PIMPRI CHINCHWAD EDUCATION TRUST'S

PIMPRI CHINCHWAD COLLEGE OF ENGINEERING

SECTOR NO. 26, PRADHIKARAN, NIGDI, PUNE- 411044.

MINI PROJECT REPORT

"Weight to Electricity conversion"

Project ID:- A1-05

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Abstract:

Nowadays energy and power are the one of the basic necessities regarding this modern world. As the demand of energy is increasing day by day, so the ultimate solution to deal with these sorts of problems is just to implement the renewable sources of energy.

The objective of this work is power generation through footsteps as a source of renewable energy that we can obtained while walking on to the certain arrangements like footpaths, stairs, plate forms and these systems can be install elsewhere specially in the dense populated areas. We can implement this foot step power generation system by use of Piezoelectric sensor and efficient diode rectifier circuit along with filter circuit. As a result of completing the above procedure or technique we made ourselves able to design such compatible system through which we could run our home appliances through DC output. As our main purpose was to charge the battery through DC output.

Thus, as a result we have concluded that these types of designs and techniques of power generating systems are very useful and handy in order to match the supply and demand of energy globally as well.

Acknowledgment:

We take this opportunity to express our gratitude towards people who have rendered valuable help in development of this project Regardless of source we would like to thank all those people for their timely help and guidance. It is our pleasure to present T.E mini project entitled "WEIGHT TO ELECTRICITY GENERATION" which has throughout a joint effort. We would also thank Mrs. Sonali Shirke, for giving valuable guidance, inspiration and encouragement to embark this project. We also acknowledge our gratitude and immense respect to Prof. Sonali Shirke Course coordinator, Dr. M. T. Kolte H.O.D (E&TC) and Principal Dr. N. B. Chopade and support staff members who inspiring me a lot to achieve the goal.

Last but not the least, we would like to thank all friends, seniors and family who help us directly or indirectly for success of our project.

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1. INTRODUCTION

1.1 Background:

1. In order to achieve electrical energy from mechanical energy we have constructed a model where, when someone applies force on model then it creates pressure on the piezoelectric sensors, which are present in between two tiles.
2. Single piezoelectric sensor will produce few watts of energy and to create more amount of energy we have a series and parallel connection as to get required output voltage and current.
3. These sensors convert's the mechanical energy (force) into electrical energy.
4. The produced energy is in the form of ac which is rectified by the rectifier circuit and then the rectified voltage is regulated to get the constant dc.
5. Then this dc voltage can be used to light the streetlights, traffic signals.

1.2 Problem statement:

To Design a Model which converts Mechanical energy (weight) to Electricity.

1.3 Objective:

- To do Literature Survey.
- To select and study appropriate components related to our system.
- To study the software tools like PSIM and Mplab.
- To simulate the system in software.
- To do troubleshooting and remove all the errors.

2. Literature Survey:

2.1 Literature Survey:

SR. NO.	TITLE	AUTHORS	INFERENCE/OUTCOME
1	Footstep Power Generation Using Piezo Electric Transducers	Kiran Boby, Aleena Paul K, Anumol.C.V, Josnie Ann Thomas, Nimisha K.K	Provides methods for increasing piezoelectric power. Increasing efficiency and overcoming the drawbacks
2	Improving power output for vibration-based energy scavengers	Roundy, S., Leland, E. S., Baker, J., Carleton, E., Reilly, E., Lai, E., Otis, B., Rabaey, J. M., Wright, P. K. and Sundararajan, V	Increasing efficiency of energy harvesting by vibrations by using different geometries of piezoelectric crystals.
3	Piezoelectric Energy Harvesting for Powering Micro Electromechanical Systems (MEMS)	Abdul Majeed	Study of SSHI method of energy harvesting and methods of AC to DC conversion

4	A family of high voltage gain single-phase hybrid switched-capacitor rectifiers	D. F. Cortez and I. Barbi	For getting a high voltage gain in AC-DC rectifiers, some efforts have been made in

Table - 1

2.1.2 Summary of Literature Survey:

1) Piezo Electric crystal sensors can be used for to convert mechanical pressure to electrical signal.

2) To harvest energy and to get high voltage gain in AC – DC rectifiers, some efforts have to be made.

3 Specification:

3.1 Specifications for power supply

3.1.1 Diode rating:

PIV: 25V

3.1.2 Filter capacitor:

Electrolytic capacitor: 1000uF

Specifications:

3.1.3 Piezo-Electric Sensor:

This Piezo-Electric Sensor converts pressure applied on it to electrical signal.

Fig -1 (Piezoelectric transducer)

The converted electrical signal is of Analog form. Piezo-Electric Sensor has two parts. The white colored part is positive node and Golden color part is negative node.

3.1.4 1N4007 Diode:

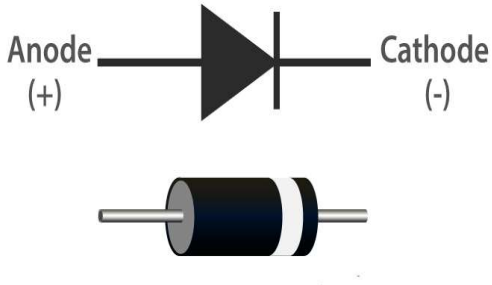

Fig – 2 (Diode)

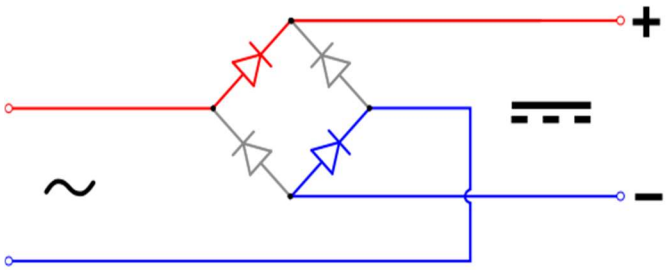

Fig – 3 (Rectifier Circuit)

1N4007 is a rectifier **diode**, designed specifically for circuits that need to convert alternating current to direct current. It can pass currents of up to 1 A, and have peak inverse voltage (PIV) rating of 1,000 V

Diode rectifier circuits are one of the key circuits used in electronic equipment. They can be used in switch mode power supplies and linear power supplies.

Here in our project case we have used an Efficient diode rectifier circuit to convert Analog for of signal coming from Piezoelectric sensors to Digital form.

3.1.5. Capacitor Filter:

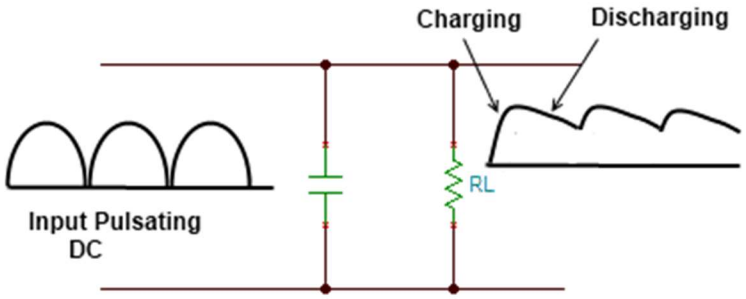

Fig – 4 (Capacitor filter and waveform)

A capacitor-input filter is a filter circuit in which the first element is a capacitor connected in parallel with the output of the rectifier in a linear power supply. The capacitor increases the DC voltage and decreases the ripple voltage components of the output.

3.1.5 **PIC18F2550 –**

Fig – 5 (PIC18F2550)

PIC18F2550 is a High-Performance, Enhanced flash, USB Microcontroller with NANO-Watt-Technology. This is an 8-bit microcontroller popular among makers and engineers due its features and low cost. PIC18F2550 comes in various packages like DIP, QPF and QPN and can be selected according to the project requirement

4. Proposed Methodology:

4.1 Introduction to the project:

- When anyone walks or run on any platform or surface they exert their weight force to ground. This is purely wastage of energy
- To overcome this wastage and to create an energy source which is not harmful for environment we introduce this idea.
- In order to achieve electrical energy from mechanical energy (weight) we have constructed a model where, when someone applies force on model then it creates pressure on the piezoelectric sensors, which are present in between two tiles.
- Single piezoelectric sensor will produce few watts of energy and to create more amount of energy we have a series and parallel connection as to get required output voltage and current.
- These sensors convert's the mechanical energy (force) into electrical energy.
- The produced energy is in the form of Analog form which is rectified by the rectifier circuit.
- Then this rectified voltage is filtered by capacitor filter and regulated to get the constant DC signal.
- In this way we can convert unused mechanical energy to Electric signal.
- This Electrical signal is fed to battery and with help of PIC microcontroller battery level is watched
- If battery id charged above certain level then LED will glow indicating charging of battery.

4.2 Explanation of block diagram :

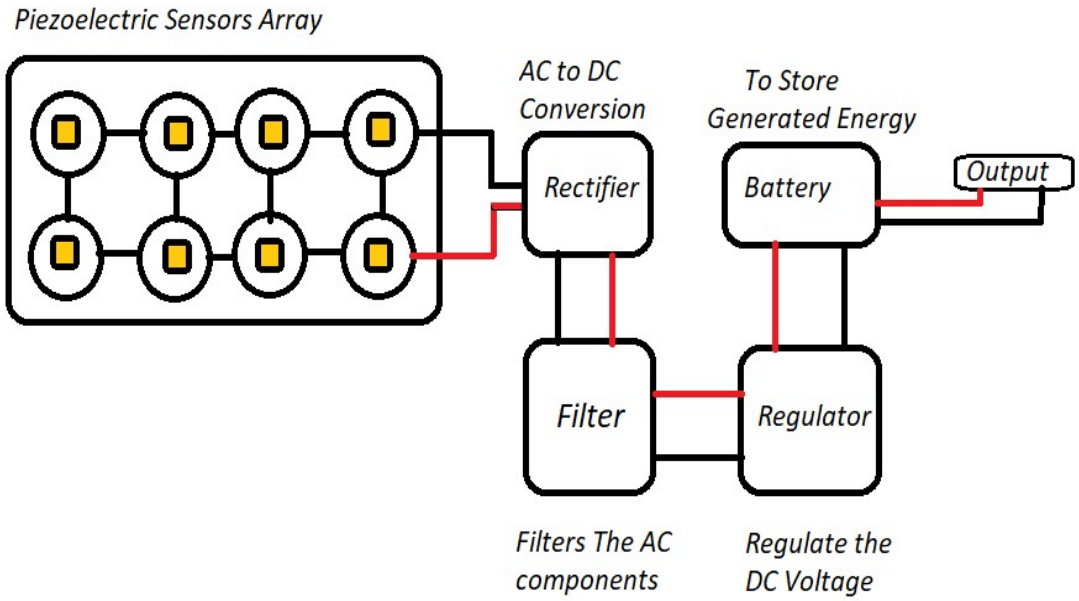

Fig – 6 **(**Block diagram**)**

- When piezoelectric sensors are connected in series combination then output voltage is large but output current is low and when piezoelectric sensors are connected in parallel combination then output current is large but the voltage is low.
- We need a combination where output voltage as well as output current is high.
- We have to do connection in such a way that it should match the required current and voltage.
- So a combination of series and parallel connection of piezoelectric sensors is made.
- The output of the piezoelectric sensor is ac and to convert this ac voltage to dc rectifier is used. The output of the rectifier is fed to the batteries for charging.

4.3 List of Components :

Sr. no	Equipment	Quantity
1)	PIC16F877A	1
2)	PIEZOELECTRIC TRANSDUCER	10-12
3)	CONNECTING WIRES	1 Bundle
4)	TILE PLATES	2
5)	CAPACITORS (10uf,1000uf)	5
7)	DIODE	4
8)	PIC18F2550	1
9)	BATTERY	1
10)	VOLTAGE REGULATOR	1
11)	LED	5
12)	HARD SPRING (between 2 metal plates)	2

Table - 2

5. Design and Implementation :

1. Piezoelectric crystal when placed between two metal plates, the material is in perfect balance and does not conduct an electric current. When Mechanical pressure is applied to material by metal plates, it forces electric charges within crystal out of balance.
2. Excess negative and positive charges appear on side of crystal face.

Fig 1) At start, Net charge = 0

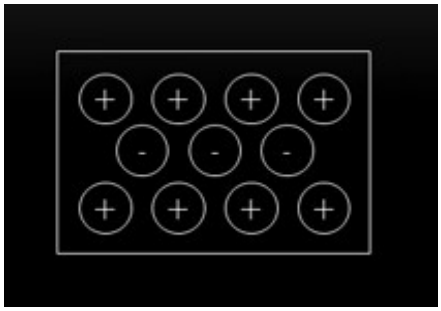

Fig – 7 (Initial Dipole moment)

Fig 2) Shift of equilibrium state, leads to accumulation of charges on opposite ends

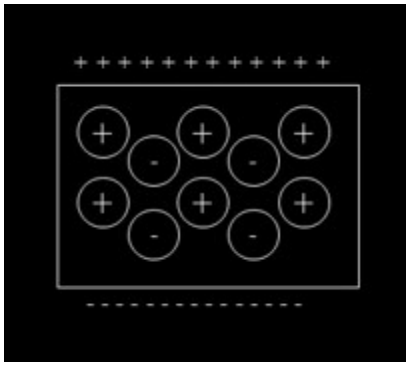

Fig – 8 (Excited state)

3. The output of the piezoelectric sensor is AC and to convert this AC voltage to DC rectifier is used.
4. The output of the rectifier is fed to the batteries for charging

6. Results

6.1 Simulation Software tool:

6.1.1 **PSIM version** 12.0

PSIM is an Electric circuit simulation software package, designed specifically for use in Power Electronics and Motor driver simulation but can be used to simulate any electronic circuit. Developed by Power-sim, PSIM uses nodal analysis and the trapezoidal rule integration as the basis of its simulation algorithm. PSIM provides a schematic capture interface and a waveform viewer Sim view. PSIM has several modules that extend its functionality into specific areas of circuit simulation and design including: control theory, Electric motors, photovaltics and wind turbines PSIM is used by industry for research and product development and it is used by educational institutions for research and teaching.

6.1.2 PSIM Simulation Procedure used for project :

Here for simulation purpose, we have selected AC power source as output coming from Piezoelectric transducers.

In real time scenario, we connected piezoelectric transducer's output to rectifier circuit

6.1.3 Simulated results (include snapshots) :

1. Snapshot of PSIM circuitry:

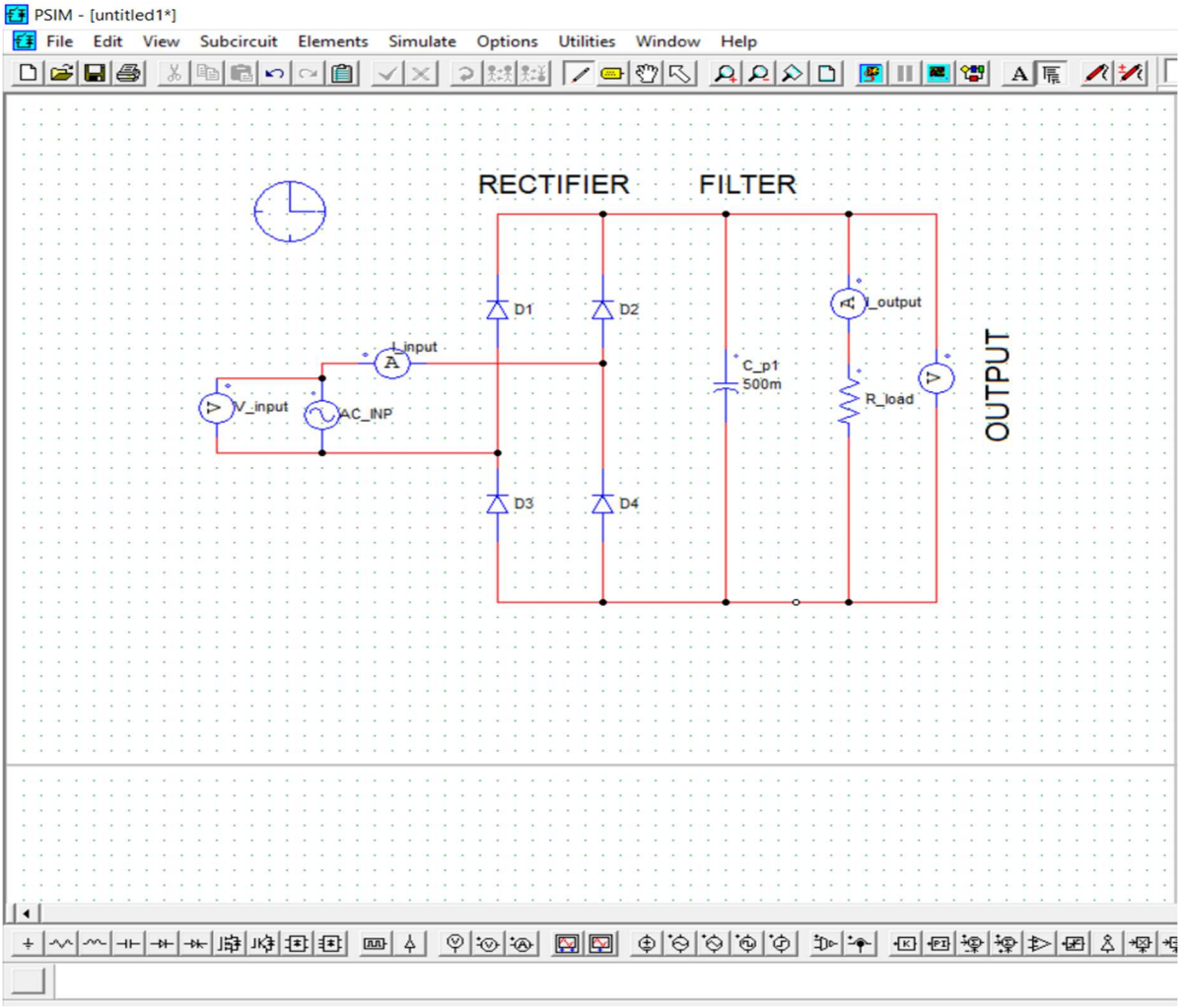

Fig - 9

1. Circuit diagram on PSIM

2.Snapshot of PSIM simulation result:

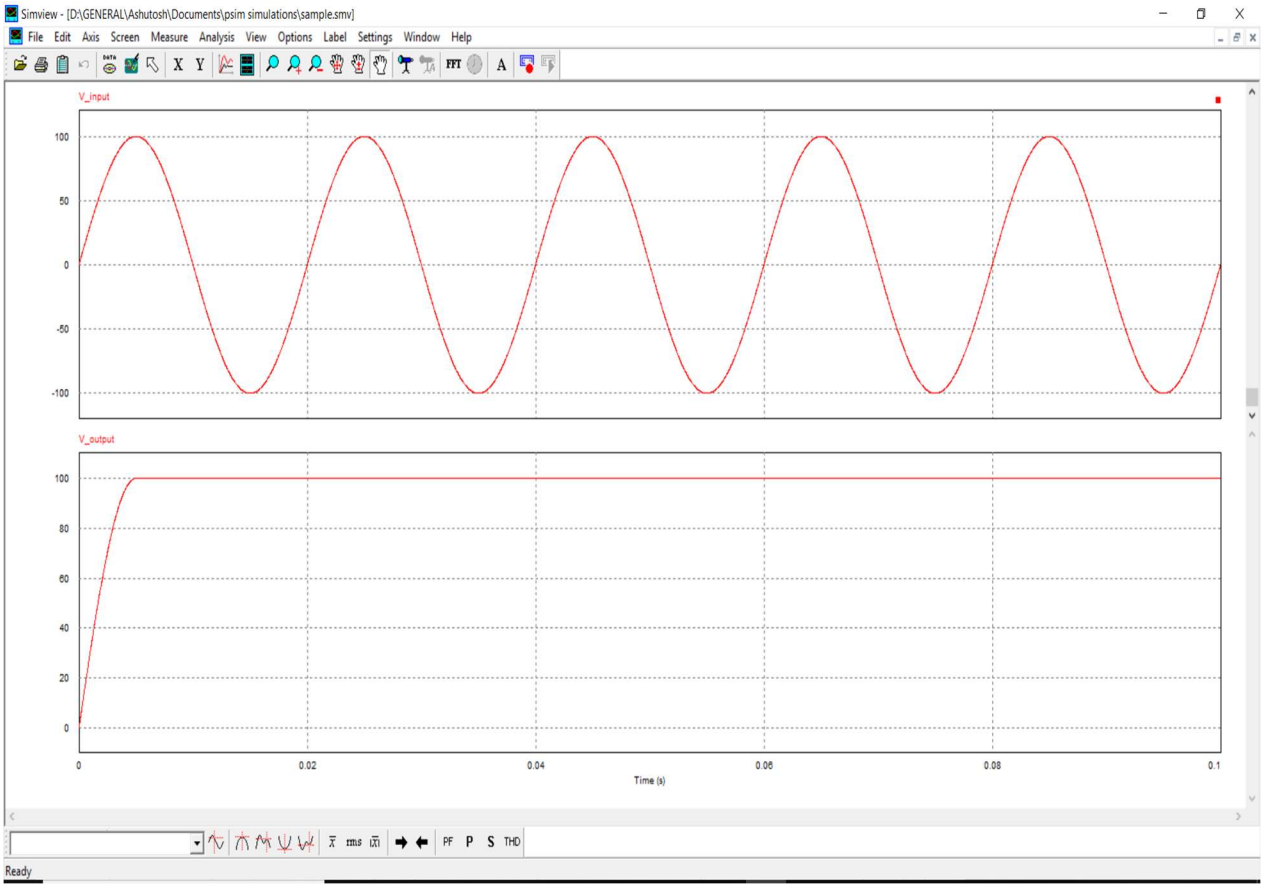

Fig - 10

2. Circuit simulation output

6.2 Mplab:

MPLAB is a proprietary freeware integrated development environment for the development of embedded applications on PIC and dsPIC microcontrollers, and is developed by Microchip Technology. MPLAB X is the latest edition of MPLAB, and is developed on the NetBeans platform.

6.2.1 Mplab code:

```
#include <xc.h>
//#include <P18f4520.h>
#include<stdio.h>
#include<stdlib.h>
//#include "lcd.h"
unsigned char L,H;
unsigned long result = 0;
```

```
unsigned long source = 0;
unsigned long read = 0;

void ADC_Init(){                    // Initialize ADC
  TRISAbits.TRISA0 = 1; //AN0 as INPUT
  PORTB = 0x00;
  CMCON = 0x07;
 ADCON0 = 0x01; //Enable ADC, at AN0 pin
 ADCON1 = 0x0C; // Configuring RA0 pin as analog input
 ADCON2 = 0x86; //Fosc/64

 }

int main() {

   ADC_Init();
   TRISB=0x00;
   while(1){
      ADCON0bits.GO = 1; //start conversion
      while(ADCON0bits.DONE == 1); //wait till conversion complete

      L=ADRESL;
                H=ADRESH;
                L>>=2;
                L &=0x3F;
      H<<=6;
      H &=0xC0;
      source = L | H;

      result = ((source * 5) / 1023);
      read = result;
      if(read==0){
         PORTB = 0x00;
      }
      if(read==1){
         PORTB = 0x1F;
      }
      /*if(read>1){
         PORTB = 0x1F;
      }
```

```
        if(read==4){
           PORTB = 0x1E;
        }
        if(read==1){
           PORTB = 0x1F;
        }*/
      }
      return 0;
   }
```

6.3 Proteus Software :

The **Proteus** Design Suite is a proprietary **software** tool suite used primarily for electronic design automation. The **software** is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards.

6.3.1 Simulated results:

Here we are giving output signal from circuit to battery and PIC18F2550 is managing and showing the battery level. There are LED's which will light up and indicates if battery is charged.

Snapshots:

1. **Battery is not charged**

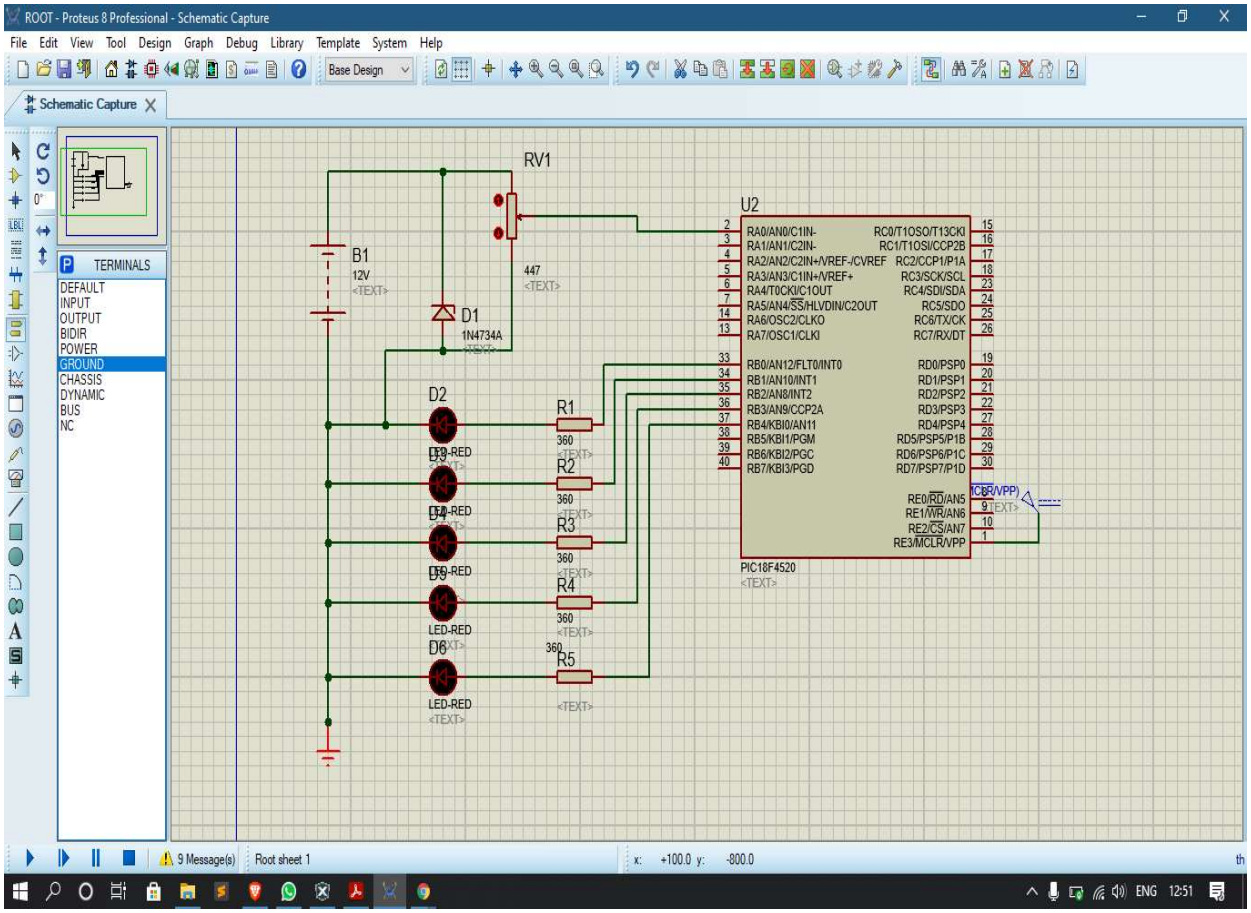

Fig – 11

2. Battery is charged and this is indicated by glowing LED

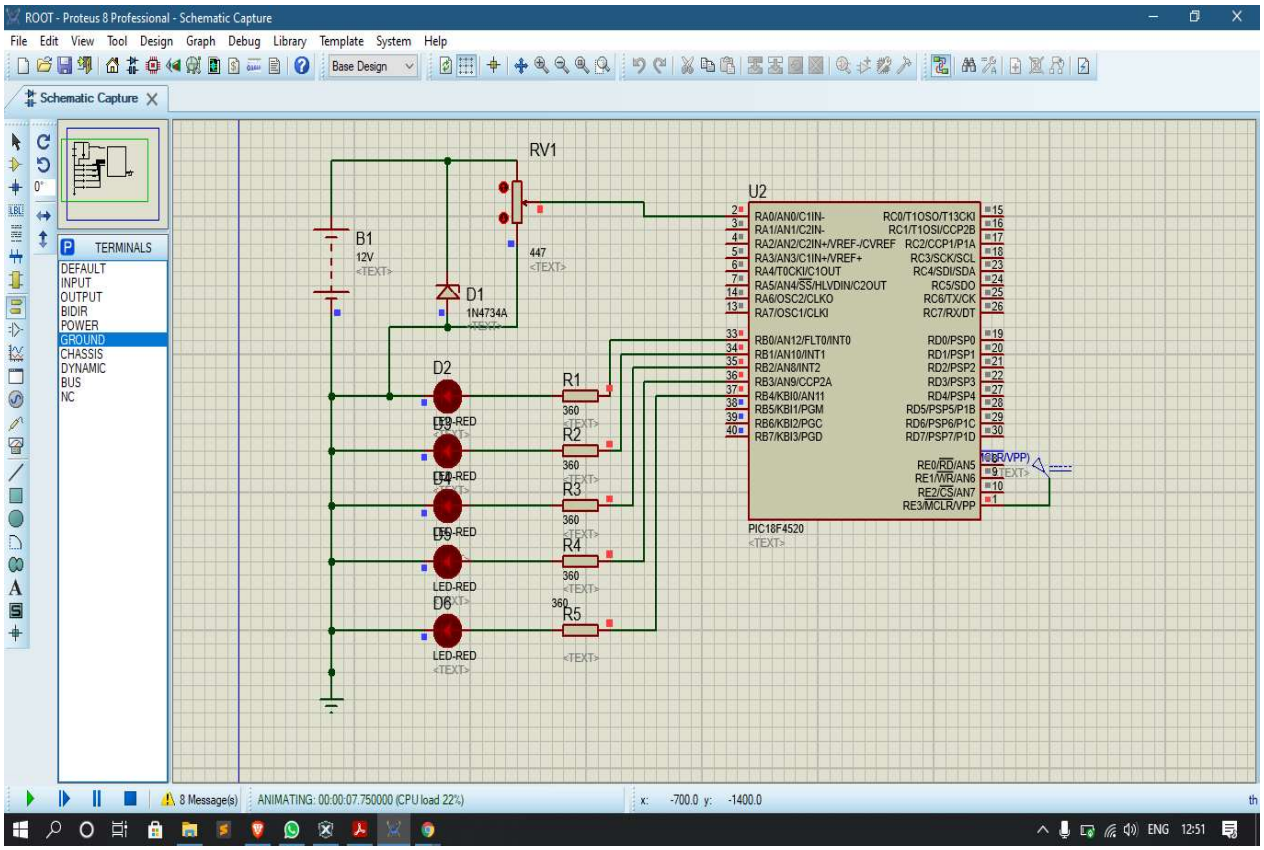

Fig - 12

7. Conclusion :

7.1 Conclusion :

- A resource of electricity is produced with mechanical energy i.e. force as input and electricity as output
- This source in no matter harms environment and its implementation can be done all over world provided, human's force will act upon it in any method (walking or any vehicle passing above it)

7.2 Advantage and Usefulness :

- The demand of electricity keeps increasing to follow population growth, prosperity improvement, and economic growth as a whole. Despite the importance of electricity and the greater demand of it, many countries still lack access of electricity. Most of the reason is about the amount of electricity payment. Then, the piezoelectric tile is the promising option to overcome the greater demand of electricity as well as the lack access of electricity.
- Besides, the tile also can overcome the electricity problem as the survival electricity generation when such disaster or extreme weather causes power loss.
- The piezoelectric ceramic tile is not only renewable electricity source but also unique, safe, reliable, geographically, and economically.
- This project is simple and easy to access.
- There is low power consumption.
- It can be operated from a long range.

7.3 Applications :

- It can be used in the area where there is crowdy it can be used as pedestrian and the energy produced will be used to light the streetlights
- It can be installed in the lift and the energy produce can be used to open and close the door of the lift.
- It can be used in the shoes and the energy produced can charge the mobile phones
- It can be used in the malls and energy produced will be used in the lighting of the mall

7.4 Disadvantages

- The main disadvantage of the tile is that it produce low amount of energy which is generated by one step
- Cost of production of the tile is little higher

8. References :

1. Y.-H. Kim, "A study of output characteristics for the generation panel using unimorph piezoelectric element," *Journal of the Korean Institute of Electrical and Electronic Material Engineers*, vol. 23, no. 3, pp. 250–259, 2010. 'Footstep Power Generation Using Piezo Electric Transducers. Kiran Boby, Aleena Paul K, Anumol.C.V, Josnie Ann Thomas, Nimisha K.K
   https://scholar.google.com/scholar_lookup?title=A%20study%20of%20output%20characteristics%20for%20the%20generation%20panel%20using%20unimorph%20piezoelectric%20element&author=Y.-H.%20Kim&publication_year=2010

2. Y.-H. Kim, "A study of output characteristics for the generation panel using unimorph piezoelectric element," *Journal of the Korean Institute of Electrical and Electronic Material Engineers*, vol. 23, no. 3, pp. 250–259, 2010. https://ieeexplore.ieee.org/document/1244755
3. Hindawi journal
   https://www.hindawi.com/journals/js/2018/7986438/

4. https://iarjset.com/upload/2015/april-15/IARJSET%206.pdf

5. C. Xu, M. Akiyama, K. Nonaka and T. Watanabe, "Electrical power generation characteristics of PZT piezoelectric ceramics", *IEEE Trans. Ultrason. Ferroelect. Freq. Contr.*, vol. 45, no. 4, pp. 1065-1070, July 1998.

   https://ieeexplore.ieee.org/document/710589