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DESIGN AND IMPLEMENATATION OF PIEZOELECTRIC BASED FOOTSTEP POWER GENERATION FOR LIGHTING APPLICATION

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ABSTRACT

Since time immemorial, man has needed and increasingly uses energy for sustenance and well-being. As a result, many energy resources have been depleted and wasted. The proposal to use the waste energy of the legs during human movement is very relevant and important for highly populated countries like India where railway stations, temples etc. are continuously crowded. When a floor is designed using piezoelectric technology, the electrical energy produced by pressure is captured by floor sensors and converted into an electrical charge using piezo transducers, then stored and used as a power source. And this power source has many applications like in agriculture, home applications and street lighting and as a power source for sensors in remote locations. This documentary is all about generating electricity when people walk on the floor. Think about the energy you waste when walking. The intention is to convert the energy of mass into electrical energy The energy generating floor intends to convert kinetic energy into electrical energy. The energy crisis is the main topic of today's world. Electricity consumption is growing at an exponential rate. This research recommends harnessing human locomotor energy, which, while extractable, is largely wasted. This research presents an energy storage concept that uses human movement, skipping and running as energy. Piezoelectric sensors are used in this innovative power generation system.

Keywords: Piezoelectric, Electricity , technology , Power Generation , Sensors.

1.INTRODUCTION

The footprint generation technology based on the piezoelectric sensor converts the mechanical energy generated by people on the ground into electrical energy to generate electrical power. If the floor is designed with piezoelectric technology, the electrical energy produced by the pressure is captured by the floor sensor, converted into electrical charge by the piezoelectric transducer, stored and used as an energy source. The sensors are placed in series to produce the maximum output voltage and send that voltage to the program. This energy is stored in a battery and is ready for use at any time. The idea is to convert mechanical energy into electrical energy. Generator floors are intended to convert kinetic energy into electricity.

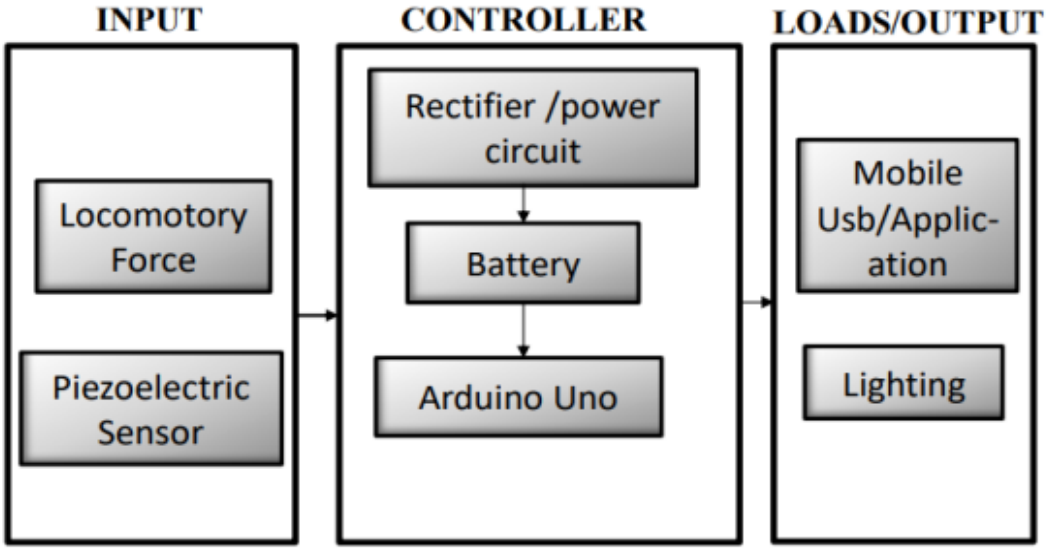
Until now, we can safely say that the sun directly or indirectly provided all the energy needed by humans and humans only used renewable energies. A proposal to use the wasted energy from foot movement for human mobility.

This issue is very relevant and important for populous countries like India and China where roads, train stations, bus stations, temples etc. are crowded and millions of people are on the move 24 hours a day. All this human/biological energy is wasted, but if it could be harnessed, it would be a great invention, and crowd energy farms would be a very useful source of energy in overpopulated countries.

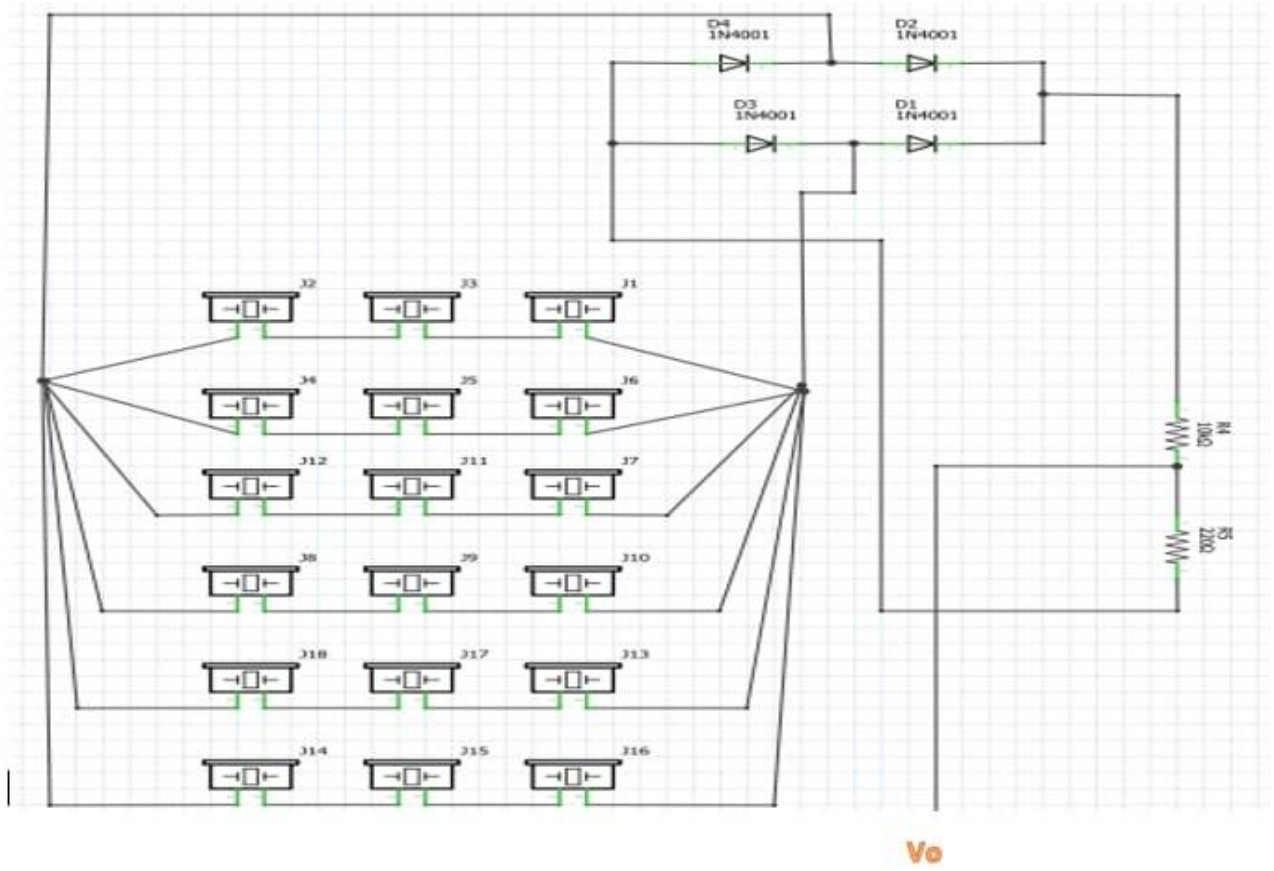
2.COMPONENTS

Sl.no	COMPONENTS	QUANTITY
1.	Piezoelectric Sensor	21
2.	LCD(16*2)	1
3.	Rectifier	1
4.	Resistor-2.2KΩ and 470Ω	1 each
5.	Arduino uno	1
6.	Potentiometer	1
7.	Jumper wires	As per required
8.	Shock absorber	4
9.	LED strips	3
10.	Relay	1
11.	Battery	1
12.	Buzzer	1
13.	Steel strips	3

3.BLOCK DIAGRAM



4.CIRCUIT DIAGRAM



5.MODEL DESCRIPTION AND WORKING

The circuit diagram for the footstep power generation system using piezoelectric sensors showed the connection of the PZT ceramic sensors was connected in both series and parallel modes. There were 7 serially placed PZT sensors, and each of these serial connections (rows) was in turn placed in parallel with 3 other rows of 7 series-connected PZT . The reason for this mode of configuration was to amplify the voltage output in the series connection and the current in the parallel connection. A series connection of 7 PZT ceramic sensors can output up to 20V AC when an even force is applied across the sensors. By using a configuration of both series and parallel, we try to minimize this voltage loss such that, the rows not affected can still output voltage in this how to generate electricity using foot-steps with backup charging station (piezoelectric generator) project or advanced footstep power generation system.

The output voltage of the piezoelectric generator is AC-based, and we intend to use it to power DC loads. To achieve this, the bridge rectifier was used to convert the AC signal to DC signal.It is observed that voltage divider rule was used which is composed of pair of known R5 and R6 resistor values connected in series from the referred paper.

The Vo wire (also called the analog input wire) will be connected to the analog pin A0 of the Arduino board ,because Arduino pins cannot withstand voltage levels above 5V.

Since we will be reading the Arduino analog input pin, which accepts voltages up to 5V. But If the controller had a 3.3V system, the input voltage supplied to it should not be greater than:

$3.3V \times 5 = 16.5V$

But Arduino came with AVR chips that have a 10-bit ADC architecture, so this setup simulates a resolution of:

0.00489V (5V/1023)

So, the minimum voltage of the input voltage detection module is: 0.00489V x 5 = 0.02445V.

The PZT sensor, Arduino, LCD display, Battery, LED strips, Relay and connecting cables are included in this project. The PZT are connected in series to boost the voltage and then they are connected in parallel to amplify the current. The positive terminal of one PZT is connected to negative terminal of another PZT and vice versa the connections are done. The PZT are placed are wooden plates and are supported by shock absorber for compression. The parallel terminals of all the PZT are connected to Rectifier .A full wave bridge rectifier is used to convert the AC into unidirectional DC and it is also used to reduce the peak voltages. From the rectifier it is connected to two resistors of 2.2KΩ and 470Ω,these values of resistors are considered by doing voltage divider rule.

The rectifier and Resistors are connected to Arduino UNO which is coded to display the Voltage in LCD display when PZT are compressed. An electromechanical relay is used as a switch to operate the LED strips. The relay is also connected to the battery and voltages obtained from the PZT are

stored in battery. When the PZT plates are applied force ,they compress which produces voltage and current in micro amps. This produced voltage will be stored in battery and will supply for the load or LED .A buzzer is also connected to produce sound when led strips are on. The LCD displays the voltage ,the displayed voltage is Analog to Digitally converted by Arduino.

Fig 1:- Cross Sectional view Piezo Tile

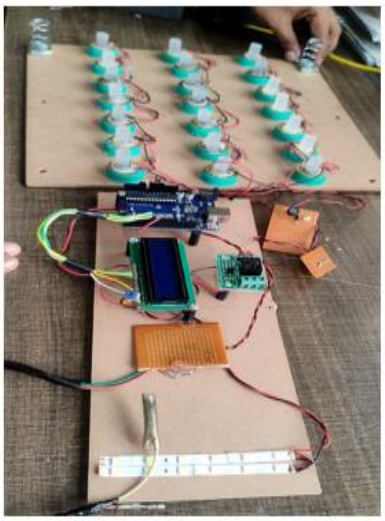


Fig 2:- Integration of piezo tiles & software

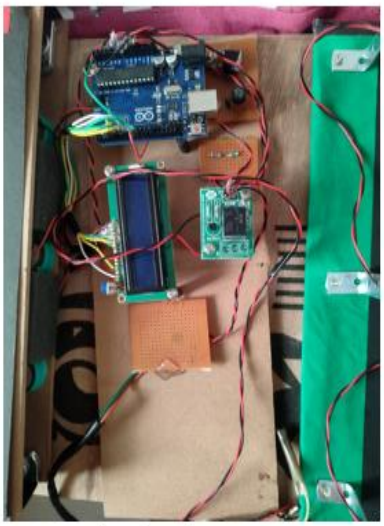


Fig 3:-hardware components

Fig 2. Components connection

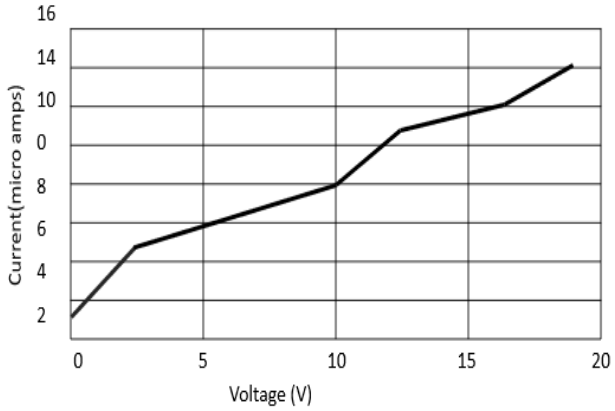
6.PRACTICAL CALCULATION

In this project we connect 7 PZT in series of 3 rows are connected in parallel in one tile. Power generated varies with different steps in PZT array that is used. The voltage obtained are based on practical results;
Min voltage=2V/step
Max voltage=8V/step
Assume that the average weight of the person using the system is 65 kg . Steps to be taken to enhance the battery's 1v charge=450 step.
To boost the battery's 12V volts,7Ah total footstep required =12x450=5400 steps.
To boost the voltage of battery on an average the steps required for 1Hour= 450 steps
Taking into consideration of generated average power is P=0.015Watts.
So, Power x time=0.015*3600=54Wh
Battery ratings is 12V, 7Ah the total power required is P(b)=12*7=84Wh.
Therefore, to boost up the battery voltage the total time required will be 1hr 33min.
Considering if time required for 1 step is 2 second then time required for 5400 steps will be 5400/(60x1)=90minutes.

Different values of weight ranging from 50kg to 80kg with intervals of 10 kg and respective graphs with respect to voltage, current and power generated is plotted in table.

Power Generation at different weights

Sl .no	Weight (Kg)	Voltage (V)	Current (µA)	Power (mW)
1.	50	2	1	0.002
2.	60	5	3	0.015
3.	70	7	7	0.049
4.	80	9	13	0.117



Graph 1. Current (micro amps) Versus Volatge.

Fig 3. Expected output

CONCLUSION

In countries facing energy crisis where there is load shedding of electricity due to shortage of energy, this footstep power generation system is the best method of power generation and by increasing the size of foot step power generation system the production of electricity generation is increased. Our work shows that foot step power generation does not require fuel to generate electrical energy. It is also an eco-friendly method of power generation, as it does not require any huge land to set up like other power plants. There is no pollution, no noise, no smoke so this is the best method to install this in public place area. There is no maintenance cost and installation cost is also less compared to others. The system can be placed in places where people travel around the clock, such as residences, schools and universities. People's weight provides the force when they walk on steps or platforms..

REFERENCES

1. M. Chavan, S. Chauhan, M. Singh, and A. Tripathi, "Footstep Power Generation using Piezoelectric Sensor and Distribution using RFID," Int. Res. J. Eng. Technol., vol. 07, no. 09, pp. 1416–1420, 2020.
2. G. S. Prakash, K. S. Kamalakant, S. S. Subhash, and Y. Tejas, "Footstep Power Generation System using Piezoelectric Sensor," Int. Res. J. Eng. Technol., vol. 08, no. 04, pp. 4212–4215, 2021
3. P. Venkatesh, M. Satya, M. Sahil, and P. Sai, "Design of footstep power generation using piezoelectric sensors," Pramana Res. J., vol. 9, no. 6, pp. 1358–1363, 2019.
4. K. Kim, W. Jang, J. Yong, S. Bum, and D. Hwan, "Nano Energy Transparent and flexible piezoelectric sensor for detecting human movement with a boron nitride nanosheet (BNNS)," Nano Energy, vol. 54, no. July, pp. 91–98, 2018.
5. K. Naresh, A. Balaji, M. Rambabu, and G. Nagaraju, "Practical oriented foot step electric power generation by using piezo Material and Microcontroller in campus," Int. Res. J. Eng. Technol., vol. 5, no. July, pp. 1590–1596, 2018.

6. P. Hole and P. Gophane, "Footstep power generation using Piezo electric sensor," Int. Res. J. Eng. Technol., vol. 07, no. 3, pp. 270–272, 2020. [12] S. Panghate, P. Barhate, and H. Chavan, "Advanced Footstep Power Generation System using RFID for Charging," Int. Res. J. Eng. Technol., vol. 07, no. 02, pp. 2408–2412, 2020.

7. S. S. Patil, M. K. Sushmitha, V. Baliga, and S. L. Vishwanath, "Footstep Power Generation," Int. Res. J. Eng. Technol., vol. 08, no. July, pp. 2835–2837, 2021.

8. K. Nam et al., "Silk fi broin-based biodegradable piezoelectric composite nanogenerators using leadfree ferroelectric nanoparticles," Nano Energy, vol. 14, pp. 87–94, 2015.

9. S. Wang, W. Rong, L. Wang, and L. Sun, "Design , analysis and experimental performance of a stepping type piezoelectric linear actuator based on compliant foot driving," Smart Mater. Struct., vol. 25, no. 115003, p. 9, 2016.

10. J. Liu et al., "Design and Experiments of a Single-Foot Linear Piezoelectric Actuator Operated in a Stepping Mode," IEEE Trans. Ind. Electron., vol. 65, no. 10, pp. 8063–8071, 2018.

11. K. Naresh, A. Balaji, M. Rambabu, and G. Nagaraju, "Practical oriented foot step electric power generation by using piezo Material and Microcontroller in campus," Int. Res. J. Eng. Technol., vol. 5, no. July, pp. 1590–1596, 2018.