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# Power Generation through Human Locomotion

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***Abstract***

*One of the basic needs of today's life is electric power. A large amount of electrical power is needed for various operations. Energy demand is increasing linearly day by day along with the increase in population. This paper focuses on the power generation from the increased population without negatively affecting the environment. The foot step, walking and running energy is converted into electricity with the help of piezo electric crystals. It is a non-conventional system in which mechanical energy from footsteps is converted into electrical energy. This system can be implemented in many public places. By using piezo electric crystals, the pressure of the footstep deforms the crstal and produced electrical energy as output.*

***Keywords:*** *AC, DC, piezoelectric effect, SMPS, transducer*

## INTRODUCTION

Today, electricity has become a life line of human population. The concern about gap between demand and supply of electricity has led to alternate sources of energy and its sustainable use. Linear increase of human population and energy demand led to the invention of a method to provide power from the increased population. This technology utilizes piezoelectric effect, in which the materials have the ability to generate electricity from pressure and strain applied to them. The ability of some materials to generate electric potential in response to applied pressure is piezoelectricity. Energy harvesting becomes a waste if not utilized properly. Pressure exerted by moving people can be converted to electric current with the help of embedded piezoelectric crystals. The foot step power generation circuit converts the walking, running and foot step energy into electrical energy [1, 2]. It is a non-conventional energy production mechanism. Transducers are used to convert mechanical energy of foot steps

into electrical energy. The system can be implemented on roads, bus stations and many public places. Populated countries like China and India have already been implemented this system. Although, the system is a little expensive, it can bring about huge difference in electrical power generation of a country.

## POWER GENERATION

### Purpose

Electrical power can be generated using fly wheel and gear wheel. These methods can be used to convert mechanical energy into electrical energy. Mechanical parts are placed where number of people are more and energy produced by their movement is converted into usable form. The crowd can generate power on the floor by their footsteps. The piezo electric plate chunk scheme can be placed beneath the floor. Power in the form of electric current will be generated by these crystals. The power produced by the pedestrians can be used to light the street lights. Both AC as well as DC loads can be driven according to the pressure exerted on the piezo electric sensor. No external power has to be applied since it is self-generating.

### Proposed System

From time immemorial, human powered transport has been in existence in forms like running, walking etc. machines led to the enhanced use of human power in an efficient manner. Energy of human locomotion can be converted to electrical energy with the help of promising technologies. In this system, there is a sub flooring block of piezo electric crystals, which imparts an electrical current when people walk across it. The pressure polarizes the crystal there by separating the centers of positive and negative charges. Application of voltage on the crystal produces mechanical distortion of the material. Direct piezo electric effect, which is the phenomenon of generation of voltage under mechanical stress is employed in the system. The application of mechanical stress produces an electric polarization which is proportional to the stress. If the crystal is short circuited, flow of charge can be observed during loading [3].

## BASIC DESIGN

The force applied on the piezoelectric crystal is converted into electrical energy. The fluctuations in the generated voltage and the battery charging is controlled by the microcontroller. Voltage generated by

series of sensors is stored by the battery [4]. This voltage can be used to drive AC or DC loads. The piezoelectric sensor interfaced with the microcontroller is used as a transducer, which converts the force into electrical energy. The voltage booster boots up the generated voltage.

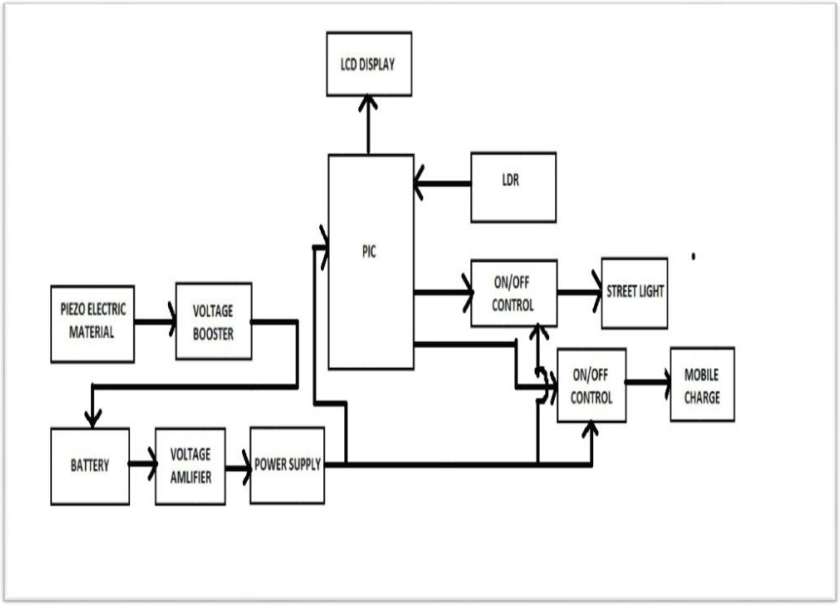


***Fig. 1:*** *Basic Block Diagram.*

**Piezoelectric Sensor**

The sensor converts the force applied on it into voltage with the help of mechanical vibrations. Kinetic energy is converted into electrical energy. Electrical power is generated with the help of sensors connected in series. They will generate 9 V, 100 mA current. Even though the sensors are electromagnetic in nature, they show almost zero deflection. So, they are rugged, have high frequency and excellent linearity over a wide amplitude range [5, 6]. The sensor is insensitive to electromagnetic radiations enabling measurements under any harsh conditions.

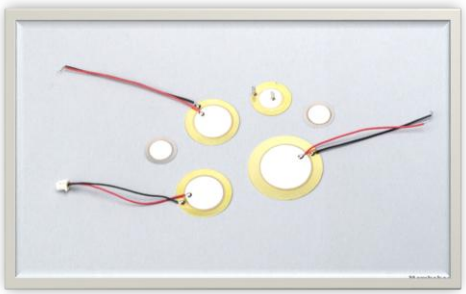

***Fig. 2:*** *Piezoelectric Sensor.*

**Voltage Booster**

It is a Dc to Dc converter with output voltage greater than the input voltage. The device has at least to semiconductors and one energy storage element. It is a class of switched mode power supply. The MC34063A series is a monolithic circuit

containing elements to carry out the primary Dc to DC conversion.


***Fig. 3:*** *Voltage Booster IC.*

**The Controller Unit**

The main controlling unit of the entire system is a microcontroller. The input of the microcontroller is the output from the voltage regulator. For the project PIC8F4520 is used.


***Fig. 4:*** *Microcontroller.*

The filter used removes the AC components from the output voltage of the sensor. It acts like a short circuit for AC voltages and open circuit for DC voltages. A LCD display is interfaced with the microcontroller. It displays the status of the sensors and battery voltages [7].

**THE WORKFLOW OF THE SYSTEM**

After initializing the system, a welcome message will be displayed. The voltage across the battery will be displace on the LCD with the help of a microcontroller. If the battery is charging it displays "charging". If fully charged it displays "battery charge full". The force sensed by the sensor will be converted to an equivalent voltage which is stored in the battery. This voltage is then used for charging a mobile phone.

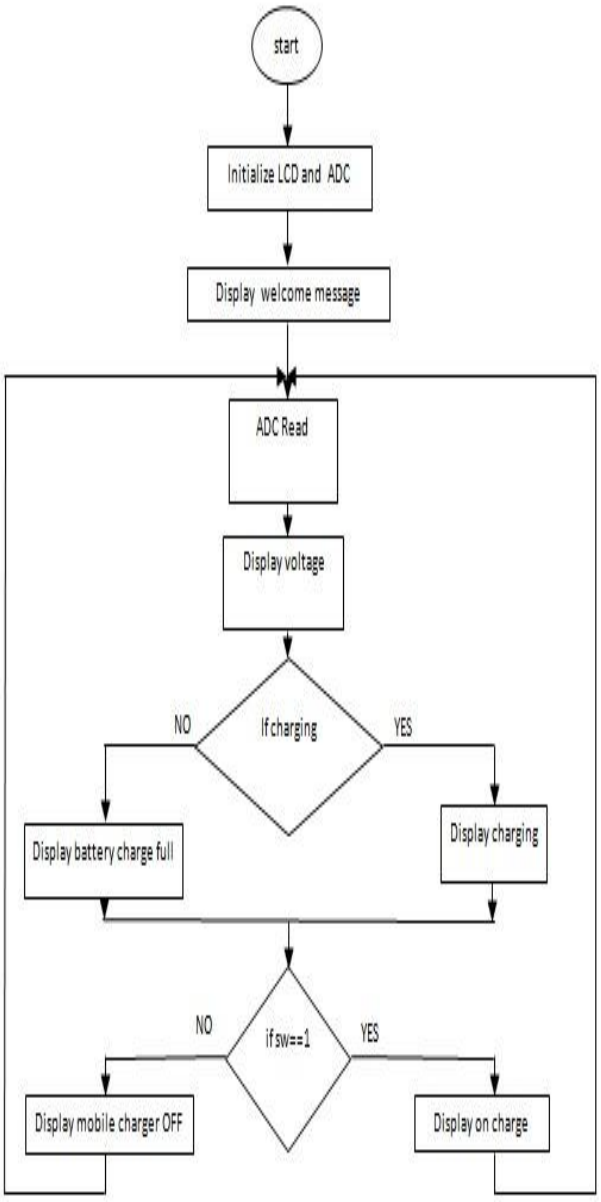


***Fig. 5:*** *Flowchart for Power Generation.*

**THE WORKING**

The main components of the system include piezoelectric sensors, voltage boosters, voltage regulator, PIC microcontroller, battery, LCD display, LDR and a socket for mobile charging. Here in this this system, at first, the output from an array of piezoelectric sensors is fed into voltage booster. In the system, two voltage boosters are used to boost the voltage to get the desired output. The output from piezoelectric sensor is in the range of 3 V to 4 V. It has to be boosted to a range of 9 V to 12 V with the help of voltage boosters. A constant output voltage irrespective of fluctuations will be maintained by a voltage regulator. This regulated voltage is stored in the battery and is fed to the microcontroller. The LCD which is interfaced with the microcontroller in turn displays the amount of charge stored by the battery. In this system the power generated has been used for two applications such as lighting a street light and charging a mobile phone. A LDR is used to indicate the street light application. A buzzer is used to alert when the battery voltage falls below the required voltage for charging the microcontroller. For PIC microcontroller 5 V is required for its working. The mobile charging socket also requires 5 V for its operation. A pull down resistor is used in the socket to pull down the voltage to 5 V. The power is generated by simply walking over a step. The system does not need any fuel input for its functioning this is a non-conventional system in which battery is used to store the generated power. Even though the force is used to generate power, the system is applicable to particular places. Mechanical moving

parts used in the system are large there by increasing the cost. The power generation using footsteps can be implemented effectively in schools, colleges, cinema theaters, shopping complexes, temples and many other buildings.

## FUTURE SCOPE

### Flooring Tiles

Several countries have already been started experimenting the use of piezoelectric crystals for power generation. The piezoelectric effect can be implemented on the stairs of a bus. Every time passengers step over the stairs, a small vibration is triggered that can be stored as energy. The flooring tiles are made up of rubber so that it can absorb the vibrations. The piezoelectric sensors will be placed beneath the flooring tiles. Energy generated by footsteps of one human being is less, but if number of steps increases, energy production also increases.

### Dance Floors

Some countries have started experimenting the piezoelectric crystals in night clubs. The floor will be compressed by dancer's feet and piezoelectric materials make contact there by generating power. The generated power can be in the range of 2 W to 20 W. The constant compression of piezo electric crystals cause huge amount of energy generation.

## SIMULATION RESULTS

The simulation part of the project is carried out with the help of soft wares such as Mikro C and Proteus.

### LCD Display

With the help of the block diagram the circuit design has been started. As the entire project has been controlled by the microcontroller; the design has been started from the controller IC PIC.

The basic design now completed is the interfacing of PIC with the LCD display. Here, we are using a 16*2 LCD display. After the completion of this first step in circuit design the working is verified using the Proteus Software and coding has been written using Mikro c program for PIC.

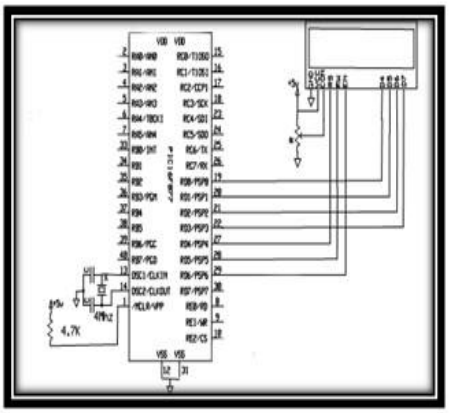

***Fig. 6:*** *LCD Display.*

**Mobile Charging**

Designed the external circuit connection as per the block diagram using PIC16F677. The input of the PIC is given from the piezo electric crystal. The output from 15th pin of the PIC is given as socket input. The output from the socket is 5 v which can be used for mobile charging.

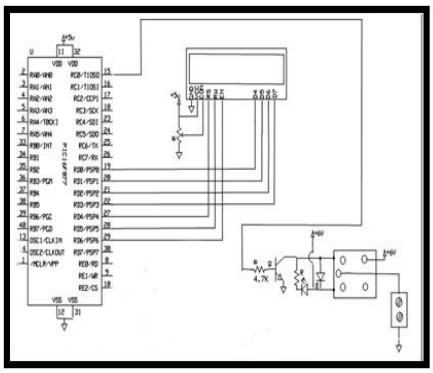

***Fig. 7:*** *Mobile Charging.*

**LDR**

From the output of piezo electric crystal some power is developed that power is displayed in the LCD. By adjusting the power it can be used for streetlight applications. Here, it is illustrated using LDR. If the output voltage is less than 1 v, the LED will glow. If it is above 1 v, LED will be OFF. The generated voltage is displayed as intensity here.

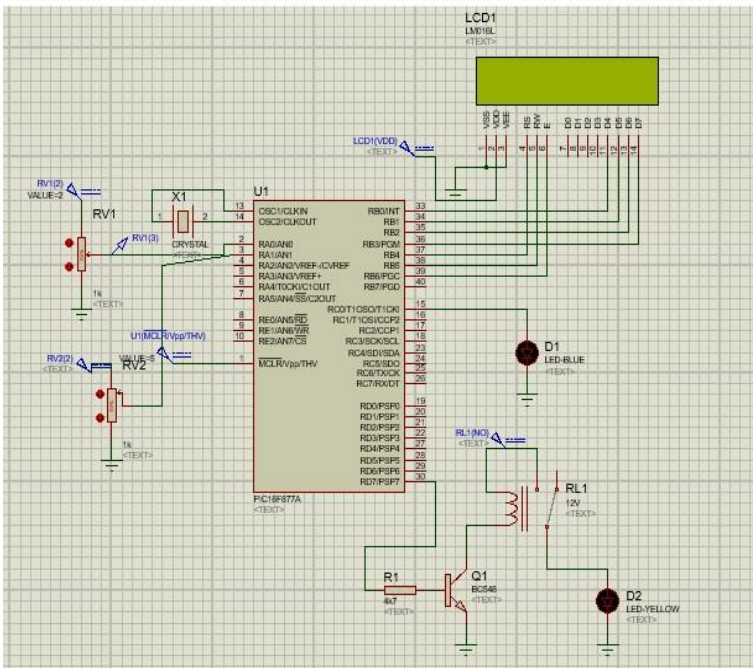


***Fig. 8:*** *LDR for Streetlight.*

**Voltage Booster**

Here, input voltage from a piezo electric crystal is 0.6 v. In order to amplify to our required output we need to amplify this operation is performed by voltage booster.

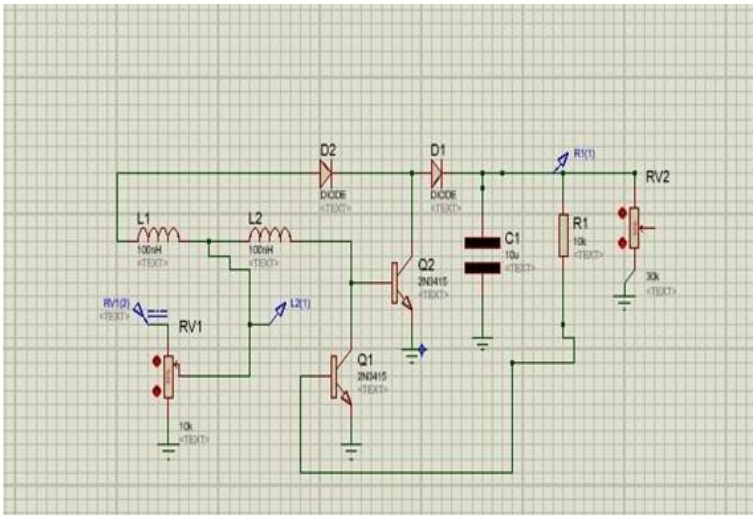


***Fig. 9:*** *Voltage Booster.*

**CONCLUSION**

In this project, we are generating electrical power as non-conventional method by simply walking or running on the foot step. Non-conventional energy system is very essential at this time to our nation. Non-conventional energy using foot step is converting mechanical energy into the electrical energy. By using this energy conservation theorem and Piezo sensor we are proposing a new method for power generation. Proposal for the utilization of waste energy of foot power with human locomotion is very much relevant and important for highly populated countries like India and China where the roads, railway stations, bus stands, temples, etc. are all over crowded and millions of people move around the clock.

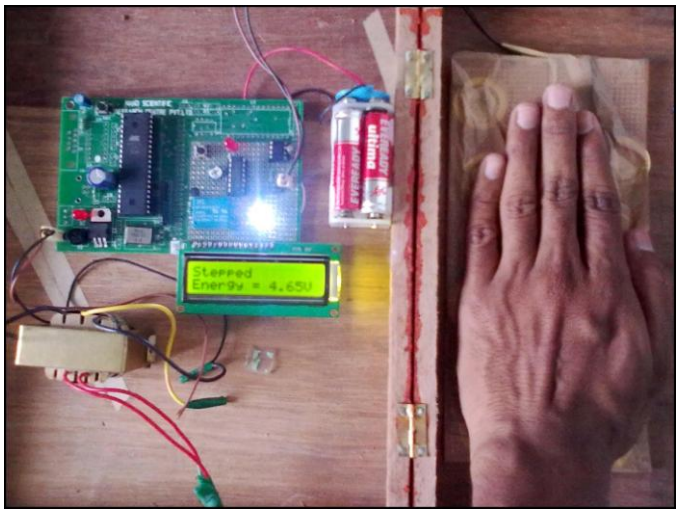


***Fig. 10:*** *Output of the Project.*

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