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Footstep Power Generation Using Piezoelectric Sensor

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Abstract: ***Man has needed and used energy at an increasing rate for the sustenance and well-being since time immemorial. Due to this a lot of energy resources have been exhausted and wasted. 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 where the railway station, temples etc., are overcrowded all round the clock. 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 electrical charge by piezo transducers, then stored and used as a power source. And this power source has many applications as in agriculture, home application and street lighting and as energy source for sensors in remote locations. This paper is all about generating electricity when people walk on the Floor. Think about the forces you exert which is wasted when a person walks. The idea is to convert the weight energy to electrical energy The Power generating floor intends to trans- late the kinetic energy to the electrical power. Energy Crisis is the main issue of world these days. The motto of this research work is to face this crisis somehow. Though it won't meet the requirement of electricity but as a matter of fact if we are able to design a power generating floor that can produce 100W on just 12 steps, then for 120 steps we can produce 1000 Watt and if we install such type of 100 floors with this system then it can produce 1MegaWatt. Which itself is an achievement to make it significant.***

Keywords: Piezoelectric sensor, Footstep, remote location, force and pressure, power generation

I. INTRODUCTION

Day by day, the population of the country increased and the requirement of the power is also increased. At the same time the wastage of energy also increased in many ways. So reforming this energy back to usable form is the major solution. As technology is developed and the use of gadgets, electronic devices also increased. Power generation using conservative methods becoming deficient. There is a necessity arises for a different power generation method. At the same time the energy is wasted due to human locomotion and many ways. To overcome this problem, the energy wastage can be converted to usable form using the piezoelectric sensor. This sensor converts the pressure on it to a voltage. So by using this energy saving method that is the footstep power generation system we are generating power. This project is used to generate voltage using footstep force. The proposed system works as a medium to generate power using force. This project is very useful in public places like bus stands, theaters, railway stations, shopping malls, etc. So, these systems are placed in public places where people walk and they have to travel on this system to get through the entrance or exists.Then, these systems may generate voltage on each and every step of a foot. For this purpose, piezoelectric sensor is used in order to measure force, pressure and acceleration by its change into electric signals. This system uses voltmeter for measuring output, LED lights, weight measurement system and a battery for better demonstration of the system. In another way, we are also saving natural energy resource

II. LITERATURE SURVEY

Earlier developments in the piezo electric circuitry involved concentration on small vibrations and hence small strains. Also, few of them required external voltage supply and there were number of losses in the system which amounts to low voltage output. In December 1929, scientists in U.S Navy perfomed various researches on piezoelectric crystals. Their focus was primary on the dimensions of crystals. This research proved that by changing the dimension and orientation of crystal the output. considerably changed. They designed the crystal named "Curie cut' or 'Zero Cut based on the changes made in the angles of the crystal. Thus, this proves that the crystals designed with such dimensions are effective in controlling oscillations of a 50watt vacuum tube. So, they act as a voltage controlling device too. In 1985, the concept of using handwriting dynamics for electronic identification was performed in Sandia Laboratories A piezoelectric sensor pen for obtaining the pen point dynamics during writing was studied.

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Design equations were derived and details of an operating device were studied. Typical output waveforms obtained from the operation of the pen and showed the
dissimilarities between dynamics of a genuine signature and an attempted forgery. So, this also shows high sensitivity of Piezo material towards marginal pressure change. In 2000, various applications of piezoelectric in wireless sensing was studied and experimented. Numerous industrial and military applications require remote sensing of various machine and equipment operating parameters in locations where traditional power sources may not be available and long periods of unattended operation are required. Quite often, however, some source of Vibrating energy may be present in operation of the machine in question. Hence a piezoelectric source is efficiently utilized to generate power for the operation of a microcontroller and radio transmitter acquire sampled machine data. Various techniques for the efficient conversion, use and storage of piezoelectric power are discovered and used in a general energy harvesting data transmitter design.
In 2005. United States Defense Advance Research Project Agency (DARPA) initiated an innovative project on Energy harvesting which attempts to power battlefield equipment by piezoelectric generators embedded in soldiers' boots. However, these energy harvesting sources put an impact on the body. DARPA's effort to harness 1-2 watts from continuous shoe impact while walking was abandoned due to the discomfort from the additional energy expended by a person wearing the shoes.
In this project the concentration is mainly on use of the piezoelectric crystals and films in high vibration system with efficient arrangement to get higher efficiency. Moreover, the amplification level designed will be such that the output rating of system will be considerably higher than previous system.

III. NEED OF SYSTEM

The Utilization of the Waste Energy foot Power With human motion is very important and highly populated countries.
India and china where the roads railway stations, temples Etc, Are all over crowded and millions of people move around the clock.

IV. PIEZOELECTRIC SENSOR

A piezoelectric sensor is a device that uses the piezoelectric effect to measure changes in pressure, acceleration, temperature, strain, or force by converting them to an electrical charge
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).A given static force results in a corresponding charge across the sensor.
Flex motions, touch, vibrations, and shock measurement all use piezoelectric sensors. They are used in sectors such as healthcare, aerospace, consumer electronics, and nuclear instrumentation
A piezoelectric sensor converts physical parameters - for example, acceleration, strain or pressure into an electrical charge which can then be measured. They are highly sensitive and very small in size making them well suited to everyday objects.



Fig 1. Piezoelectric Sensor

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V. TREE DIAGRAM

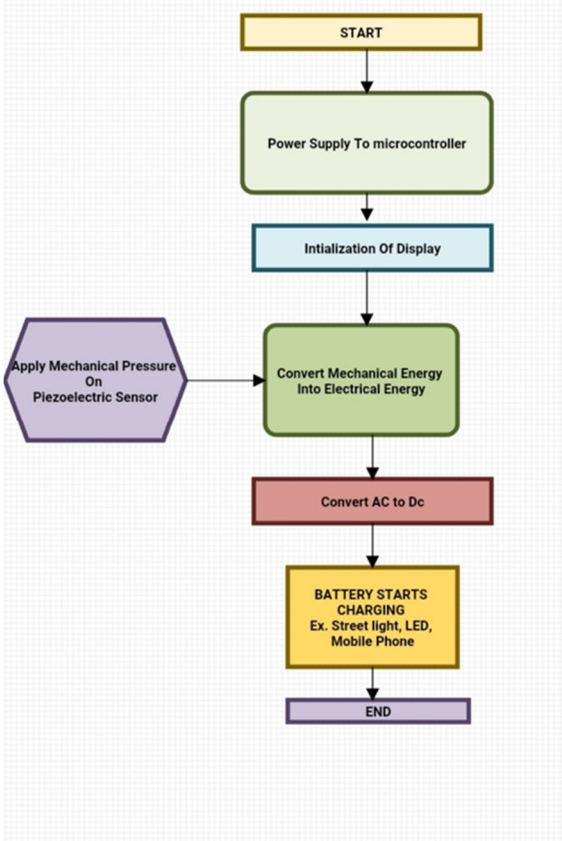
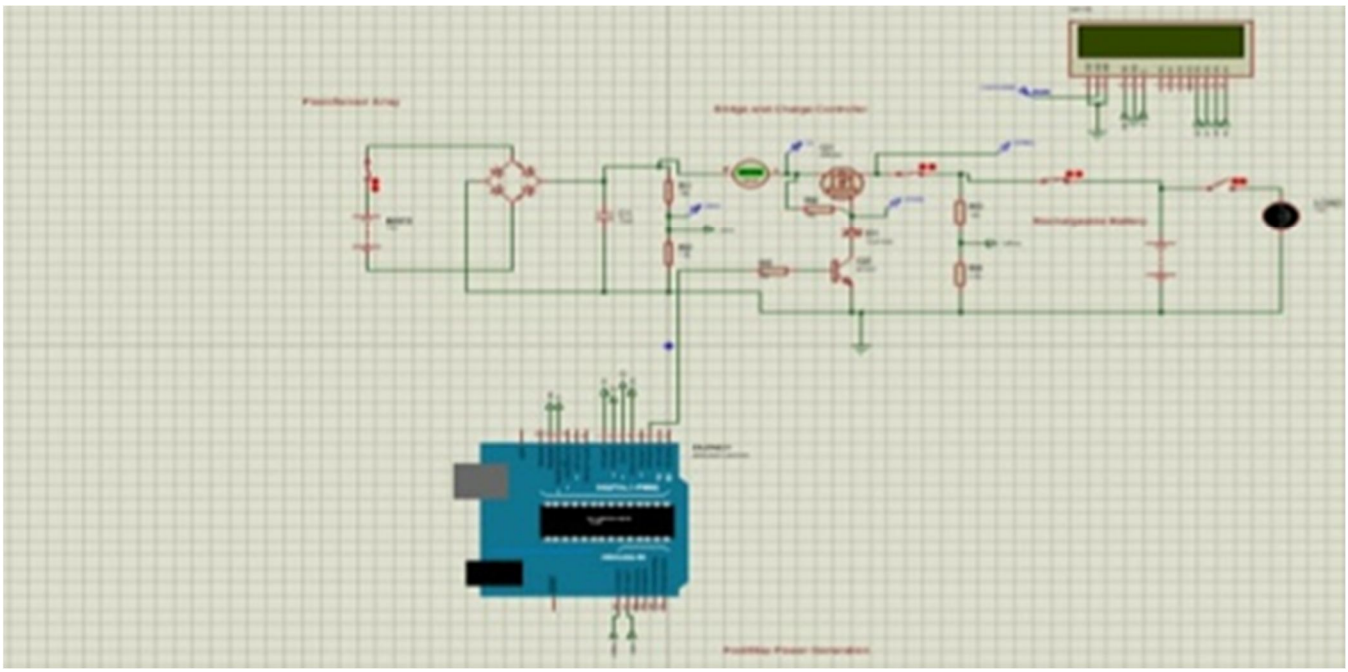


FIG 2. Tree Dioagram

VI. SIMULATION DIAGRAM



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VII. 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 12V 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.

A. Microcontroller Unit

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

The filter used removes the AC components from the output voltage of the sensor. It acts like a short circuit for ac voltage and open circuit for dc voltage. A LCD display is interfaced with the microcontroller.



Fig 4. Controller Unit

B. Voltage Booster

It is a DC to DC converter and 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.



Fig 5. Voltage Booster

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C. Simulation Result

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 e program for PIC.

D. Mobile Charging

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

VIII. FUTURE SCOPE

The piezoelectric crystals have being start better use with the positive result. In china and Japan, maximum public movement is observed in railway station, airports and shopping malls. Hence this place can be used for piezoelectric crystals for generation of electric power. Apart from all the above places attempts are made to develop energy from our daily life by initialing piezoelectric in shoes thus in each step piezoelectric crystal can be compressed which can turned enough power to charge a cell phone,mp3 player etc. Through this we can generate electric power and used that for small electronic gadgets.

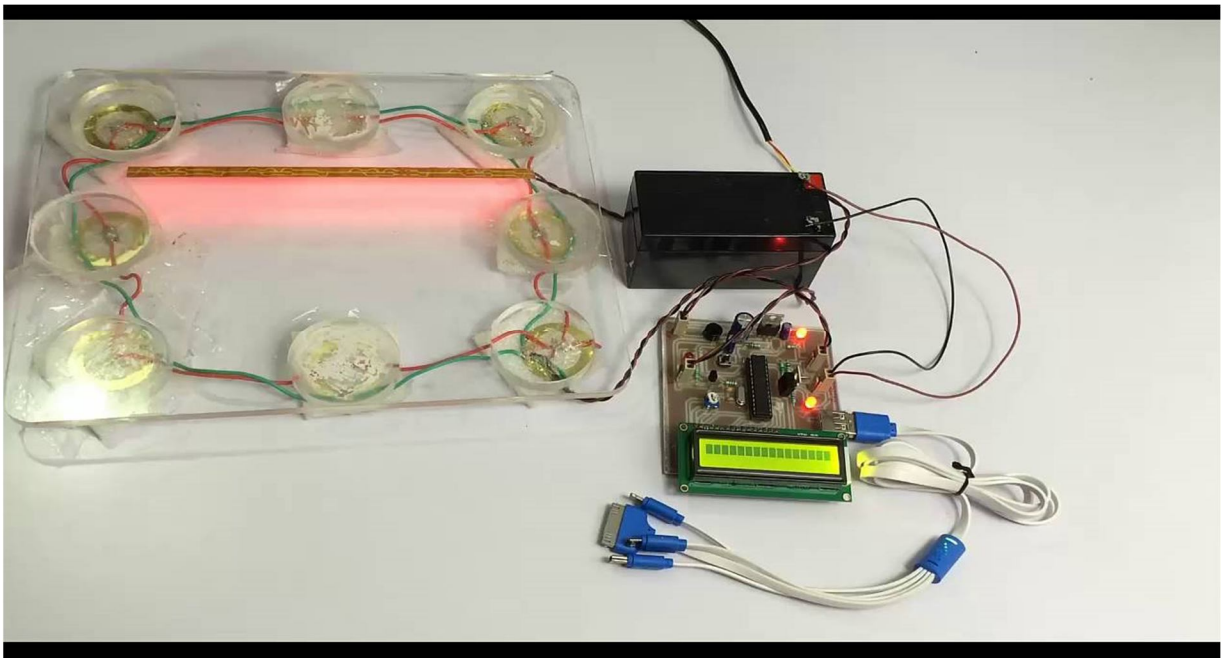


Fig 6. Actual View of Project

IX. USE OF 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

X. PROBLEM FORMULATION & SOLVING

A. As technology is developed use of electronics equipment also increased
B. Conventional methods of power generation becoming insufficient.
C. It introduced a new problem, lack of power.
D. There is a need arises for an alternative power generation method
E. At the same time energy is wasted in many form and one of them is due to the human locomotion

XI. ADVANTAGES AND DISAVANTAGES

A. Advantages

1) Power generation is simply walking on step
2) No need fuel input
3) There is a non-conventional system
4) No moving parts long service life
5) Compact yet highly sensitivity
6) Self generating no external power required

B. Disadvantages

1) Only applicable for the particular place
2) Intial cost of the arrangement is high
3) Output affected by temperature variations
4) Crystal is prone to crack if overstressed

XII. CONCLUSION

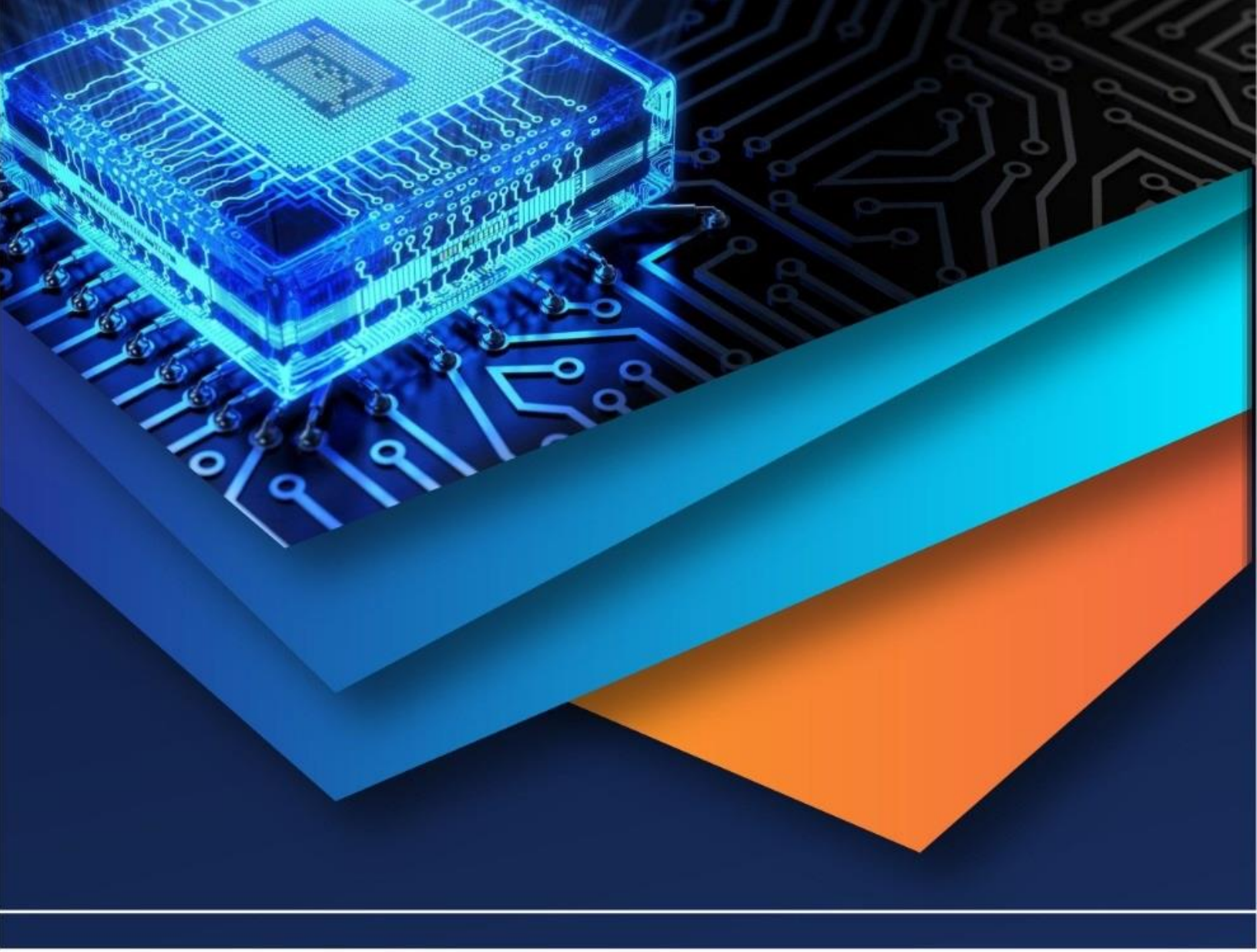
In this project, we are generating electrical power as non-conventional method by simply walking or running on the foot step. Non-conventional energy system is very essential at this time to our nation. Non-conventional energy using foot step is converting mechanical energy into the electrical energy. 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

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