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Advanced Footstep Power Generation System

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Abstract: The Advanced Footstep Power Generation System uses the piezo electric sensors to generate power. In this system footsteps acts as a source of renewable energy that we can obtain while striding on the arrangement of piezo tiles. A material prone to piezoelectricity is used to produce energy while people stepping on these will trigger electric charge for generating energy and the same energy is stored. When the flooring is contrived with piezo electric technology, the electrical energy produced by the pressure is captured by floor sensors and converted to an electrical charge by piezoelectric transducer. These sensors are placed in such a fashion that it generates maximal output voltage. This output is provided to a microcontroller based circuit that displays the voltage and charges a battery, and this power can be utilized for various applications .This project model is cost effective and easy to implement.

Keywords: Piezoelectric sensors, Boost Converter, LCD Display, Arduino Uno, Bridge Rectifier, Charging Circuit

I. INTRODUCTION

Due to excessive usage by people, a lot of energy resources are getting exhausted and wasted. The Proposal for the utilization of the waste energy of foot power with human locomotion is very much relevant and important for highly populated countries like India. The energy wastage can be converted into usable form by using the piezoelectric sensor. So by using this method, power is generated. Then, this system may generate voltage on each and every step of a foot.

Whenever a force is applied on piezoelectric sensor, that force is converted into electrical energy. In that movement, the output voltage is stored in the battery. The output voltage which is generated from the sensor is used to drive DC loads. LCD is used to display the amount of the battery getting charged. The output voltage stored can be used for various applications such as Mobile charging, LED light etc.

II. METHODOLOGY

The hardware components used in this project are piezo electric sensors, rechargeable battery, boost converter and the LCD display. All these components are interfaced to the Arduino Uno. By applying pressure on the piezo sensors, the voltage is generated and is displayed on the LCD.

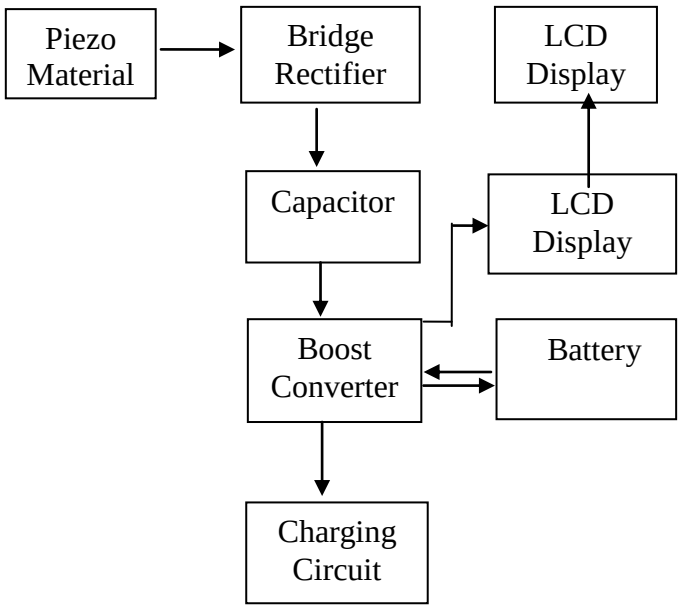

Figure1. Block Diagram

The Block Diagram of an Advanced footprint power generation system is as shown in figure 1. The piezoelectric transducer work on the principle of the piezoelectric effect. When mechanical stress or forces are applied to some materials along certain planes, they produce electric voltage. It basically converts kinetic energy into electrical energy.

The circuit is a microcontroller based monitoring circuit that allows user to monitor the voltage and charges a connected battery. It also displays the charge generated on an LCD display. Also it consists of a USB mobile phone charging point where user may connect cables to charge mobile phone from the battery charge. Thus we charge a battery using power from user footsteps, display it on LCD using microcontroller circuit and allow for mobile charging through the setup.

III. PIEZO ELECTRIC EFFECT

Piezoelectric Effect is the ability of certain materials to generate an electric charge in response to applied mechanical stress. When piezoelectric material is placed under mechanical stress, a shifting of the positive and negative charge centers in the material takes place, which then results in an external electrical field. When reversed, an outer electrical field either stretches or compresses the piezoelectric material. The principle of operation of a piezoelectric sensor is that a physical dimension, transformed into a force, acts on two opposing faces of the sensing element. The detection of pressure variations in the form of sound is the most common sensor application element. The detection of pressure variations in the form of sound is the most common sensor application.

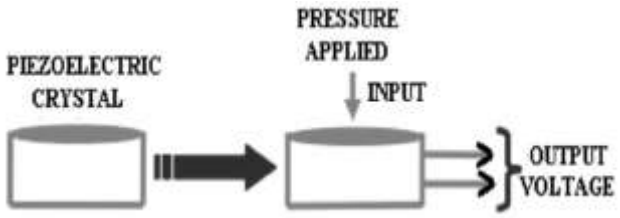

Figure2. Principle of piezoelectric effect

Quartz crystal becomes shorter due to electric field applied in reversed direction. It is self-generating transducer. It does not require electric voltage source for operation. The electric voltage produced by piezoelectric transduce is linearly varies to applied stress or force. Piezoelectric transducer has high sensitivity. So, it acts as a sensor and is used in accelerometer due to its excellent frequency of response. The piezoelectric effect is used in many application that involve production and detection of sound, electronic frequency generation.

IV. BOOST CONVERTER

A boost converter is a DC-to-DC power converter that steps up voltage from its supply to its load. It is a class of switched-mode power supply (SMPS) containing at least two semiconductors at least one energy storage element: a capacitor, inductor, or the two in combination. To reduce voltage ripple, filters made of capacitors, which are normally added to such a converter's output (load-side filter) and input (supply-side filter).

Power for the boost converter can come from any suitable DC sources, such as batteries, solar panels, rectifiers and DC generators. A process that changes one DC voltage to a different DC voltage is called DC to DC conversion. A boost converter is a DC-to-DC converter with an output voltage greater than the source voltage.

V. BRIDGE RECTIFIER

A Bridge Converter is an Alternating Current (AC) to Direct Current (DC) converter that rectifies mains AC input to DC output. Bridge Rectifiers are widely used in power supplies that provide necessary DC voltage for the electronic components or devices.

The input AC signal is applied across two terminals A and B and the output DC signal is obtained across the load resistor R_L which is connected between the terminals C and D.

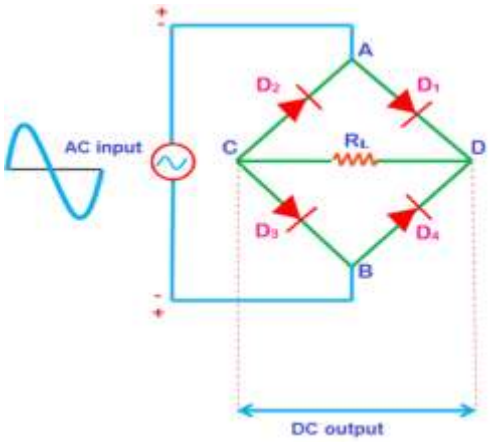

Figure3. Bridge Rectifier Principle

The four diodes D_1, D_2, D_3, D_4 are arranged in series with only two diodes allowing electric current during each half cycle. For example, diodes D_1 and D_3 are considered as one pair which allows electric current during the positive half cycle whereas diodes D_2 and D_4 are considered as another pair which allows electric current during the negative half cycle of the input AC signal.

When input AC signal is applied across the bridge rectifier, during the positive half cycle diodes D_1 and D_3 are forward biased and allows electric current while the diodes D_2 and $D_4$are reverse biased and blocks electric current. On the other hand, during the negative half cycle diodes D_2 and D_4 are forward biased and allows electric current while diodes D_1 and $D_3$are reverse biased and blocks electric current.

VI. PROJECT IMPLEMENTATION

All the hardware components are interfaced to the Arduino UNO. The footsteps are taken from the people by applying pressure on the piezoelectric material. The result is to be displayed on the LCD with the value of voltage that is generated due to each footstep. This voltage generated is being stored in the battery and can be used for charging electronic appliances.

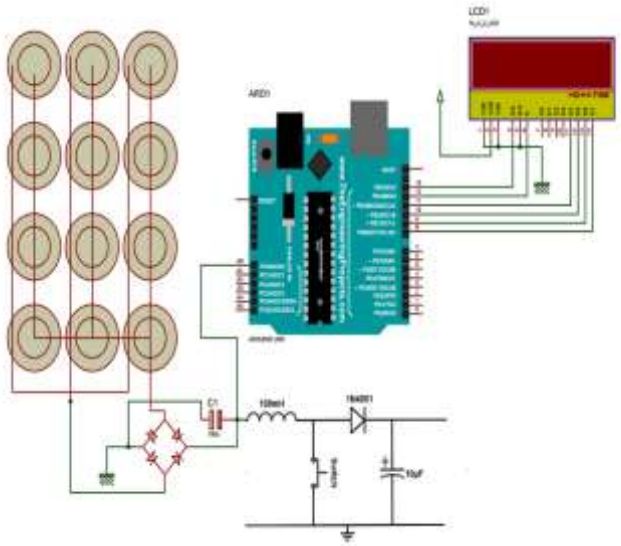

Figure4. Circuit Diagram

VII. RESULTS AND CALCULATION

When the pressure is applied on the footstep module the result is obtained as shown in figure 5 and figure 6. The value of the voltage will be displayed on the serial monitor as well as LCD display. The charging circuit is connected to the lithium ion battery. This is used for charging the electronic appliances.

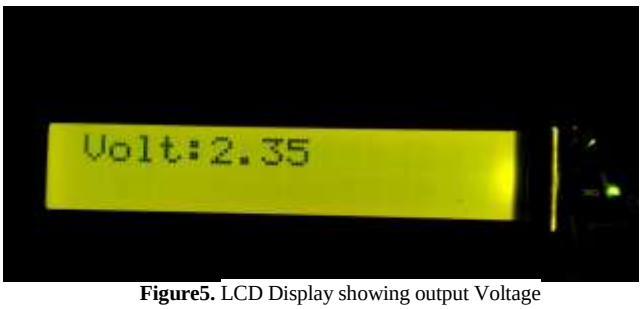

Figure5. LCD Display showing output Voltage

Figure6. Charging Circuit

VIII. CONCLUSION AND FUTURE SCOPE

The Project "ADVANCED FOOTSTEP POWER GENERATION SYSTEM" will provide the affordable energy solution. It is also best, economical as energy management is a big challenge for a huge population. It can be used for many applications such as Mobile Charging, Street Lighting, Bus station lighting, Emergency power failure stations, Colleges, Schools, Cinema theaters, Shopping complex.

This project can be used to drive both AC and DC loads according to the pressure applied on the piezoelectric sensor. This technique produces the electric power without polluting our surrounding. The waste energy supplied by human is used in this frame-work. This energy source is ceaseless & renewable. The well implemented system can be a savior to our energy crisis. Proper research and development in the field of piezo electricity can prove to be a big step in providing green energy and environmental conservation.

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