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Footstep Power Generation System

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Abstract *– The Footstep Power Generation, here we proposed an advanced footstep power generator system that uses the piezo electricsensors to generate power through footsteps as a source of renewable energy that we can obtain while walking on a certain arrangement like stepping foot on a piezo tiles. This project describes the use of piezoelectric materials in order to harvest energy from people walking vibration for generating and accumulating the energy. The basic working principle of "footstep power generation system" isbased on piezo electric sensors. When the flooring is engineered with piezo electric technology, the electrical energy produced by the pressure is captured by floor sensors and converted to an electricalcharge by piezo-electric transducer. These sensors are placed in such a way that it generates maximum output voltage. This output is provided to our monitoring circuitry which is microcontroller based circuit that allows user to monitor the voltage and charges a battery, and this power source has many applications. Our project model is cost effective and easy to implement.*

Keywords-
piezoelectricity,footsteps,power,generation,energy conservation,force or pressure.

1. INTRODUCTION

At present, electricity has become a lifeline for human population. Energy is nothing but the ability to do the work. In day to day life, Electricity is most commonly used energy resource.[2] Its demand is increasing day by day. Modern technology needs a huge amount of electrical power for its various operations. 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. In this electric power is generated as non-conventional method. And this wasted energy can be converted into electricity using the principle called piezoelectric effect. Piezoelectricity effect refers to the ability of some materials to generate an electric potential in response to applied pressure. piezoelectric material can provide the magic of converting pressure exerted by the moving people into electric current. A tile is made from piezo material for stepping on it. The voltage generated across a piezo tile is supplied to a battery for it to get recharge and supply it to the dc loads. Voltage generated is also given to an microprocessor. A LCD is interfaced to the tile using a PIC microcontroller to display the voltage generated across the piezo tile.

II. RESEARCH ELEBORATIONS

A. STUDY OF PIEZOELECTRIC SENSORS

Piezoelectric materials are being more and more studied as they turn out to be very unusual materials with very specific and interesting properties. In fact, there materials have the ability to produce electrical energy from mechanical energy for example they can convert mechanical behavior like vibrations in to electricity. Such devices are commonly referred to as energy harvesters and can be used in applications where outside power is unavailable and batteries are not a feasible option. While recent experiments have shown that these materials could be used as power generators, the amount of energy produced is still very low, hence the necessity to optimize them. Piezoelectric materials have two properties that are define as direct and converse effect. Direct effect is the property of some materials to develop electric change on their surface when mechanical stress is exerted on them, while converse effect is the property of some materials to develop mechanical stress when an electric charge is induced. The piezoelectric sensors has very high frequency response and is self generating, so need of external source. It is simple to use as they have small dimensions and large measuring range.

B. BEIDGE RECTIFIER

Full-bridge rectifier is commonly used as rectifier circuits to convert the AC output of a piezoelectric into a DC voltage. The rectifying circuits consist of 4 diodes. The voltage needs to rectify due to the need for constant supply of voltage light up the series of LED placed in parallel. A bridge rectifier provides full-wave rectification from a two wire AC input, resulting in lower cost and weight as compared to a rectifier with a three wire input from a transformer with a center tapped secondary winding.

C. LEAD ACID BATTERY

Battery an array of electrochemical cells for electricity storage, either individually linked or individually linked and housed in a single unit. An electrical battery combination of one or more electrochemical cells, used to

convert stored chemical energy into electrical energy. Battery standby power applications. Miniature cells are used to power devices such as hearing aids and wristwatches; larger batteries provide standby power for telephone exchanges or computer datacenters.

D. VOLTAGE DIVIDER CIRCUIT

Voltage divider lowers the voltage to the level of microcontroller. We can't fed 12 volt directly to microcontroller. Voltage divider is used to divide the voltage. After that microcontroller reads the analog voltage and displays on the LCD. If you don't know how to measure dc voltage using microcontroller, dc voltmeter using microcontroller project can help you to get its good understanding.

E. LOADS

The USB charging converter convert 12V dc to 5V dc. It consist of IC-AD84064, capacitor, diode and LED. All of this component convert voltage to charge device like as Mobile, IPod, Tab, MP3 devices, and charger light etc. All the rechargeable equipment will be charged.

III. POWER HARVESTING BY USING HUMAN FOOTSTEP

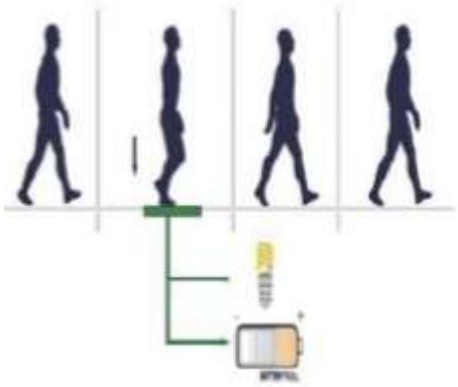
In this paper use of piezoelectric crystal is to generate electric output from surrounding vibration. Piezoelectric materials have crystalline structure. They can convert mechanical energy into electrical energy and vice versa. The produced electrical energy from piezoelectric crystal is very low in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

A boost converter is also called as step-up-converter. It is a power converter having greater output DC voltage than its input DC voltage. It is same as switching mode power supply having at least two semiconductor switches (a diode and a transistor) and at least one energy storage element. Capacitor filter is added output of converter to reduce the ripple in the output voltage. The basic principle of boost converter having two modes of operation, continuous and discontinuous mode.



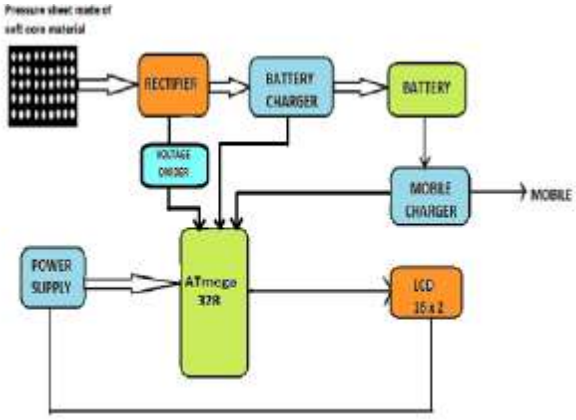
II- LITERATURE SURVEY

IV. HARDWARE IMPLEMENTATION

A. CONSTRUCTION OF PIEZOELECTRIC TILES

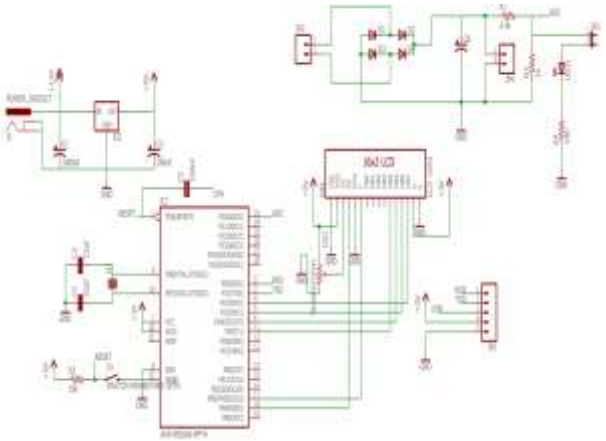
For Piezoelectric tile, a tile of dimension 26cm x 20cm is taken. The thickness of the tile is 0.8mm.To implement and protect the piezo-electric sensors a PU(i.e poly urethien) sheet is placed on a tile. This PU sheet is of 0.3mm. On this sheet 30 piezo-electric sensors are placed. As the power output from a single piezo-film was extremely low, combination of few Piezo films is investigated. Two possible connections were tested - parallel and series connections. The parallel connection did not show significant increase in the voltage output. With series connection, additional piezo-film results in increased of voltage output but not in linear proportion. So here a combination of both parallel and series connection is employed for producing voltage output with high current density. One more tile of same dimension is taken to place on the first tile, So that it can be pressed by the foot. Between these two tiles springs are placed at the corners and nails are placed on the second tile equivalent to the sensors at the centre of tile in 6 x 5 arrangement. And thus, the piezo-electric tile is ready for stepping.

B. BLOCK DIAGRAM AND ITS DESCRIPTION



The system consists of blocks that depress slightly under pressure of human steps and which will depress the mechanical setup placed immediately after it inside the system. This consists of immovable bottom platform and compressible top platform. The piezoelectric material converts the pressure applied to it into electrical energy. The source of pressure can be either from the weight of the moving vehicles or from the weight of the people walking over it. The output of the piezoelectric material is not a steady one. So a bridge circuit is used to convert this variable voltage into a linear one. Again an AC ripple filter is used to filter out any further fluctuations in the output. The output dc voltage is then stored in a rechargeable battery. The LCD is interfaced with the microcontroller ATMEGA328P for programming purpose. The battery charger is connected to Microcontroller ATMEGA328P to display on LCD that the battery is getting charged. In the similar way the mobile charger is also connected microcontroller to display that the mobile is getting charged. The 5V power supply is given to the microcontroller and the LCD. With the mobile charger we can charge mobiles also this generates electricity can be used to drive other DC loads.

V. WORKING



The schematic diagram is shown in above figure. A tile made up of piezo material generates voltage across a piezo tile which is supplied to a bridge rectifier circuit to obtained DC voltage and given to a rechargeable battery and thus the battery gets charged and this can be used to drive DC loads. The battery used here is a Lead Acid Battery of 6V. A LCD is interfaced with microcontroller. The microcontroller used here is ATMEGA 328P which is 8-bit,32kb flash with 1k RAM and has 16MHz speed. The 16 x 2 LCD is used to display the voltage generated by the piezo-electric tile. The crystal oscillator is connected to microcontroller which is used to give clock signal. The power supply unit is used to supply power to microcontroller and LCD.

This unit consist of an IC called IC7805 which will convert the 12V to 5V.

VI. RESULT AND FINDING

If in 1 square ft. Area 30 piezo sensor are used.

As piezo sensors power generating varies with different steps, get Minimum voltage=1 V per step

Maximum voltage=10V per step

If an average of 50 Kg weight pressure from single person is taken,Considering the steps of a 50 Kg weighted single person, the average calculation is:

It takes 800 steps to increase 1 V charge in battery.

So, to increase 12 V in battery

Total steps needed =(12 × 800) =9600 steps

As this project is implemented in a populated area where foot step as source are available, if an average of 2 steps in 1 second are taken . For 9600 steps time needed =9600/(60 × 2) =80 minutes. (Approximately)

FUTURE ASPECTS

In future aspects we can use this principal in the speed breakers at high ways where are rushes of the vehicals too much thus increases input torque and ultimate output of generator, If we are used this principle at very busy stairs palace then we produce efficient useful electrical for large purposes.

ADVANTAGES

1. Power generation is simply walking on the step.
2. Power also generated by running or exercising on the step.
3. No need of fuel input.
4. This is non-conventional system.

APPLICATIONS

This can be used in very populated places such as,
1. Colleges
2. Cinema Theatres
3. Shopping Complex
4. Railway Stations

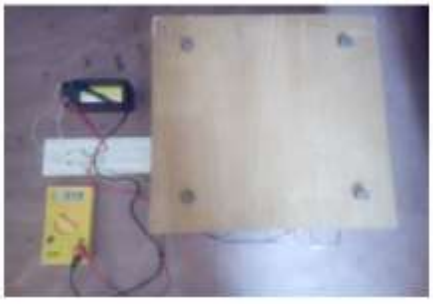


Figure 5: Connected allloads

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