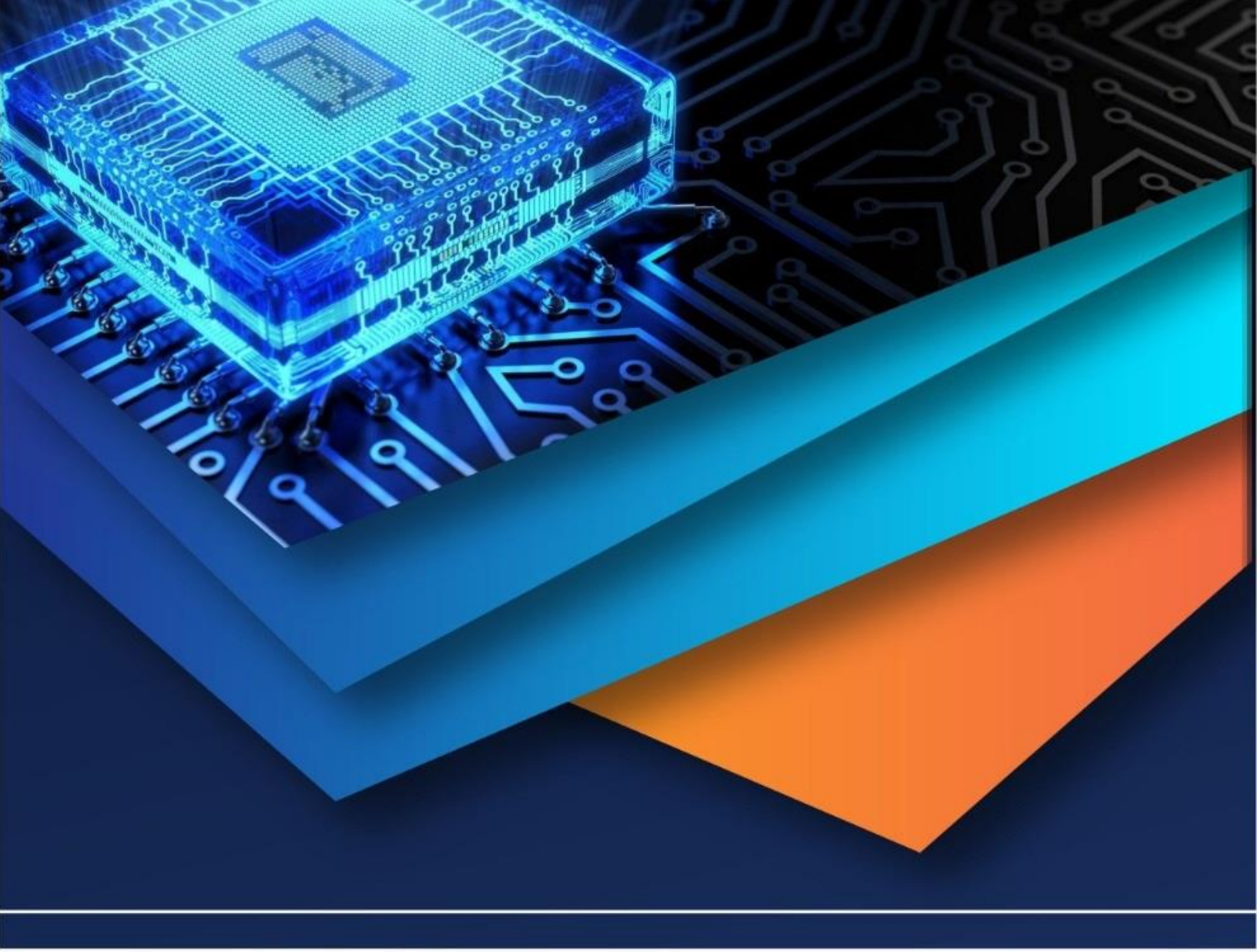
IV. CONCLUSION

A piezo tile capable of generating 40V has been devised. Comparison between various piezoelectric materials shows that PZT is superior in characteristics. Also, by comparison, it was found that a 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 the use of long power lines. It can also be used as charging ports, lighting in buildings.

A. Future Scope

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

1) *Flooring Tiles:* They implement the 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 materials are placed. When the movement is felt by the material, it can generate electricity. This generated energy is simultaneously stored in the battery. Generated electricity we can use the lightning of lamp or streetlight. Energy is generated by step of one human being is too less but if several steps increases ultimately energy production also increases.



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