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Advance Footstep Power Generation System

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Abstract - To generate the power through footsteps is a source of renewable energy sources that we can obtain while walking on a certain arrangement like stepping foot on piezoelectric tiles. An advanced footstep power generation system proposed here uses the piezoelectric sensors. To generate a voltage from footstep the piezo sensors are mounted below the platform. To generate maximum output voltage the sensors are placed in such an arrangement. This is then forwarded to our monitoring circuitry. The circuit is the microcontroller based monitoring circuit that allows users to monitor the charges and voltage a connected battery to it and this power source has many applications. It also displays the charge generated by our footstep and displays it on an LCD. Also, it consists of a USB mobile phone charging point where a user may connect cables to charge the mobile phone from the battery charge. Thus we charge a battery using power from footsteps, display it on LCD using a microcontroller circuit and allow for mobile charging through the setup. Our project model cost is effective and easy to implement and also it is green and not harmful to the environment.

Key Words: Piezoelectric, Renewable Energy Sources, Microcontroller, Battery, LCD.

1. INTRODUCTION

Energy is nothing but the ability to do work. Power has turned into help for the human populace nowadays. Its request is expanding rapidly. In day to day, life innovation needs an immense measure of electrical power for its different activities. Power generation is the single largest wellspring of contamination in the world. Due to which numerous energy resources are produced and wasted. Electricity is generally generated from resources like water, wind, coal, etc. for generating the electricity from these resources development of big plants that are needed having high maintenance and high cost. In like manner, it is the target of the present development to give the technique for electrical power generation from which regularly expanding human populace that does not adversely affect the natural resources. This innovation depends on a rule called the piezoelectric effect impact, in which certain materials can develop an electrical charge from having weight, the strain applied to them. The piezoelectric effect is the effect of specific materials to generate the electric charge in response to applied mechanical stress on it. It is the effect in which mechanical vibrations, pressure or strain applied to the piezoelectric material are converted into electrical form. Piezoelectricity alludes to the capacity of a few materials to produce an electric potential in light of connected weight. The inserted piezoelectric material can give the enchantment of the changing overweight applied by moving individuals into the electric current, which is stored in a battery.

1.2. RESEARCH METHODS:

In this study, lead zirconate titante (PZT) piezoelectric transducer has been used to harvest the kinetic energy from the footstep. The output voltage of this piezoelectric transducer is dependent to the structure of the ceramic and magnitude of strain and stress that applies on its structure. This transducer has diameter of 5 cm crystalline structure. The common output voltage is around 0-12 V. However at instant impact on this transducer, it can achieve until 30 V while the output current is about 5 mA. There are two shape of PZT piezoelectric transducer that been considering in this study which are the circular shape and the square shape. The circular shape of piezoelectric transducer is more suitable to accept the stress or strain a Indonesian J Elec Eng & Comp Sci ISSN: 2502-4752 ρ Study on footstep power generation using piezoelectric tile (Anis Maisarah Mohd Asry) 595 the middle of the transducer meanwhile, the square shape of piezoelectric produce high output voltage when the strain or stress applied on the tip of the transducer. This circular shape piezoelectric transducer has been choosing because it is most suitable transducer for footstep rather than square piezoelectric transducer. The circular shape of piezoelectric give higher output voltage when testing on oscilloscope. This is due to the deflection on its structure when foot press is applied on it. The piezoelectric transducer is connected in series-parallel connection where the value of voltage as well as current output is both satisfactory. The output of the piezoelectric is in AC form. Before being stored in storage components such as battery or capacitor, it needs to be rectified into DC form then, supply it to the DC loads. In this study, the full wave bridge rectifier was used to rectify the output from the piezoelectric tile. The full wave bridge that is used in the study consists of four diodes and two capacitors as shown in Figure 1. One of the capacitors acts as smoothing capacitor to filter the output waveform and another one as a storage component to store the energy.

2. PROPOSED SYSTEM

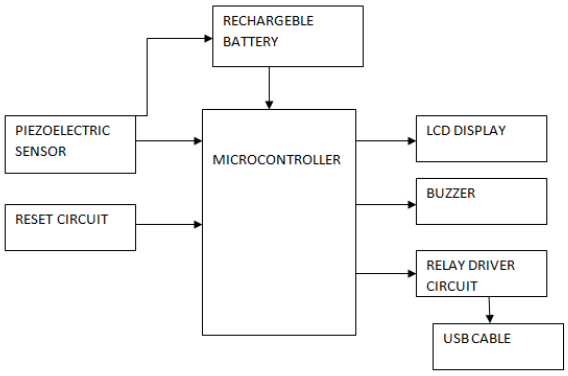

Fig -1: Block Diagram

The Footstep power generator works on the principle of piezoelectric effect impact. Piezoelectric Effect is the ability of certain materials for generating electric charges in response to applied mechanical stress on the piezoelectric plate. Thus, squeeze certain crystals and you can make electricity flow through them. In most crystals, the unit cell is symmetrical in piezoelectric crystals. Normally, the piezoelectric crystals are electrically neutral and atoms inside the piezoelectric plate may not be symmetrically arranged, but their electrical charges are perfectly balanced, the positive charge in one place cancels out a negative charge nearby them. However, if you squeeze or stretch the piezoelectric crystal, you deform the structure, negative, and causing net electrical charges to appear. This effect carries through a whole structure so net positive and negative charges appear on the opposite, outer faces of the crystal. Normally, the charges in the piezoelectric crystal are exactly balanced, even if they are not symmetrically arranged. If you squeeze the crystal (massively exaggerated in this picture!), you force the charges out of balance. Now the effects of the charges are no longer eliminated one another out and net positive and negative charges appear on opposite crystal faces. By squeezing a crystal, you have produced the voltage across its opposite faces and that's piezoelectricity. In this project, we have used the same phenomenon of producing piezoelectricity from the piezoelectric crystal in the form of a coin shape disc. FIGURE-2: Circuit Diagram of Advance Footstep Power Generating System. When one steps on a weighing machine the piezoelectric disc gets compressed. After the leg is lifted a crystal is decompressed. Thus a full vibration is sensed by a crystal disc and a voltage across it is produced. This voltage is sensed by a voltmeter and displayed on its display. Also, at the same time, this voltage is used to charge the 12V DC Battery. LED's have been mounted under the weighing machine that is switched on by relay through 555 timers IC whenever a voltage is generated. This event is notified by a glowing LED on the PCB. (Also one can hear the switching sound of the relay)Thus, whenever a person walks through a weighing machine the battery gets charged due to the voltage which is also displayed on the voltmeter. This event is notified by a glowing LED beneath the weighing machine.

2.1 PIC16f690 microcontroller:

The PIC16F range of microcontrollers from Microchip are 8-bit MCUs that incorporate Microchip's PIC® architecture into a variety of pin and package options, from space efficient 14-pin devices to feature-rich 64-pin devices. Devices with Baseline, Mid-Range or Enhanced Mid-Range architecture are available with numerous different peripheral combinations, giving designers flexibility and choice for their applications.

The PIC16F631/677/685/687/689/690 family of microcontrollers is based upon Microchip's Mid-range core with an 8 level deep hardware stack and 35 instructions. These MCUs provide up to 5 MIPS, up to 7 Kbytes program memory, up to 256 bytes RAM and Data EEPROM of up to 256 bytes. On board is a configurable oscillator factory calibrated to ±1% accuracy.

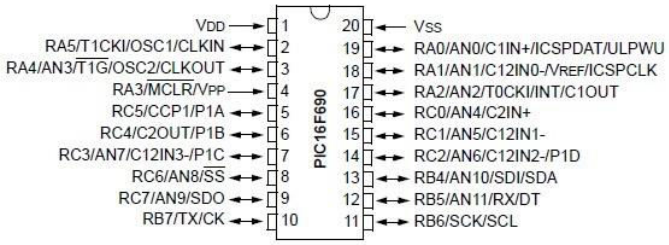

Fig -2: PIC16f690 Microcontroller

2.2 Piezoelectric Sensor:

When a force is applied to a piezoelectric material, an electric charge is generated across the faces of the crystal. This can be measured as a voltage proportional to the pressure (see diagram to the right).There is also an inverse piezoelectric effect where applying a voltage to the material will cause it to change shape. A given static force results in a corresponding charge across the sensor. However, this will leak away over time due to imperfect insulation, the internal sensor resistance, the attached electronics, etc. As a result, piezoelectric sensors are not normally suitable for measuring static pressure. The output signal will gradually drop to zero, even in the presence of constant pressure. They are, however, sensitive to dynamic changes in pressure across a wide range of frequencies and pressures.

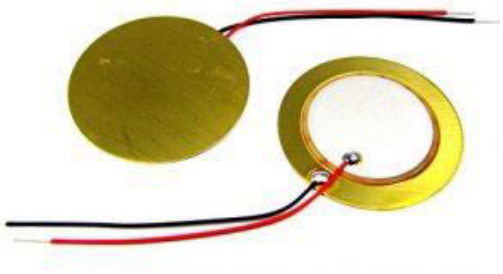

Fig -3: Piezoelectric Sensor

2.3. Relay Driver Circuit:

A relay driver circuit is a circuit which can drive, or operate, a relay so that it can function appropriately in a circuit. The driven relay can then operate as a switch in the circuit which can open or close, according to the needs of the circuit and its operation. Since DC and AC voltages operate differently, to build relay drivers for them requires slightly different setup. We will also go over a generic relay driver which can operate from either AC or DC voltage and operate both AC and DC relays. Now that we're using a transistor to drive the relay, we can use considerably less power to get the relay driven. Because a transistor is an amplifier, we just have to make sure that the base lead gets enough current to cause a larger current to flow from the emitter of the transistor to the collector. Once the base receives sufficient power, the transistor will conduct from emitter to collector and power the relay.

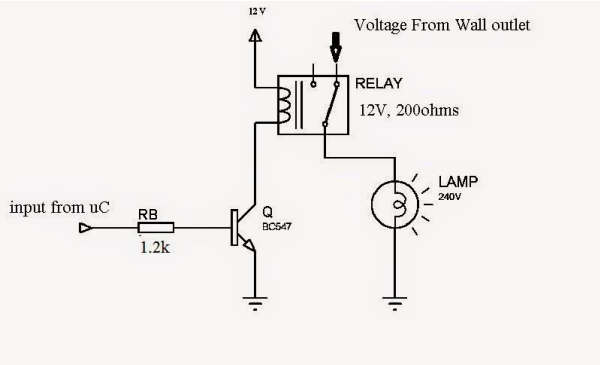

Fig -4: Relay Driver Circuit

3. ADVANTAGES:

Power generation is strolling on the step.

- No need for fuel input.
- This is the non-ordinary technique for producing power.
- No moving parts -long administration life.
- Self-producing-no outside power required.
- The system is reduced yet exceedingly touchy.
- It is Reliable, Economical, and Eco-Friendly.
- Less utilization of Non-sustainable power sources.
- Power is likewise produced by running or practicing on the progression.
- Extremely wide powerful range, free of commotion.
- No big industries required for generation.
- Very high-frequency response.
- Simple to use; they have small dimensions and large measuring range.
- Barium titanate and quartz can be made in any desired shape and form. It also has a large dielectric constant. The crystal axis is selectable by orienting the direction of orientation.

3. DISADVANTAGES:

The initial cost of this arrangement is high.

- Care ought to be taken for batteries.
- It isn't reasonable for estimation in static conditions.
- It is not suitable for measurement in static conditions.
- Since the device operates with a small electric charge, they need high impedance cable for electrical interface.
- The output may vary according to the temperature variation of the crystal.

3. CONCLUSIONS

The project undertaken is effectively tried and actualized which is the best conservative, reasonable vitality answer for average citizens of our country. This can be utilized for some applications in rustic zones where control accessibility is less or thoroughly truant. By utilizing this task we can drive both A. C. and besides, D.C loads as indicated by the power we connected on the piezoelectric sensor. This technique gives an effective power generation in very populated nations as it diminishes control request without contamination. As a reality, just 11% of sustainable power source adds to our essential vitality. On the off chance that this undertaking is sent at that point not just, we can conquer the vitality emergency issue yet, besides make a solid worldwide ecological change. A piezoelectric tile is capable of generating more voltage when longer the time taken. The longer the time taken means more footstep/force are applied on the tile. The linear relation is found between the voltage generated and the time taken. This piezoelectric are specifically suitable for the implementation in the crowded area such as pavement street, train ticket counter, stairs and dance floor. The piezoelectric tile is also suited for the exercise tile such as for skipping or on the treadmill. The power that is generated from this piezoelectric tile can be used to power up the light street, light along the stairs and also low power appliances.

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