SONARGAON UNIVERSITY (SU)

FOOT STEP POWER GENERATION SYSTEM / ENERGY HARVESTINGFROM SPEED BREACKERS

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Declaration

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Certification

This is to certify that this project entitled “FOOT STEP POWER GENERATION SYSTEM/ENERGY HARVESTINGFROM SPEED BREACKERS” is done by the following students under my direct supervision. This project work has been carried out by them in the laboratories of the Department of Mechanical Engineering under the Faculty of Engineering, Sonargaon University (SU) in partial fulfillment of the requirements for the degree of Bachelor of Science in Mechanical Engineering.

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Dedicated To

OUR PARENTS

With

Love & Respect

ABSTRACT

This project is all about the generation of electrical energy through non-conventional way when people walks on floor there some forces exerts these forces usually wastes during the walking. So my idea is to convert mechanical energy of footsteps that is exerted by person during walking into electrical energy by using transducers that is known as “FOOT STEP POWER GENERATION SYSTEM / ENERGY HARVESTINGFROM SPEED BREACKERS”.

The power generating floor is used to interpret the kinetic energy into electrical power now a day’s demand of electrical energy is increasing and energy crises became the root issue in all over the world and conventional sources are not enough for total demand of electrical energy.

The principle goal of this research work is to face these energy disasters, despite the fact that it won’t meet the requirements but at least to vary and reduce the dependency on conventional electricity generation.

It can be implemented on substations and on several public places that can make difference in electrical power generation of country can make huge difference.

TABLE OF CONTENTS

DECLARATION……02
APPROVAL……03
ACKNOWLEDGEMENT……...04
ABSTRACT……....06

CHAPTER 1

INTRODUCTION

1.1 Introduction……..13
1.2 Background Study……14
1.3 Project Overview……..15
1.4 Scopes……...16
1.5 Project/Thesis Outline……..16
1.6 Methodology……16

CHAPTER 2

LITERATURE REVIEWS

2.1 Introduction…….…….17
2.2 Initiative…….……..17
2.3 Need of that System …….……18
2.4 Literature Survey…….…….18
2.4.1 Purpose……..…….……18

2.4.2 Literature Analysis……19

2.4.2.1 Aspects……...……...19

2.4.2.2 Upcoming extent……..…….20

2.5 Advantages & Disadvantages of this project……...20

2.5.1 Advantage……....20

2.5.2 Disadvantage……21

2.6 Application……..…….21

2.7 Summary……..……21

CHAPTER 3

ANALYSIS AND SIMULATION

3.1 Introduction…….……...22

3.2 Block Diagram…….…….……..22

3.3 Circuit Diagram & Description…...…….……23

3.4 Working Principle…….……23

3.4.1 Introduction…….…….…….….23

3.4.2 Description…….…….……...24

3.5 Summary…….…….……..24

CHAPTER 4

HARDWARE DEVELOPMENT

4.1 Introduction…….…….……25

4.2 Sensor……..…….…….…25

4.2.1 Piezoelectric Sensor…….…….…….....25

4.2.1.1Crystal Classes…….…….…….27

4.3 Rectifier……..…….28

4.3.1 Introduction……..…….…….28

4.3.2 Full Wave Bridge Rectifier……..…….…….29

4.3.2.1 Diode…….…….…….30

4.3.2.2 IN4007 Diode……..…….……...31

4.4 Zener Diode……...……..32

4.5 Applications of Diode……..32

4.6 Vero Board……...…….……..33

4.7 Capacitor…….…….34

4.8 NPN Transistor…….……...36

4.9 1.2v Battery…….……37

4.10 Resistor…….…….……38

4.11 OP-AMP…….…….……..40

4.12 SPDT Switch…….…….……...41

4.13 Light-Emitting Diode (LED)…….…….……42

4.14 Connecting Wire…….…….….44

4.15 List of Components with Price…….....45

4.16 Summary…….…….…….46

CHAPTER 5

RESULTS AND DISCUSSIONS

5.1 Introduction…….…….…...47

5.2 Real Model of Footstep Power Generation…….…….…...47

5.3 Energy Storing Table……..……..…48

5.4 Our Project during Pressure…….……...50

5.5 Discussion……51

5.6 Used Countries…….51

5.6.1Japan…….……..51

5.6.2 Europe……...52

5.7 Summary……...52

CHAPTER 6

CONCLUSION

6.1 Conclusion……53

REFERENCES

References……..……..55

LIST OF FIGURES

FIGURE NO	FIGURE NAME	PAGE NO
1.1	Electro-wetting method	14
1. 2	Generate by applying pressure	15
3.1	Block Diagram of the project	22
3.2	Circuit Diagram of this Project	23
4.1	Piezoelectric Sensor	26
4.2	Pressure system on Piezo	27
4.3	Schematic representation of the Piezo plate	27
4.4	Full Wave Bridge Rectifier	29
4.5	Typical Diode	30
4.6	Characteristic curve of Diode	31
4.7	Diode (IN 4007)	31
4.8	Symbol of Zener Diode	33
4.9	Vero Board	34
4.10	Capacitor Symbol	34
4.11	Our Used Capacitor	36
4.12	Transistor Symbol	36
4.13	BC547 Transistor	37

4.14	1.2v 1000mAh Battery	37
4.15	Resistor Color Code	39
4.16	Used resistor in our project	39
4.17	LM358 IC	41
4.18	SPDT switch	42
4.19	LED (Light Emitting Diode)	43
4.20	Inside of a LED (Light Emitting Diode)	43
4.21	Parts of a LED (Light Emitting Diode)	44
4.22	Connecting Wire	45
5.1	Real image of our project	48
5.2	Schematic representation of the working model	49
5.3	Our project during pressure	50
5.4	Flooring tiles on the piezo	51
5.5	Piezo used in night club	52

LIST OF TABLES

TABLE NO	TABLE NAME	PAGE NO
5.1	Energy storing system	53
4.1	Cost of the project	49,50

CHAPTER 1

INTRODUCTION

1.1 Introduction

In this paper the generation of electrical energy is described by using the weight energy. Person can amaze simply knowing that how much energy a person has by simply walking on the floor with normal speed. So the people usually have thousands steps in a day. While people walk they lose huge amount of energy that their weight energy of foot may be used and converted into electrical energy. The actual electro-kinetic floor is really an approach to make electrical energy by using kinetic energy of person who walks on the floor.

The energy that is usually produced by the floor which can make the environment sound without any pollution such kind of energy will cost effective indeed the power floor does not need any fuel or any type of energy source only by using the kinetic energy which based on the person weight who moves on the floor. Regarding this modern world now a day's energy and power are the basic key factors as the energy demand is increasing day by day so ultimate solutions of renewable energy are implemented. In case of our project we have used a technique of generating power through foot step which is the source of renewable energy that is obtained by walking on footpaths, stairs, platforms and such a system is installed mainly in populated areas.

The basic principle of 'Foot step power generation' is based on piezoelectric sensor in order to employ this system we will adjust wooden plates above and below the piezoelectric sensor and moving springs when person will walk on that mat the force will be applied in the result magnet will be fixed under the top wooden sheet and moves into the cavity. This cavity is fixed at the bottom wooden sheet of mat. As completing the above procedure, we made ourselves to be able to design a compatible system by the help of which we could run the load, Home appliances by AC output voltage.

1.2 Background Study

Earlier various researchers had work on the conversion of dynamic energy to electrical by human locomotion Jeff Krupen-kin and Ashley Taylor proposed a new technique called re-verse electro-wetting in which motion of conductive liquid on dielectric coated conductive substrate causes to create electrical energy so whenever there is any vibration on the upper plate due to human locomotion or by any mean could result in producing electrical energy as shown in following figure 1.1:

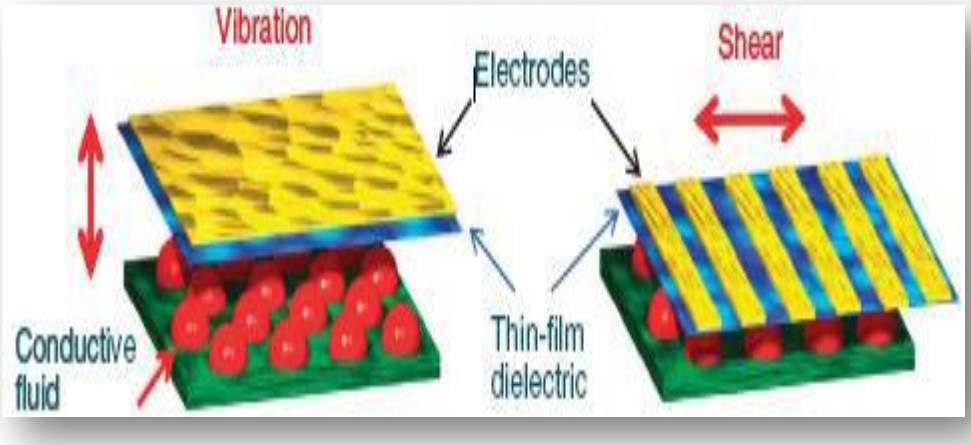


Fig: 1.1: Electro-wetting method

Scientist of the hull university also worked on transforming man motion in to electrical energy and get positive results. Various experiments had made in Japan also to harnesses energy from footsteps. They installed the special flooring tiles on the Tokyo Japan busiest stations and observe that an average person weighting 60 kg can generate 0.1 watt in single second. A similar approach with different mechanism for generation of electricity from footstep is proposed by Tom Jose. He used rick and pinion gear system with dynamo fitting with its gear mechanism as shown in following figure1.2:

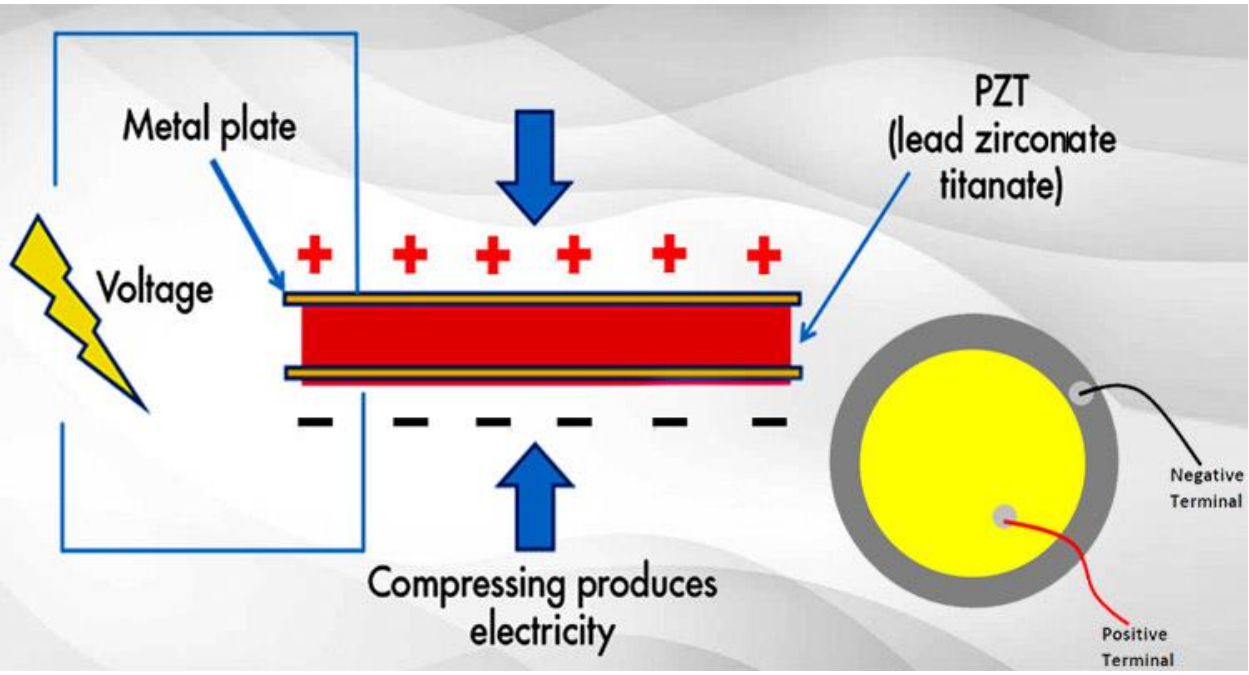


Fig: 1. 2: Generation by applying pressure

1.3 Project Overview

This project paper is divided into six chapters:

In the first chapter entitled “Introduction” that discussed about Introduction, Background Study, Scopes, and Project/Thesis Outline& Methodology

In the second chapter entitled “Literature reviews” that discussed about Introduction, Initiative, Need of that system, Literature survey, Advantages & Disadvantages of this project, Application and Summary.

In the third chapter entitled “Analysis and Simulation” that discussed about Introduction, Block Diagram, Circuit Diagram & Description, and Working Principle and Summary

In the fourth chapter entitled “Hardware Development” that discussed about Piezoelectric, Sensor, Rectifier, Diode, Vero Board, Capacitor, NPN Transistor, Battery, Resistor, OP-AMP, SPDT Switch, Light-Emitting Diode (LED), Connecting Wire, List of Components with Price and Summary.

In the fifth chapter entitled “Results and Discussions” that discussed about Introduction, Real model of Footstep Power Generation, Energy Storing Table, Our project during pressure, Discussion, Used Countries and Summary

In the sixth chapter entitled “Conclusion” that discussed about Conclusion

1.4Scopes

This report will cover the types of machinery used in Project for operating Piezoelectric Sensor, spring, diode, BC547 Transistor, LM358 IC,SPDT switch, battery, LED and Vero Board some resistors, some capacitors etc.

1.5 Project/Thesis Outline

CHAPTER 1: INTRODUCTION

CHAPTER 2: LITERATURE REVIEWS

CHAPTER 3: ANALYSIS AND SIMULATION

CHAPTER 4: HARDWARE DEVELOPMENT

CHAPTER 5: RESULTS AND DISCUSSIONS

CHAPTER 6: CONCLUSION

1.6 Methodology

This report has been done with the help of the different sources most of the program are collected from different books and website. During the preparation of the report help from supervised by faculty Nahiyan Chowdhury Sir of Sonargaon University. Although there were several sources but here some are mentioned as for the proper references.

CHAPTER 2
LITERATURE REVIEWS

2.1 Introduction

Though in this era electricity is one of the most important parts of our life, approximately 1.6 billion people still living without electricity. It's only for the high cost of power grid building and maintains. This vast quantity of energy crisis can be meeting up by footstep power generation system across the developing world. Footstep power generation system (FSPGS) is the most suitable energy resource, because it is harmless and pollution free.

2.2 Initiative

Working on the idea to harness human locomotion power, MIT (USA) architecture students James Graham and Thaddeus Jusczyk recently unveiled what they're calling the "Crowd Farm," a setup that would derive energy from pounding feet in crowded places. This technology is a proposal to harness human power as a source of sustainable energy. Population of Bangladesh, India and their mobility of its masses will turn into boon in generating electricity from its (population's) footsteps. Human locomotion in over crowded subway stations, railway stations, bus stands, airports, temples or rock concerts thus can be converted to electrical energy with the use of this promising technology. The technology would turn the mechanical energy of people walking or jumping into a source of electricity. The students' test case, displayed at the Venice Biennale and in a train station in Torino, Italy, was a prototype stool that exploits the passive act of sitting to generate power. The weight of the body on the seat causes a flywheel to spin, which powers a dynamo that, in turn, lights five LEDs. In each case, there would be a subflooring system consisting of independent blocks. When people walk across this surface, the forces they impart will cause the blocks to slip slightly, and a dynamo would convert the energy in those movements into electric current. Students say that moving from this Proof-of-concept device to a large-scale Crowd Farm would be expensive, but it certainly sounds a great option.

2.3Need of that System

Proposal for the utilization of waste energy of foot power with human locomotion is very much relevant and important for highly populated countries like Bangladesh, India and China where the roads, railway stations, bus stands, temples, etc. are all over crowded and millions of people move around the clock. This whole human bioenergy being wasted if can be made possible for utilization it will be great invention and crowd energy farms will be very useful energy sources in crowded countries. Walking across a "Crowd Farm," floor, then will be a fun for idle people who can improve their health by exercising in such farms with earning. The electrical energy generated at such farms will be useful for nearby applications

- The utilization of waste energy of foot power with human motion is very important for highly populated countries.

- Bangladesh, India and China where the roads, railway stations, temples, etc. are all over crowded and millions of people move around the clock.

2.4 Literature Survey

2.4.1 Purpose

There are some methods to generate electrical energy from the footsteps. Such as Gear wheel and fly wheel are methods to generate electrical power. This method works on the principle and in it mechanical parts are used because this is placed where there are so many people and the energy is produced by their movements on the floor.

Generation of power is done by footsteps from the crowed on floor and piezo plate scheme is used below the floor, then there will be sheet which cover the piezo-plate and also spring will be there for vibrating force on piezo sensor.

The piezo plate will be struck in the floor such a plates will generate power in the form of electric current. The power which is produced by footsteps can be used as additional features like street light or light which is used at the place of pedestrian’s. So the pedestrians should give credit the energy which is produced by their movement.

2.4.2 Literature Analysis

Generate electrical power by using footsteps. The footsteps are more than enough to produce electrical energy.

Following are the few method of generating power like the steps of fly and gear wheel method and piezo plate is also used in these steps.

- To arrange the electrical components and equipment properly to convert the mechanical energy into electrical energy.
- After arranging the electrical system in proper manner that will transfer mechanical energy into electrical energy.
- Then spring is attached to piezo with the help of Sheet in this manner spring arrangement is done, spring is used to vibrate the piezo by force then power will be generated.
- After that voltage which is produced through the steps can be rectified and after betry charger circuit the DC voltage will be stored in the 3.6-volt battery of lead acid.
- Finally, the AC voltage can be used in many appliances like charging the laptop battery as well as to charge the handset; it may also use to lightening up energy saver.
- If we need more power in this method then use more steps for more energy also the ability of battery and inverter should be increase, then output will be increased.

2.4.2.1 Aspects

The main features of power generation through foot step by piezo electric are that the power generated by transforming mechanical energy into electrical by movement of people on the floor where piezo plate is placed. Piezo electric power system is safe and secures to use it is totally risk free method this system will not produce any problem and discomfort for people. Foot step power generation through piezoelectric process has electrical and mechanical parts but it hasn't so many losses. This system has low cost if the system is damaged so no issue the cost of equipment is very low. This system has also ability to store the electrical power in the batteries. Foot step power generation system is cheap reliable and efficient method.

2.4.2.2Upcoming extent

Now world is stirring to the renewable resources due to worldwide heating so our this project foot step power generation through piezo electric has vast extent. Other renewable sources are also used such like sterling plant, biogas, wind turbine etc.

But if we compare them with foot step power generation through piezo electric sensor so this will be inexpensive, useful, efficient and reliable as compare to other renewable resources.

2.5 Advantages & Disadvantages of this project

2.5.1 Advantage

- Power generation is simply walking on step.
- No need fuel input.
- This is a Non-conventional system.
- No moving parts.
- Long life service.
- Self-generating.
- No external power required.
- Compact yet highly sensitive.
- Reliable, Economical, Eco-Friendly.
- Less consumption of Non-renewable energies.
- Power also generated by running or exercising on the step.
- Battery is used to store the generated power.
- Extremely wide dynamic range, almost free of noise.
- Simple circuit.

2.5.2 Disadvantage

- Only application the particular place.
- Initial cost of this arrangement is high,
- Output affected by temperature variation.
- Care should be taken for batteries.

2.6 Application

- Foot step generated power can be used for home applications, street lighting.
- It can use in emergency power failure situations like hospitals.
- It can be used as a source for both A.C. and D.C applications.
- It is also used in College, Universities, Cinema Theatres, Shopping Complex, Railway Stations, Bus stations, Airports.
- Electric escalators.

2.7 Summary

In this chapter has discussed about principle of footstep power generation system. It has included literature survey, literature analysis, advantage, disadvantage and application of this project.

CHAPTER 3
ANALYSIS AND SIMULATION

3.1 Introduction

Whenever force is applied on Piezo electric crystals that force is converted to Electrical energy is used to drive DC loads. And that minute voltage which is stored in the lead acid battery. We are using conventional battery charging unit also for giving supply to the circuitry.

3.2 Block Diagram

The block diagram of Footstep Power Generation content project comprises seven main components namely sensor, rectifier, transistor, resistor, IC, battery and LED (Load). The block diagram of the project as given next page:

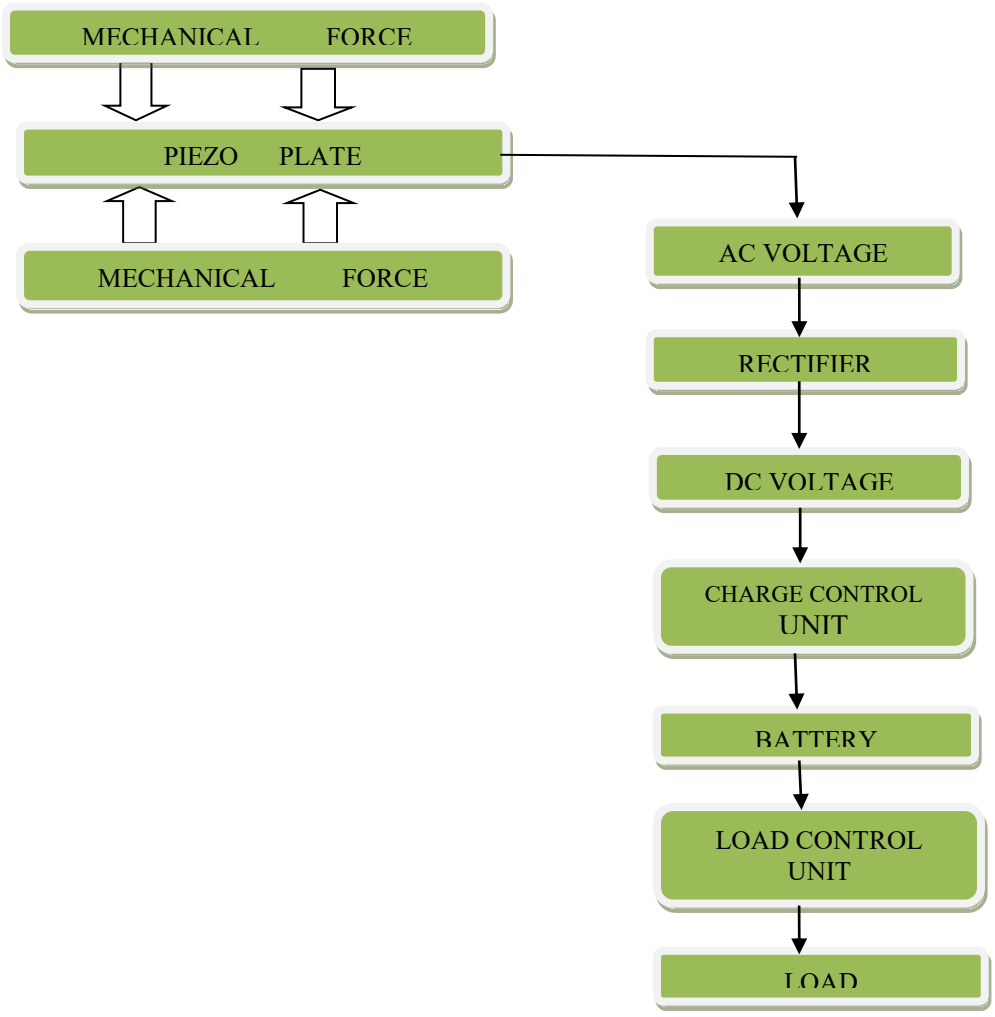


Fig: 3.1 Block Diagram of the Project

3.3 Circuit Diagram & Description

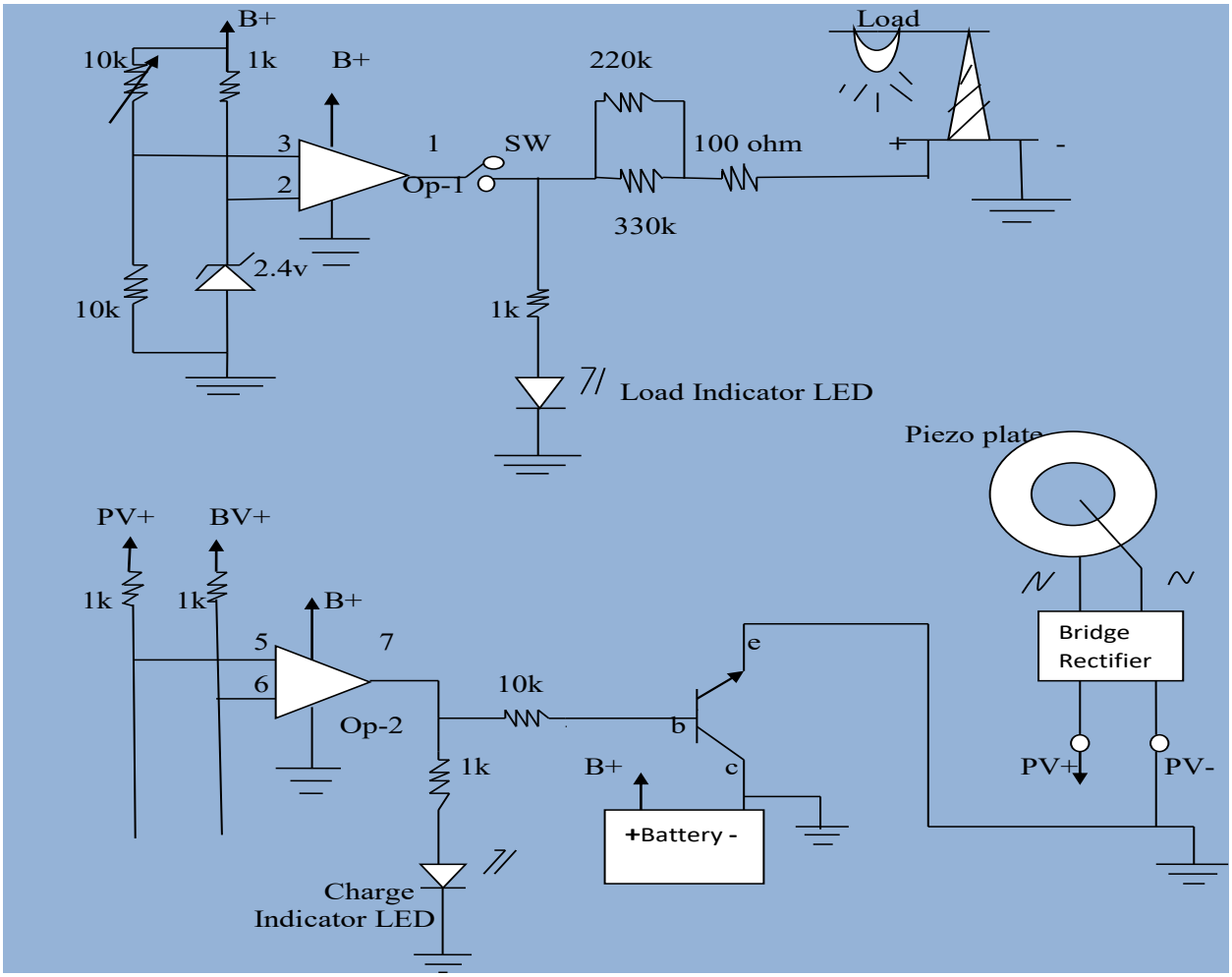


Fig: 3.2: Circuit Diagram of this Project

The schematic diagram is shown in above figure. A tile made up of piezo material generates voltage across a piezo tile which is supplied to a bridge rectifier circuit to obtained DC voltage and given to a rechargeable battery and thus the battery gets charged and this can be used to drive DC loads. The battery used here is a lead acid battery of 3.6V.

3.4 Working Principle

3.4.1 Introduction

Key concept of working of this system is capturing unused energy from surrounding any system and converting it into electrical energy. The piezoelectric placed under insulating material like hard rubber and pressure created by foot step and water fall pressure will produce electrical

energy which can be stored and used for domestic purpose. The property of piezoelectric material is to generate electricity when we apply pressure. It has two axis, mechanical axis & electrical axis. When we apply pressure in mechanical axis, it generates power in its electrical axis. Piezo means the generation of the electrical polarization of a material as a response to mechanical strain. This phenomenon is known as direct effect or generator effect and is applied fundamentally in the manufacture of sensors (mobile phone vibrators, lighters, etc.). In these cases piezoelectric materials, also used in actuators, undergo an inverse or motor effect, i.e. a mechanical deformation due to the application of an electrical signal.

3.4.2 Description

Generate electrical power by using footsteps. The footsteps are more than enough to produce electrical energy. Following are the few method of generating power like the steps of fly and gear wheel method and piezo plate is also used in these steps.

The basic working principle of our project is based on the piezoelectric sensor.

- To arrange the electrical components and equipment properly to convert the mechanical energy into electrical energy
- After arranging the electrical system in proper manner that will transfer mechanical energy into electrical energy

The spring is attached to piezo with the help of Sheet in this manner spring arrangement is done, spring is used to vibrate the piezo by force then power will be generated

- After that voltage which is produced through the steps can be rectified and after battery charger circuit the DC voltage will be stored in the 3.6-volt battery of lead acid
- If we need more power in this method then use more steps for more energy also the ability of battery and inverter should be increase, then output will be increased.
- Footstep board it consist of 4 piezoelectric sensors which are connected in parallel.

3.5 Summary

In this chapter has discussed about working principle of this system. It has included block diagram, circuit diagram and description of this project. It has also explained operating system of the project.

CHAPTER 4

HARDWARE DEVELOPMENT

4.1Introduction

To develop this power generation system we have used several devices like, piezoelectric sensor, spring, diode, capacitor, BC547 transistor, resistor, LM358 IC, SPDT switch, battery, LED and Vero board so on. The description of these components as bellow:

4.2 Sensor

A sensor is a device that measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument. For example, mercury converts the measured temperature into expansion and contraction of a liquid which can be read on a calibrated glass tube. At thermocouple converts temperature to an output voltage which can be read by a voltmeter. For accuracy, most sensors are calibrated against known standards.

4.2.1 Piezoelectric Sensor

A piezoelectric sensor is a device that uses the piezoelectric effect to measure pressure, acceleration, strain or force by converting them to an electrical signal. Piezoelectric sensors have proven to be versatile tools for the measurement of various processes. They are used for quality assurance, process control and for research and development in many different industries it was only in the 1950s that the piezoelectric effect started to be used for industrial sensing applications. Since then, this measuring principle has been increasingly used and can be regarded as a mature technology with an outstanding inherent reliability. It has been successfully used in various applications, such as in medical, aerospace, nuclear instrumentation, and as a pressure sensor in the touch pads of mobile phones. In the automotive industry, piezoelectric elements are used to monitor combustion when developing internal combustion engines. The sensors are either directly mounted into additional holes into the cylinder head or the spark/glow plug is equipped with a built in miniature piezoelectric sensor.

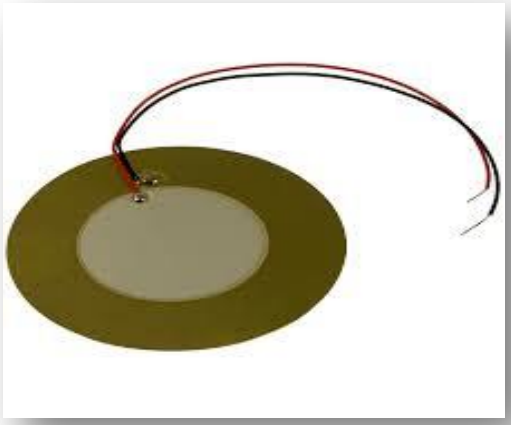


Fig: 4.1: Piezoelectric Sensor

The rise of piezoelectric technology is directly related to a set of inherent advantages. The high modulus of elasticity of many piezoelectric materials is comparable to that of many metals. Even though piezoelectric sensors are electromechanical systems that react to compression; the sensing elements show almost zero deflection. This is the reason why piezoelectric sensors are so rugged, have an extremely high natural frequency and an excellent linearity over a wide amplitude range. Additionally, piezoelectric technology is insensitive to electromagnetic fields and radiation, enabling measurements under harsh conditions. Some materials used (especially gallium phosphate or tourmaline) have an extreme stability even at high temperature, enabling sensors to have a working range of up to 1000°C. Tourmaline shows piezoelectricity in addition to the piezoelectric effect; this is the ability to generate an electrical signal when the temperature of the crystal changes. This effect is also common to piezo ceramic materials.

One disadvantage of piezoelectric sensors is that they cannot be used for truly static measurements. A static force will result in a fixed amount of charges on the piezoelectric material. While working with conventional readout electronics, imperfect insulating materials, and reduction in internal sensor resistance will result in a constant loss of electrons, and yield a decreasing signal.

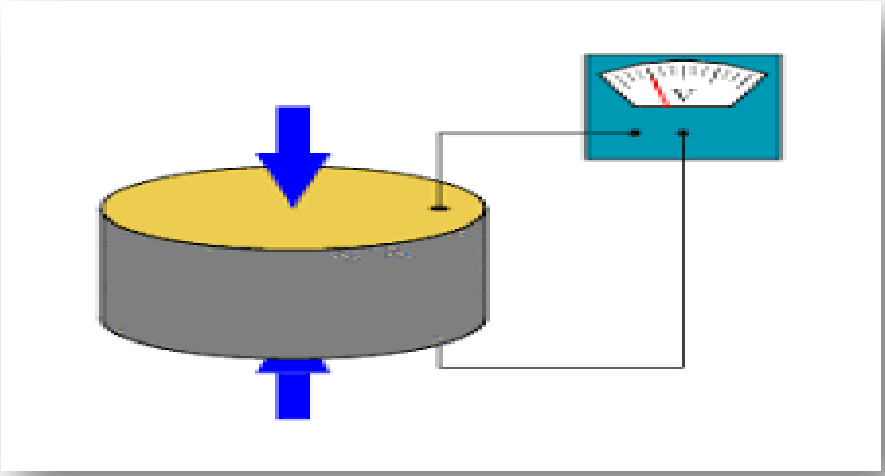


Fig: 4.2: Pressure system on piezo

Elevated temperatures cause an additional drop in internal resistance and sensitivity. The main effect on the piezoelectric effect is that with increasing pressure loads and temperature, the sensitivity is reduced due to twin-formation. While quartz sensors need to be cooled during measurements at temperatures above 300°C, special types of crystals like GalPO4 gallium phosphate do not show any twin formation up to the melting point of the material.

4.2.1.1 Crystal Classes

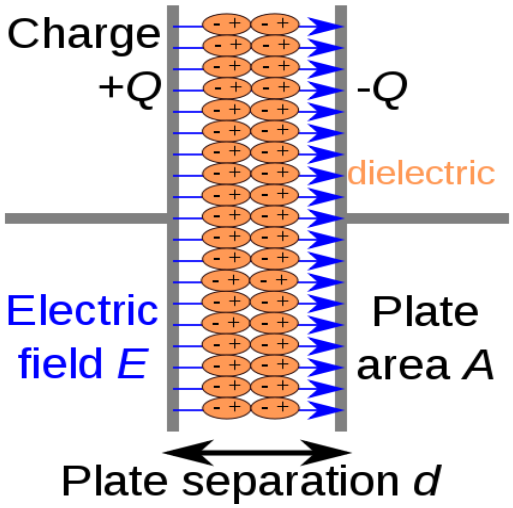


Fig: 4.3: Schematic representation of the Piezo plate

Any spatially separated charge will result in a field, and therefore a potential. Shown here is a standard dielectric in a capacitor. In a piezoelectric device, mechanical stress, instead of an externally applied voltage, causes the charge separation in the individual atoms of the material, of the thirty-two crystal, twenty-one are non-Centre symmetric (not having a Centre of symmetry), and of these, twenty exhibit direct piezoelectricity (the 21st is the cubic class432). Ten of these represent the polar crystal classes, which show a spontaneous polarization without mechanical stress due to a non-vanishing electric moment associated with their unit and which exhibit piezoelectricity. If the dipole moment can be reversed by the application of an electric field, the material is said to be ferroelectric

- Polar crystal classes: 1, 2, m, mm2, 4, 4 mm, 3, 3m, 6, 6 mm.
- Piezoelectric crystal classes: 1, 2, m, 222, mm2, 4, 4, 422, 4 mm,42m, 3, 32, 3m, 6, 6, 622, 6 mm, 62m, 23, 43m.

For polar crystals, for which $P \neq 0$ holds without applying a mechanical load, the piezoelectric effect manifests itself by changing the magnitude or the direction of P or both.

For the non-polar, but piezoelectric crystals, on the other hand, a polarization P different from zero is only elicited by applying a mechanical load. For them the stress can be imagined to transform the material from a non- polar crystal class ($P = 0$) to a polar one, having $P \neq 0$.

4.3Rectifier

4.3.1Introduction

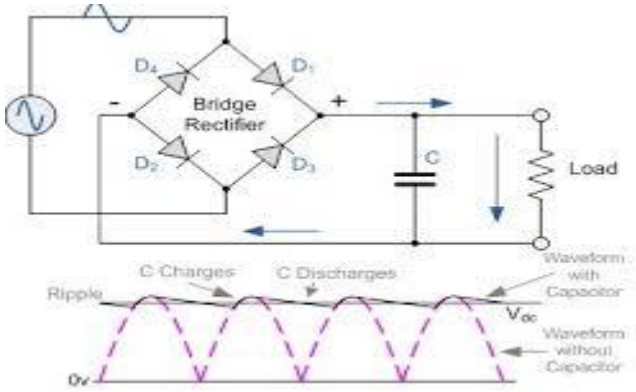
A rectifier is an electrical device composed of one or more diodes that converts alternating current (AC) to direct current (DC) by using one or more P-N junction diodes.



The output from the transformer is fed to the rectifier. It converts A.C. into pulsating D.C. The rectifier may be a half wave or a full wave rectifier. In this project, a full wave bridge rectifier is used because of its merits like good stability and full wave rectification.

4.3.2 Full Wave Bridge Rectifier

Full wave bridge rectifier is another type of full wave rectifier used to convert an alternating current input into a direct current output. In a bridge circuit configuration, it comprises of four diodes that provide the same polarity of output for either polarity of the input. The main feature of this diode bridge which makes it more efficient than Centre tap rectifier is its polarity i.e. the polarity of output is same as that of input.



Fig; 4.4: Full Wave Bridge Rectifier

The bridge rectifier is a circuit, which converts an A.C. voltage to dc voltage using both half cycles of the input ac voltage. The Bridge rectifier circuit is shown in the figure. The circuit has four diodes connected to form a bridge. The ac input voltage is applied to the diagonally opposite ends of the bridge. The load resistance is connected between the other two ends of the bridge.

For the positive half cycle of the input ac voltage, diodes D1 and D3 conduct, whereas diodes D2 and D4 remain in the OFF state. The conducting diodes will be in series with the load resistance RL and hence the load current flows through RL. For the negative half cycle of the input ac voltage, diodes D2 and D4 conduct whereas, D1 and D3 remain OFF.

The conducting diodes D2 and D4 will be in series with the load resistance RL and hence the current flows through RL in the same direction as in the previous half cycle. Thus bi-directional wave is converted into a unidirectional wave. The diode used in this rectifier is D=1N4007.

4.3.2.1Diode

A diode is a device which only allows unidirectional flow of current if operated within a rated specified voltage level.

A diode only blocks current in the reverse direction while the reverse voltage is within a limited range otherwise reverse barrier breaks and the voltage at which this breakdown occurs is called reverse breakdown voltage. The diode acts as a valve in the electronic and electricalcircuit. A P-N junction is the simplest form of the diode which behaves as ideally short circuit when it is in forward biased and behaves as ideally open circuit when it is in the reverse biased. Beside simple PN junction diodes, there are different types of diodes although the fundamental principles are more or less same. So a particular arrangement of diodes can convert AC to pulsating DC, and hence, it is sometimes also called as a rectifier.

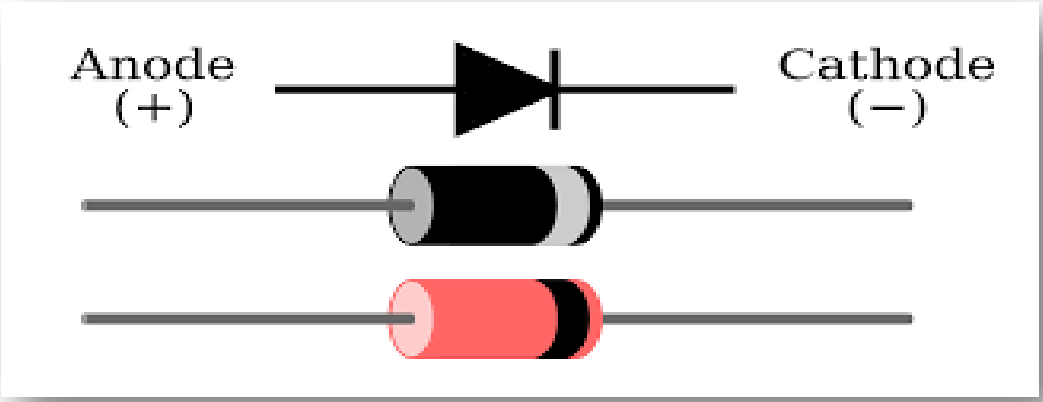


Fig: 4.5: Typical Diode

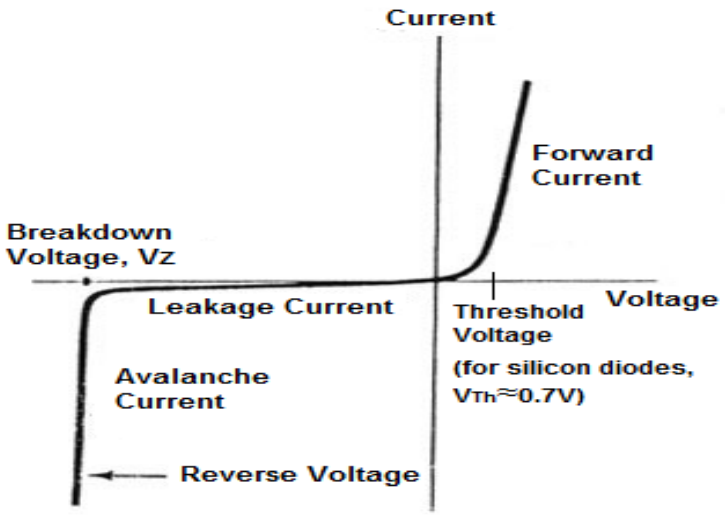


Fig: 4.6: Characteristic curve of Diode

4.3.2.2 IN4007 Diode

IN4007 diode is a very simple, common rectifier diode. It's another name is often used for reverse voltage protection; the IN4007 is a staple for much power and breadboard projects. IN4007 is rated for up to 1A/1000V.

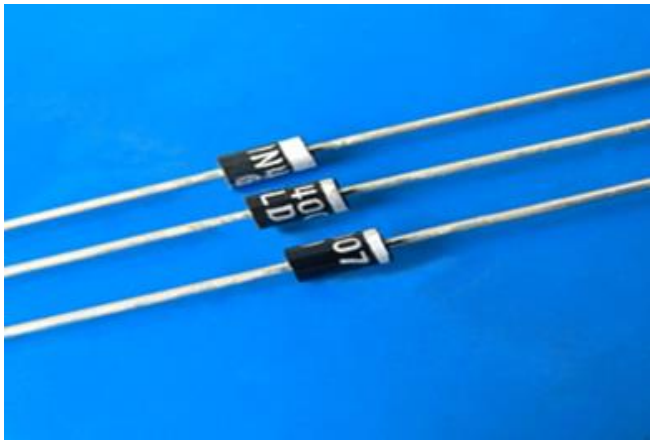


Fig: 4.7: Diode (IN 4007)

4.4 Zener Diode

A Zener diode is a particular type of diode that, unlike a normal one, allows current to flow not only from its anode to its cathode, but also in the reverse direction, when the so-called "Zener voltage" is reached. Zener diodes have a highly doped p-n junction. Normal diodes will also break down with a reverse voltage but the voltage and sharpness of the knee are notas well defined as for a Zener diode. Also normal diodes are not designed to operate in the breakdown region, but Zener diodes can reliably operate in this region.

The device was named after Clarence Melvin Zener, who discovered the Zener effect. Zener reverse breakdown is due to electron quantum tunneling caused by a high strength electric field. However, many diodes described as "Zener" diodes rely instead on avalanche breakdown. Both breakdown types are used in Zener diodes with the Zener effect predominating under 5.6 V and avalanche breakdown above.

Zener diodes are widely used in electronic equipment of all kinds and are one of the basic building blocks of electronic circuits. They are used to generate low power stabilized supply rails from a higher voltage and to provide reference voltages for circuits, especially stabilized power supplies. They are also used to protect circuits from over-voltage, especially electrostatic discharge (ESD).

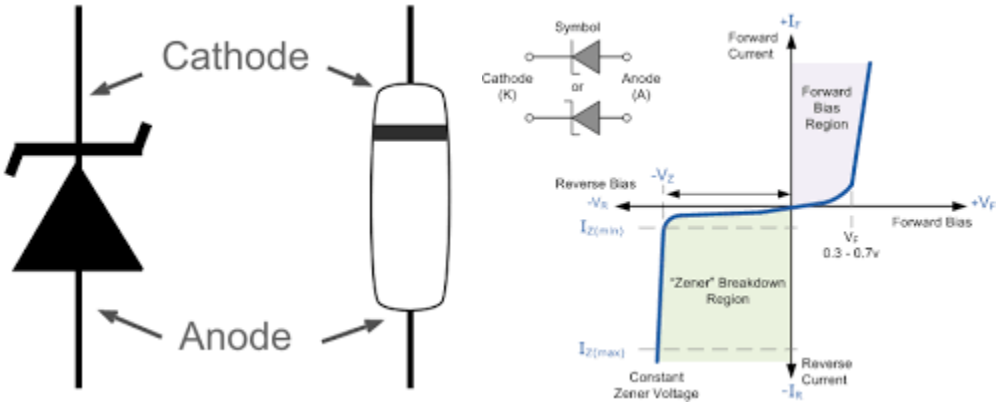




Fig: 4.8: Symbol of Zener Diode

4.5 Applications of Diode:

- Rectifying a voltage, such as turning AC into DC voltages.
- Isolating signals from a supply.
- Voltage Reference.
- Controlling the size of a signal.
- Mixing signals.
- Detection signals.
- Lighting.
- Lasers diodes.

4.6 Vero Board

Vero board is a brand of strip board, a pre-formed circuit board material of copper strips on an insulating bonded paperboard which was originated and developed in the early 1960s by the Electronics Department of Vero Precision Engineering Ltd (VPE). It was introduced as a general-purpose material for use in constructing electronic circuits - differing from purpose-designed printed circuit boards (PCBs) in that a variety of electronic circuits may be constructed using a standard wiring board.

The first single-size Vero board product was the forerunner of the numerous types of prototype wiring board which, with worldwide use over five decades, have become known as strip board. The generic terms 'Vero board' and 'strip board' are now taken to be synonymous.

The original and best strip board available, invented by Vero, and resulting in a range of prototyping boards with copper tracks and punched component holes in Euro card and Non Euro card sizes. Products are available with single or double sided copper and as bare boards without copper.



Fig: 4.9: Vero Board

4.7Capacitor

A capacitor is a passive two-terminal electrical component that stores electrical energy in an electric field.The effect of a capacitor is known as capacitance. While capacitance exists between any two electrical conductors of a circuit in sufficiently close proximity, a capacitor is specifically designed to provide and enhance this effect for a variety of practical applications by consideration of size, shape, and positioning of closely spaced conductors, and the intervening dielectric material. A capacitor was therefore historically first known as an electric condenser.

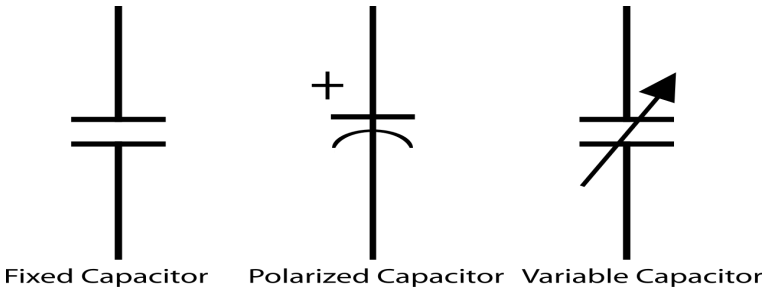


Fig: 4.10: Capacitor Symbol

The physical form and construction of practical capacitors vary widely and many capacitor types are in common use. Most capacitors contain at least two electrical conductors often in the form of metallic plates or surfaces separated by a dielectric medium. A conductor may be a foil, thin film, sintered bead of metal, or an electrolyte. The non-conducting dielectric acts to increase the capacitor's charge capacity. Materials commonly used as dielectrics include glass, ceramic, plastic film, paper, mica, and oxide layers. Capacitors are widely used as parts of electrical circuits in many common electrical devices. Unlike a resistor, an ideal capacitor does not dissipate energy.

When two conductors experience a potential difference, for example, when a capacitor is attached across a battery, an electric field develops across the dielectric, causing a net positive charge to collect on one plate and net negative charge to collect on the other plate. No current actually flows through the dielectric; however, there is a flow of charge through the source circuit. If the condition is maintained sufficiently long, the current through the source circuit ceases. However, if a time-varying voltage is applied across the leads of the capacitor, the source experiences an ongoing current due to the charging and discharging cycles of the capacitor.

Capacitance is defined as the ratio of the electric charge on each conductor to the potential difference between them. The unit of capacitance in the International System of Units (SI) is the farad (F), defined as one coulomb per volt (1 C/V). Capacitance values of typical capacitors for use in general electronics range from about 1 Pico farad (pF) (10^{-12} F) to about 1 mill farad (mF) (10^{-3} F).

The capacitance of a capacitor is proportional to the surface area of the plates (conductors) and inversely related to the gap between them. In practice, the dielectric between the plates passes a small amount of leakage current. It has an electric field strength limit, known as the voltage. The conductors and leads introduce an undesired inductance and resistance.

Capacitors are widely used in electronic circuits for blocking direct current while allowing alternating current to pass. In analog filter networks, they smooth the output of power supplies. In resonant circuits they tune radios to particular frequencies. In electric power transmission systems, they stabilize voltage and power flow. The property of energy storage in capacitors was exploited as dynamic memory in early digital computers.

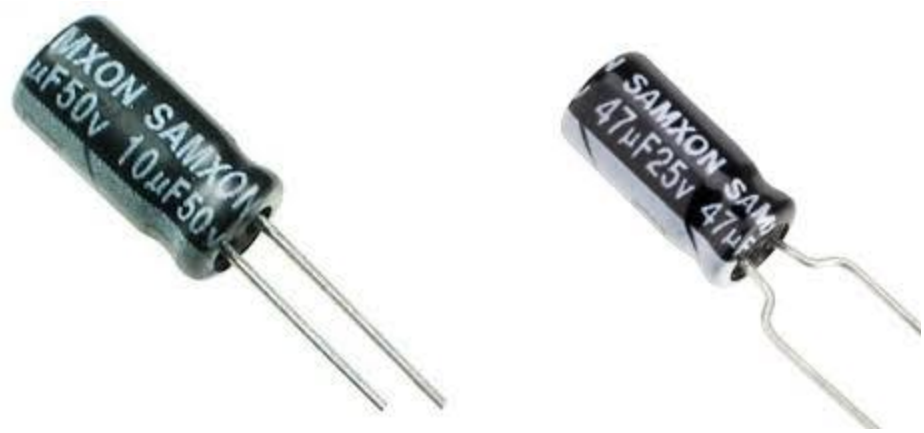


Fig: 4.11: Our Used Capacitor

4.8 NPN Transistor

NPN is one of the two types of bipolar transistors, consisting of a layer of P-doped semiconductor (the "base") between two N-doped layers. A small current entering the base is amplified to produce a large collector and emitter current. A bipolar junction transistor (bipolar transistor or BJT) is a type of transistor that uses both electron and hole charge carriers. In contrast, unipolar transistors, such as field-effect transistors, only use one kind of charge carrier. For their operation, BJTs use two junctions between two semiconductor types, n-type and p-type.

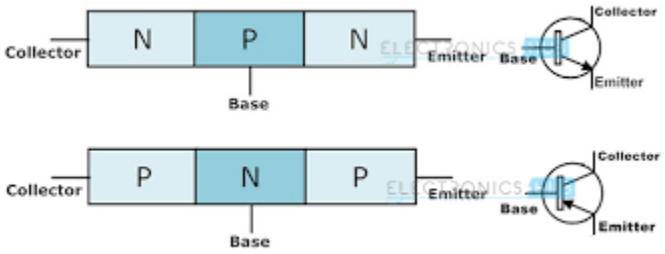


Fig: 4.12: Transistor Symbol

BJTs are manufactured in two types, NPN and PNP, and are available as individual components, or fabricated in integrated circuits, often in large numbers. The basic function of a BJT is to amplify current. This allows BJTs to be used as amplifiers or switches, giving them wide applicability in electronic equipment, including computers, televisions, mobile phones, audio amplifiers, industrial control, and radio transmitters.

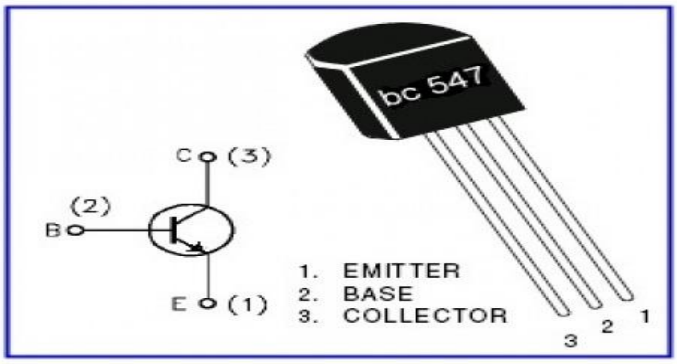


Fig: 4.13: BC547 Transistor

4.9 1.2v Battery

Battery (electricity), an array of electrochemical cells for electricity storage, either individually linked or individually linked and housed in a single unit. An electrical battery is a combination of one or more electrochemical cells, used to convert stored chemical energy into electrical energy. Batteries may be used once and discarded, or recharged for years as in standby power applications. Miniature cells are used to power devices such as hearing aids and wristwatches; larger batteries provide standby power for telephone exchanges or computer data centers.



Fig: 4.14: 1.2v 1000mAh Battery

Lead-acid batteries are the most common in PV systems because their initial cost is lower and because they are readily available nearly everywhere in the world. There are many different sizes and designs of lead-acid batteries, but the most important designation is that they are deep cycle batteries. Lead-acid batteries are available in both wet-cell (requires maintenance) and sealed no-

maintenance versions. Lead acid batteries are reliable and cost effective with an exceptionally long life. The Lead acid batteries have high reliability because of their ability to withstand overcharge, over discharge vibration and shock.

The use of special sealing techniques ensures that our batteries are leak proof and no spoilable. The batteries have exceptional charge acceptance, large electrolyte volume and low self-discharge, which make them ideal as zero- maintenance batteries lead acid batteries are manufactured/tested using CAD (Computer Aided Design). These batteries are used in Inverter & UPS Systems and have the proven ability to perform under extreme conditions. The batteries have electrolyte volume, use PE Separators and are sealed in sturdy containers, which give them excellent protection against leakage and corrosion.

4.10 Resistor

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses. High-power resistors that can dissipate many watts of electrical power as heat may be used as part of motor controls, in power distribution systems, or as test loads for generators. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage. Variable resistors can be used to adjust circuit elements (such as a volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity.

Resistors are common elements of electrical networks and electronic circuits and are ubiquitous in electronic equipment. Practical resistors as discrete components can be composed of various compounds and forms. Resistors are also implemented within integrated circuits.

The electrical function of a resistor is specified by its resistance: common commercial resistors are manufactured over a range of more than nine orders of magnitude. The nominal value of the resistance falls within the manufacturing tolerance, indicated on the component.

The current through a resistor is in direct proportion to the voltage across the resistor's terminals. This relationship is represented by Ohm's law:

$$I = \frac{V}{R}$$

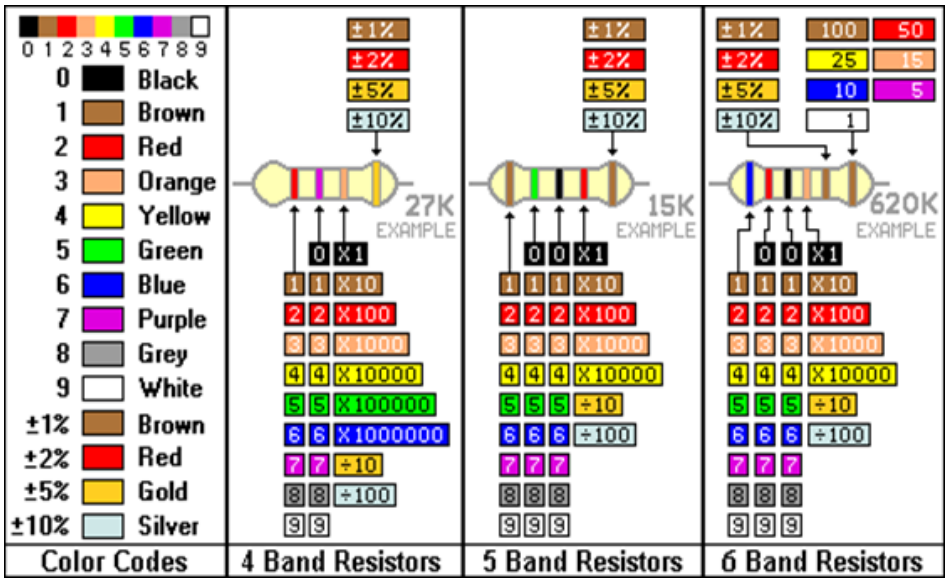
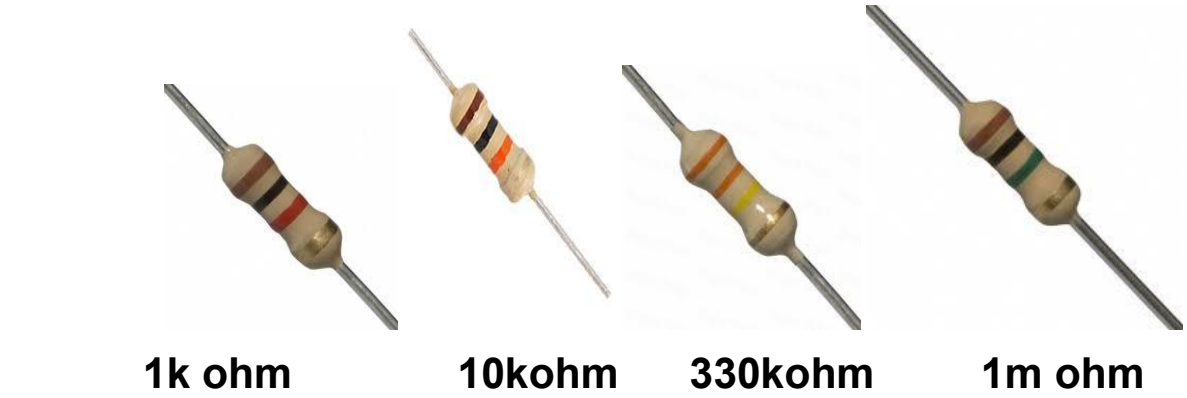


Fig: 4.15: Resistor Color Code



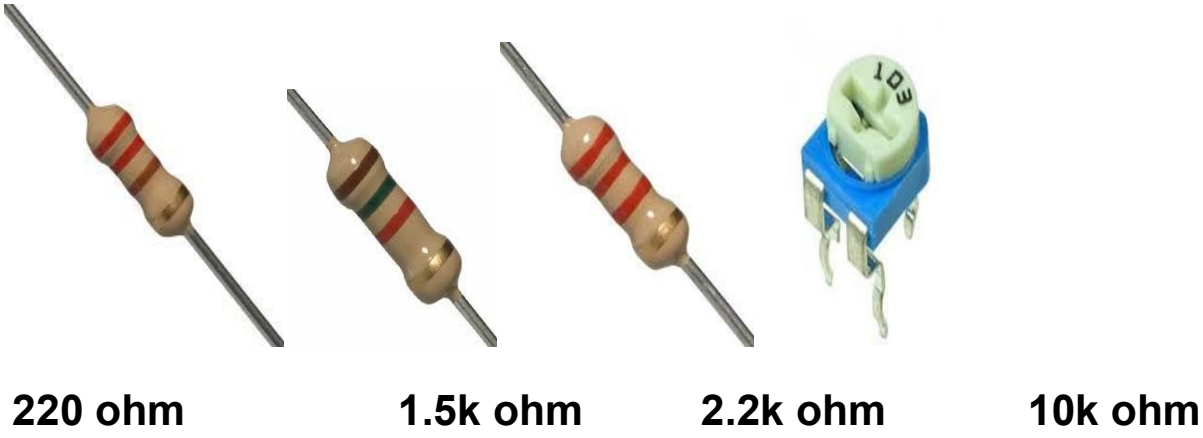


Fig: 4.16: Used resistor in our Project

Where the current through the conductor in units of amperes, V is the potential difference measured across the conductor in units of volts, and *R* is the resistance of the conductor in units is (ohms).

The ratio of the voltage applied across a resistor's terminals to the intensity of current in the circuit is called its resistance, and this can be assumed to be a constant (independent of the voltage) for ordinary resistors working within their ratings.

4.11 OP-AMP

An operational amplifier (often op-amp or opamp) is a DC-coupled high-gain electronic voltage amplifier with a differential input and, usually, a single-ended output.In this configuration, an op-amp produces an output potential (relative to circuit ground) that is typically hundreds of thousands of times larger than the potential difference between its input terminals. Operational amplifiers had their origins in analog computers, where they were used to perform mathematical operations in many linear, non-linear, and frequency-dependent circuits.

The popularity of the op-amp as a building block in analog circuits is due to its versatility. Due to negative feedback, the characteristics of an op-amp circuit, its gain, input and output impedance, bandwidth etc. are determined by external components and have little dependence on temperature coefficients or manufacturing variations in the op-amp itself.

Op-amps are among the most widely used electronic devices today, being used in a vast array of consumer, industrial, and scientific devices. Many standard IC op-amps cost only a few cents in moderate production volume; however, some integrated or hybrid operational amplifiers with special performance specifications may cost over US$100 in small quantities.Op-amps may be packaged as components or used as elements of more complex integrated circuits.

The op-amp is one type of differential amplifier. Other types of differential amplifier include the fully differential amplifier(similar to the op-amp, but with two outputs), the instrumentation amplifier (usually built from three op-amps), the isolation amplifier (similar to the instrumentation amplifier, but with tolerance to common-mode voltages that would destroy an

ordinary op-amp), and negative-feedback amplifier (usually built from one or more op-amps and a resistive feedback network).

IC LM358- LM358 consists of two independent, high gain operational amplifiers in one package. Important feature of this IC is that we do not require independent power supply for working of each comparator for wide range of power supply. LM358 can be used as transducer amplifier, DC gain block etc. It has large dc voltage gain of 100dB. This IC can be operated on wide range of power supply from 3V to 32V for single power supply or from ±1.5V to ±16V for dual power supply and it also support large output voltage swing.

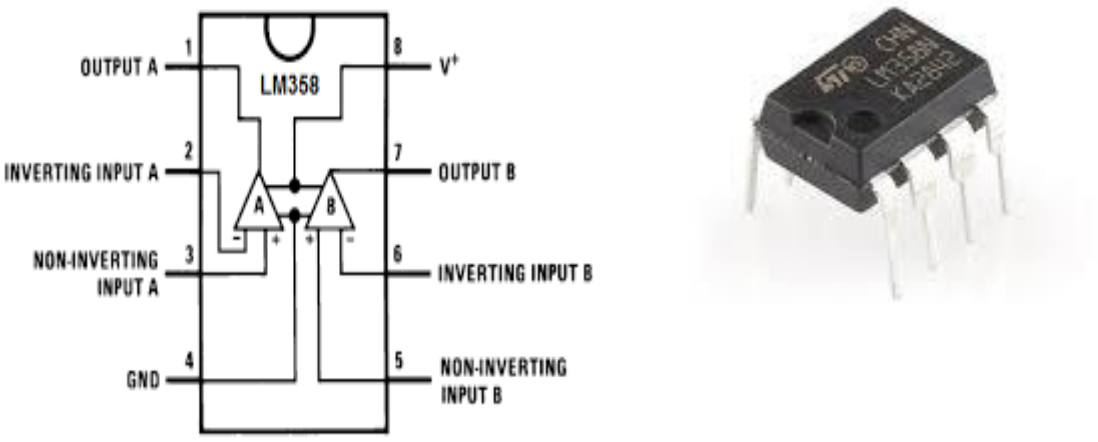


Fig: 4.17: LM358 IC

4.12SPDT Switch

In a telecommunications network, a switch is a device that channels incoming data from any of multiple input ports to the specific output port that will take the data toward its intended destination. In the traditional circuit-switched telephone network, one or more switches are used to set up a dedicated though temporary connection or circuit for an exchange between two or more parts.

On an Ethernet local area network (LAN), a switch determines from the physical device (Media Access Control or MAC) address in each incoming message frame which output port to forward it to and out of. In a wide area packet-switched network such as the Internet, a switch determines

from the IP address in each packet which output port to use for the next part of its trip to the intended destination. In the Open Systems Interconnection (OSI) communications model, a switch performs the layer 2 or Data-Link layer function. That is, it simply looks at each packet or data unit and determines from a physical address (the "MAC address")



Fig: 4.18: SPDT switch

4.13Light-Emitting Diode (LED)

A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices and are increasingly used for other lighting. Appearing as practical electronic components in 1962 early LEDs emitted low- intensity red light, but modern versions are available across the visible, ultraviolet, and infrared wavelengths, with very high brightness. When a light-emitting diode is forward- biased (switched on), electrons are able to recombine with electron holes within the device, releasing energy in the form of photons.



Fig: 4.19: LED (Light Emitting Diode)

This effect is called electroluminescence and the color of the light (corresponding to the energy of the photon) is determined by the energy gap of the semiconductor. An LED is often small in area (less than 1 mm2), and integrated optical components may be used to shape its radiation pattern. LEDs present many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved physical robustness, smaller size, and faster switching. LEDs powerful enough for room lighting are relatively expensive and require more precise current and heat management than compact fluorescent lamp sources of comparable output.

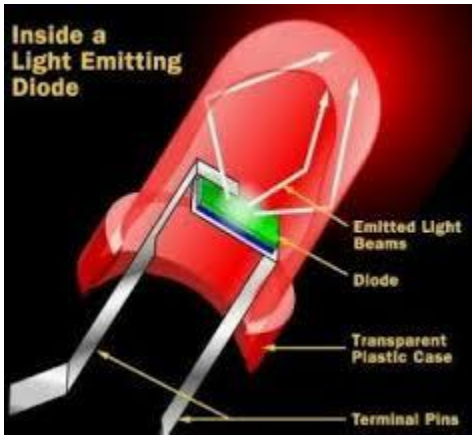


Fig: 4.20: Inside of a LED (Light Emitting Diode)

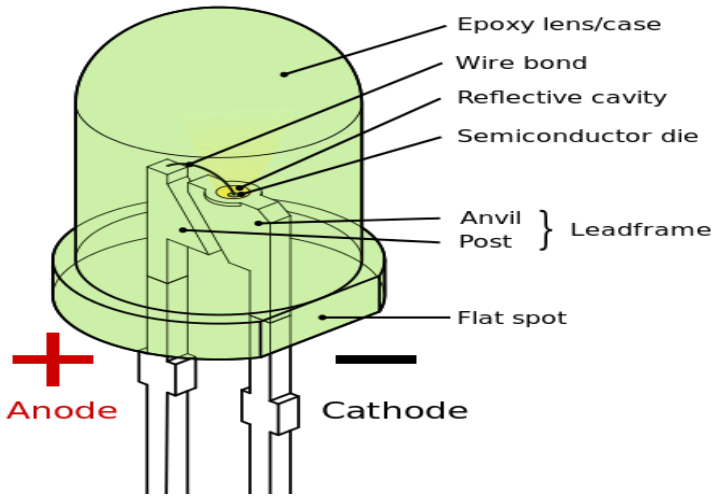


Fig: 4.21: Parts of a LED (Light Emitting Diode)

The structure of the LED light is completely different than that of the light bulb. Amazingly, the LED has a simple and strong structure. The light emitting semiconductor material is what determines the LED's color. The LED is based on the semiconductor diode. LED lights have a variety of advantages over other light sources:

- High-levels of brightness and intensity.
- High-efficiency.
- Low-voltage and current requirements.
- Low radiated heat.
- High reliability (resistant to shock and vibration).
- No UV Rays.
- Long source life.
- Can be easily controlled and programmed.

Applications of LED fall into three major categories:

- Visual signal application where the light goes more or less directly from the LED to the human eye, to convey a message or meaning.
- Illumination where LED light is reflected from object to give visual response of these objects.

Generate light for measuring and interacting with processes that do not involve the human visual system.

4.14 Connecting Wire

A wire is a single, usually cylindrical, flexible strand. Wires are used to bear carry electricity and telecommunications signals. Standard sizes are determined by various wire gauges. The term

wire is also used more loosely to refer to a bundle of such strands, as in 'multi stranded wire', which is more correctly termed a wire rope in mechanics, or a cable in electricity.



Fig: 4.22: Connecting Wire

Although usually circular in cross-section, wire can be made in square, hexagonal, flattened rectangular or other cross-sections, either for decorative purposes, or for technical purposes such as high-efficiency voice coils in loudspeakers. Edge-wound coil springs, such as the Slinky toy, are made of special flattened wire.

4.15 List of Components with Price

SERIAL NO	PARTS NAME	PRICE(BDT)
1	Sensor	1140
2	Wood	100
3	Wood burnish	50
4	Wood color	80
5	Wood drill	50
6	Iron bolt	120
7	Spring	160
8	Glue gun	200
9	Glue gun stick	30
10	Battery	240

11	Multimeter	300
12	Project Board	30
13	Vero board	50
14	Switch	15
15	Capacitor	15
16	Resistor	55
17	Transistor	5
18	Diode	10
19	LED	15
20	Connector	20
21	Super glue	25
22	Wire	20
23	IC	20
24	Battery case	50
25	Others	25
Total=		2,825 TK

Table 4.1: Cost of the Project

4.16 Summary

The chapter describes about some important equipment that related to the project. Describes of all equipment like piezo electric sensor, Full Wave Bridge Rectifier, Diode, Zener Diode, Vero Board, Capacitor, NPN Transistor, Battery, Resistor, OP AMP, SPDT Switch, Light-Emitting Diode (LED) and Connecting Wirethat works properly use for show data read related this project.

CHAPTER 5
RESULTS AND DISCUSSIONS

5.1 Introduction

This chapter contains the results obtained and discussion about the project. We have also covered discussions about real model of footstep power generation, energy, storing table, our project during pressure and used countries of the system.

5.2 Real Model of Footstep Power Generation System / Energy Harvesting from speed breakers

The working of the Foot Step Electric Converter (FSEC) is demonstrated in photographs in the right side photograph shows the foot touching the top plate without applying weight. The left side Photograph shows the foot when full weight of the body is transferred to the top plate. 1W LED connected to the output of the alternator glows, to indicate the electric output when foot load is applied. The unit is designed to generate full power pulse when actuated by a person weighing nearly 60 kg.

The power generated by the footstep generator can be stored in an energy storing device. The output of the generator was fed to a 3.6V lead acid battery, through an ac-dc converter bridge. Initially, the battery was completely discharged. Then, the FSEC was operated by applying foot load and energy was stored in the battery. The arrangement is shown in Fig. 4. The duration of lighting, the bulb for number of footsteps and corresponding energy stored, are given in Table 1.

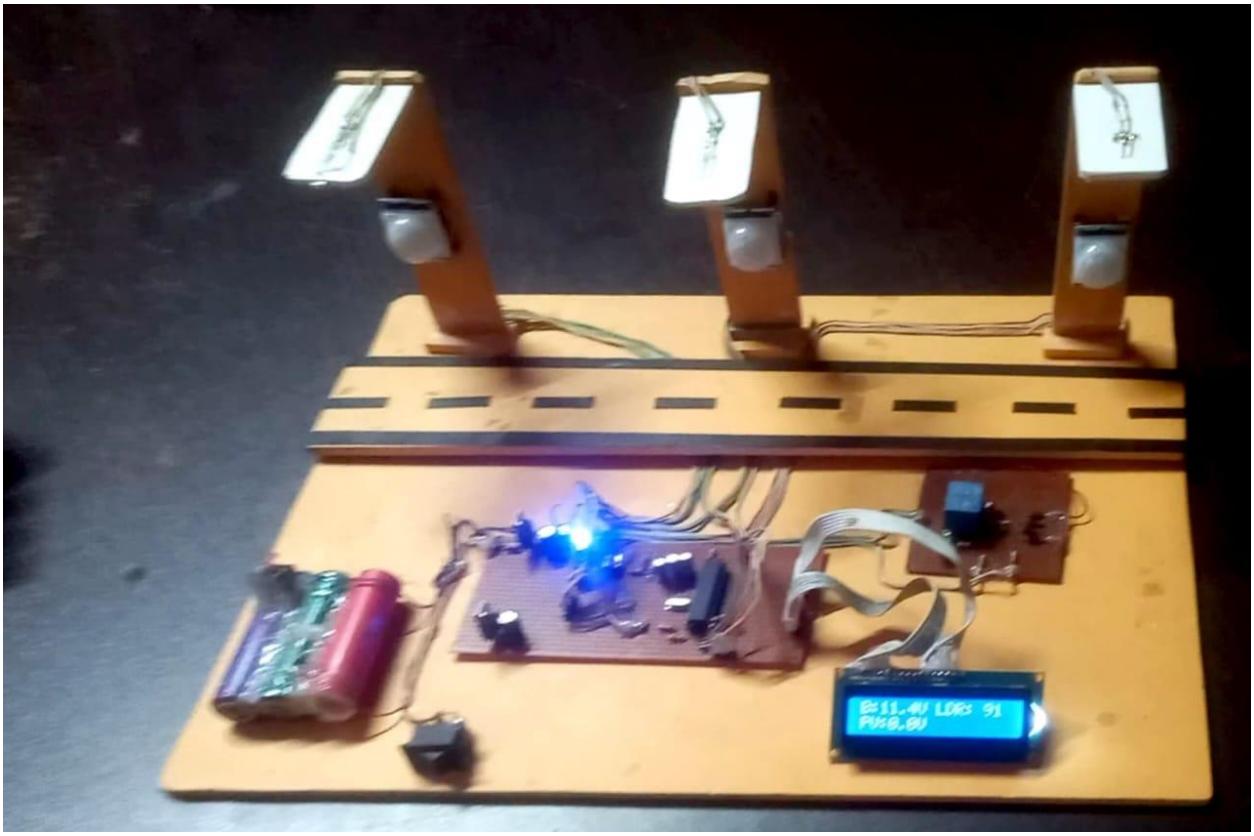


Fig 5.1: Real image of our project

5.3 Energy Storing Table

The power generated by the footstep generator can be stored in an energy storing device. The output of the generator was fed to 3.6v lead acid battery, through an ac-dc converter bridge. Initially, the battery was completely discharged. Then, the FSEC was operated by applying foot load and energy was stored in the battery. The arrangement is shown in table 5.1

Weight(kg)	Time	No. of Piezo	Energy(watt)
1	1 sec.	1	0.018w
1	1 minute	1	1.08w
1	1 hour	1	64.8w
1	1 sec.	4	0.072w
1	1 minute	4	4.32w
1	1 hour	4	259.2w

Table 5.1: Energy storing system

The piezoelectric material converts the pressure applied to it into electrical energy. The Source of pressure can be either from the weight of the moving vehicles or from the weight of the people walking over it. The output of the piezoelectric material is not a steady one. So a bridge circuit is used to convert this variable voltage into a linear one. Again an AC ripple filter is used to filter out any further fluctuations in the output. The output de voltage is then stored in a rechargeable battery. As the power output from a single piezofilm was extremely low, combination of few Piezo films was investigated. Two possible connections were tested - parallel and series connections. The parallel connection did not show significant increase in the voltage output. With series connection, additional piezofilm results in increased of voltage output but not in linear proportion. So here a combination of both parallel and series connection is employed for producing maximum 259W voltage output with high current density. From battery provisions are provided to connect dc load.

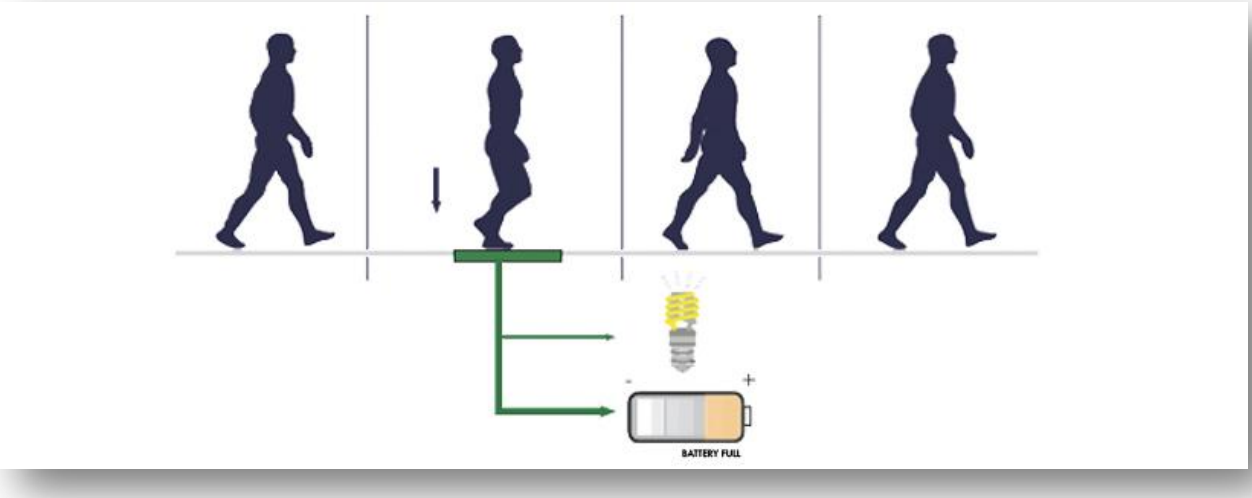


Fig: 5.2: Schematic representation of the working model

5.4 Our Project during Pressure

Here one of the pictures of work of this project work with pressure is given below:

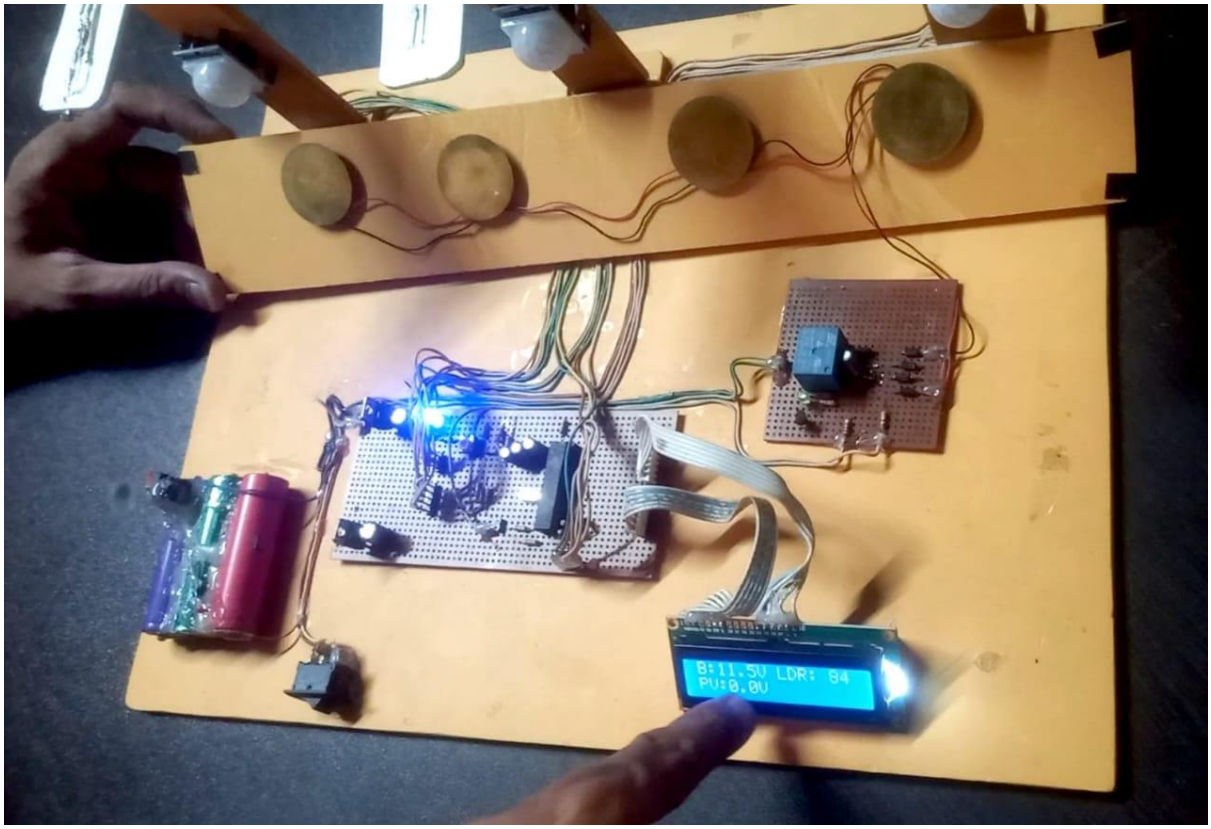


Fig. 5.3our project during pressure

When 1 kg is applied on 4 piezo material, .072W charge is generated across it in 1 second. Thus, it can be assumed to be an ideal capacitor. Thus, all equations governing capacitors can be applied to it. In this project, on one tile, we connect 4 piezo in parallel. If we connected 4 piezoelectricdiscs are connected in series.

Hence, the net voltage generated in series connection is the sum of individual voltages generated across each piezoelectric disc. Output voltage from 1 piezo disc is 13V.

Thus. Veq = V1 + V2 + V3+V4

Thus the maximum voltage that can be generated across the piezo tile is around 52W.

Hence, the net voltage generated in series connection is the sum of individual voltages generated across each piezoelectric disc. Output voltage from 1 piezo disc is 13V.

5.5 Discussion

Man has needed and used energy at an increasing rate for his sustenance and wellbeing ever since he came on the earth a few million years ago. 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 Japan, Europe and so on.

5.6Used Countries

5.6.1Japan

Japan has already started experiment the use of piezoelectric effect for energy generation. They implement piezoelectric effect on the stairs of the bus. Thus every time passenger steps on the tiles; they trigger a small vibration that can be stored as energy.

The flooring tiles are made up of rubber which can absorb the vibration. This vibration generates when running or walking on it. Under these tiles piezoelectric material are placed. When the movement is felt by the material they can generate the electricity. This generated energy is simultaneously stored into the battery. Generated electricity we can use the lightning of lamp or street light. Energy is generated by step of one human being is too less but if number of steps increases ultimately energy production also increases.



Fig: 5.4: Flooring tiles on the piezo

5.6.2 Europe

Europe is another one of the country which started experimenting use of piezoelectric crystal for energy generation in night clubs. Floor is compressed by the dancer's feet and piezoelectric materials makes contact and generate electricity. Generated electricity is nothing but 2-20 watt. It depends on impact of the dancer's feet. Constant compression of piezoelectric crystal causes a huge amount of energy.



Fig: 5.5: Piezo used in night club

5.7 Summary

In this chapter has discussed about result and discussion. With our project we became successful to demonstrate with regarding the objectives of the project. At last completing this chapter the project is ready to use.

CHAPTER 6
CONCLUSION

6.1 Conclusion

The project "POWER GENERATION USING FOOT STEP" is successfully tested and implemented which is the best economical, affordable energy solution to common people. This can be used for many applications in rural areas where power availability is less or totally absence. Bangladesh is a developing country where energy management is a big challenge for huge population. By using this project we can drive both A.C. as well as D.C loads according to the force we applied on the piezoelectric sensor. Comparison between various piezoelectric material shows that PZT is superior in characteristics. Also, by comparison it was found that series-parallel combination connection is more suitable. The weight applied on the tile and corresponding voltage generated is studied and they are found to have linear relation. It is especially suited for implementation in crowded areas. This can be used in street lighting without use of long power lines. It can also be used as charging ports, lighting of pavement side buildings.

As a fact only 11% of renewable energy contributes to our primary energy. If this project is deployed then not only we can overcome the energy crises problem but this also contributes to create a healthy global environmental change.

REFERENCES

[1] Prabaharan R, Jayramaprakash A, Vijay Anand. “Power Harvesting by Using Human Foot Step”- International Journal of Innovative Research in Science Engineering and Technology, vol.2, issue 7, July2013

[2]Ramesh Raja R, Sherin Mathew.”Power Generation from Staircase (steps)”- International Journal of Innovative Research in Science Engineering and Technology, vol.3, Issue 1, February 2014

[3] Itika Tandon, Alok Kumar.”A Unique Step towards Generation of Electricity via New Methodology”- International Journal of Advanced Research in Computer and Communication Engineering, vol.3, Issue 10, October 2014

[4] Kiran Boby, Aleena Paul K, Anumol. C.V, Josnie Ann Thomas, Nimisha K.K.”Footstep Power Generation Using Piezoelectric Transducer”- International Journal of Engineering and Innovative Technology, vol.3, Issue 10, April 2014

[5] Jose Ananth Vino, AP.”Power Generation Using Footstep”- International Journal of Engineering Trends and Technology, vol.1, Issue 2, May 2011

[6]Alla Chandra Sekhar, B Maruti Kishore, T Jogi Raju.”Electromagnetic Foot Step Power Generation”- International Journal of Scientific and Research Publication, vol.4, Issue 6, June 2014

[7]Shiraj Afzal, Farrukh Hafeez.”Power Generation Footstep”- International Journal of Advancement in Research and Technology, vol.3, Issue 4, April 2014

[8] K. Ramakrishna, Guruswamy Ravana, Venu Madhav Gopaka.”Generation of electrical Power through Footsteps”- International Journal of Multidisciplinary and Current Research

[9] Jose Ananth Vino, AP.”Power Generation using Footstep”-International Journal of Engineering Trends and Technology, vol.1, issue 2, may 2011

[10]Umeda, M., Nakamura, K., and Ueha, S. “Energy Storage Characteristics of a Piezogenerator Using Impact Vibration”- Japan Journal of Applied Physics, Vol. 36, Part 1, No. 5b, May 1997, pp.3146-3151.

[11] Tom Jose V,Binoy Boban, Sijvo MT, “Electricty generation from footsteps”-International journal of sciventic and research Publication,pp 1-3,March 2013

