Project Report
on

Advance Foot Step Power Generation

Submitted in partial fulfillment of the requirement
for the award of the Degree of

Bachelor of Engineering
In
Electronics and Telecommunication Engineering

BY

Mr. Jathan Pratik Premnath **(Roll No.:823)**
Mr. Kapadia Raj Dinesh **(Roll No.:825)**
Mr. Mohammad Yaqub Abdul Hafiz **(Roll No.:836)**
Miss. Kudikala Mamata Satyanarayana **(Roll No.:853)**

under the supervision of

Prof. S. S. REPAL

MANJARA CHARITABLE TRUST
RAJIV GANDHI INSTITUTE OF TECHNOLOGY, MUMBAI Juhu
Versova Link Road, Versova, Andheri(W), Mumbai-400053
(Permanently Affiliated to University of Mumbai)
Department of Electronics and Telecommunication Engineering
University of Mumbai

Academic Year 2018-19

MANJARA CHARITABLE TRUST
RAJIV GANDHI INSTITUTE OF TECHNOLOGY, MUMBAI
Juhu Versova Link Road,Versova, Andheri(W), Mumbai-400053
(Permanently Affiliated to University of Mumbai)
Department of Electronics and Telecommunication Engineering

CERTIFICATE

This is to certify that the project entitled **"Advance Foot Step Power Generation"** is a bonafide work of **Mr. Jathan Pratik Premnath, Mr. Kapadia Raj Dinesh, Mr. Mohammad Yaqub Abdul Hafiz and Miss. Kudikala Mamata Satyanarayana** under the supervision of **Prof. S. S. REPAL** submitted to the University of Mumbai in partial fulfillment of the requirement for the award of the Degree of Bachelor of Engineering in Electronics and Telecommunication Engineering.

Prof. S. S. REPAL	**Dr. S. D. Deshmukh**
Supervisor	**Head of Department**

Dr. Sanjay U. Bokade

Principal

MANJARA CHARITABLE TRUST
RAJIV GANDHI INSTITUTE OF TECHNOLOGY, MUMBAI Juhu
Versova Link Road,Versova, Andheri(W), Mumbai-400053
(Permanently Affiliated to University of Mumbai)
Department of Electronics and Telecommunication Engineering

PROJECT STAGE-II REPORT APPROVAL FOR B.E.

This project report entitled **"Advance Foot Step Power Generation"** by **Mr. Jathan Pratik Premnath, Mr. Kapadia Raj Dinesh, Mr. Mohammad Yaqub Abdul Hafiz and Miss. Kudikala Mamata Satyanarayana** is approved for the degree of Bachelor of Engineering in Electronics and Telecommunication Engineering from University of Mumbai, in academic year 2018-19.

Examiners:

1.Internal_____

2.External_____

Date: 26/04/2019
Place: MUMBAI

Seal of the Institute

MANJARA CHARITABLE TRUST
RAJIV GANDHI INSTITUTE OF TECHNOLOGY, MUMBAI
Juhu Versova Link Road,Versova, Andheri(W), Mumbai-400053
(Permanently Affiliated to University of Mumbai)
Department of Electronics and Telecommunication Engineering

DECLARATION

We declare that this written submission for B.E project entitled **"Advance Foot Step Power Generation"** represents our ideas in our own words and where others ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

Signature

Mr. Jathan Pratik Premnath **(Roll No.: 823)** _____

Mr. Kapadia Raj Dinesh **(Roll No.: 825)** _____

Mr. Mohammad Yaqub Abdul Hafiz **(Roll No.: 836)** _____

Miss. Kudikala Mamata Satyanarayana **(Roll No.: 853)** _____

Date: 26/04/2019

MANJARA CHARITABLE TRUST
RAJIV GANDHI INSTITUTE OF TECHNOLOGY, MUMBAI
Juhu Versova Link Road,Versova, Andheri(W), Mumbai-400053
(Permanently Affiliated to University of Mumbai)
Department of Electronics and Telecommunication Engineering

ACKNOWLEDGEMENT

This project would not have been possible without the kind support and help of many individuals and organizations. We would like to extend our sincere thanks to all of them. We thank our Principal Dr. Sanjay U. Bokade and our Head Of Department Dr. S. D. Deshmukh. We are highly indebted to our project guide Prof. S. S. Repal and Project-coordinator Prof. S. R. Bhoyar for their guidance and constant supervision well as for providing necessary information regarding the project and also for their support in completing the project. We would like to express our gratitude towards our parents for their kind cooperation and encouragement which helped us in completion of this project.

Abstract

The increase in energy consumption of portable electronic devices and the concept of harvesting renewable energy in human surrounding arouses renewed interest. This project idea is focused on one such advanced method of energy harvesting using piezoelectric material.Piezoelectric materials can be used as mechanisms to transfer mechanical energy, usually ambient vibration, into electrical energy that can be stored and used to power other devices. A piezoelectric substance is one that produces an electric charge when mechanical stress is applied.Conversely, a mechanical deformation is produced when an electric field is applied. Piezo-film can generate enough electrical density that can be stored in a rechargeable battery for later use.Piezoelectric materials have vast application.

Table of Contents

List of Figures

List of Tables

Chapter 1

Introduction

In the current era, which is witnessing a sky rocketing of energy costs and an exponential decrease in the supplies of fossil fuels, there arises a need to develop methods for judicious use of energy which lay emphasis on protecting the environment as well. One of the novel ways to accomplish this is through energy harvesting. Energy harvesting or energy scavenging, is a process that captures small amounts of energy that would otherwise lost as heat, light, sound, vibration or movement. It uses this captured energy to improve efficiency and to enable new technology, like wireless sensor networks. Energy harvesting also has the potential to replace batteries for small, low power electronic devices. Piezoelectric materials can be used as a means of transforming ambient vibrations into electrical energy that can then be stored and used to power other devices. With the recent surge of micro scale devices, piezoelectric power generation can provide a convenient alternative to traditional power sources used to operate certain types of sensors/actuators, telemetry, and MEMS devices. The advances have allowed numerous doors to open for power harvesting systems in practical real-world applications. Much of the research into power harvesting has focused on methods of accumulating the energy until sufficient amount is present, allowing the intended electronics to be powered. We have cited implementation of piezoelectric materials in harvesting energy from tapping of keys of keyboard and use it for various application like charging the mobile phones.The aim of the project is to build a system that can generate power from that energy which was previously used to get lost.Our project is extremely simple but highly useful.This system when applied on large scale can generate very high amount of power .This power later can be used for upliftment of the civilization.

Chapter 2

Literature Survey

5V output is obtained while walking which is later boosted up by the DC to DC boost converter. This boost converter gives 8-9V voltage output,which can be used to charge the mobile phone in real time.Thus,in all the energy can be extracted from human feet, convert it into electric energy and use it in real time application of charging the device.[1].

The waste energy supplied by human is used in this frame work. This energy source is ceaseless and renewable.In addition this technique for power era will be utilize for rustic jolt and to satisfy energy needs.Additionally this frame work looks extremely eco-accommodating from the natural perspective, MLI have become more attractive for to their advantages over conventional three level PWM inverters. They offer improved output waveform, smaller filter size,lower EMI,lower THD.[2].

The downward movement of the plate cause a force which rotates the gear wheel of the alternator,resulting in generation of electrical energy.When a force is applied to the plate it causes a downward force a rack is connected to it gives rotation to the pinion which is fixed on a rod by means of two bearings on either side on the same rod sprockets are fixed through the help of chain, another sprockets on the other rod is connected on this rod gear wheel is there which provides rotational force to the PMDC generation at final the output from the generator is stored in the battery connected to it.[3]

Chapter 3

Problem Statement and Objectives

3.1 Problem Statement

1. As technology is developing and with the use of gadgets it is a need to develop a power generation system using conservative methods.
2. Design a circuit which is used to generate electric power from human body.
3. From the past few years the demand of low power electronic portable devices is increasing rapidly. Due to increase in demand of energy consumption for the devices there is emerging of alternative renewable energy in human surroundings. So, either design a long lasting battery or a smaller power generator which uses human power to generate electricity and feed the device.

3.2 Objectives

1. The objective is to convert footstep i.e (walking and running) pressure into electrical energy.
2. This whole human/ bio-energy is being wasted, it is possible for utilize it for greater invention.
3. Design a long lasting battery or a smaller power generator which uses human power to generate electricity and feed the device. For this, Piezoelectric Effect is the best example to produce electricity by using the footstep of the human body.

Chapter 4

Work Done

4.1 Circuits Tested

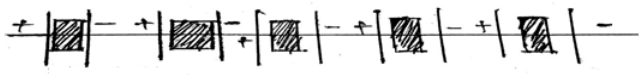

Figure 4.1: Series combination of piezo electric sensor

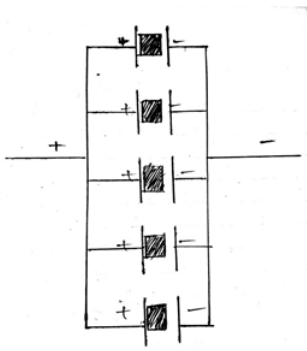

Figure 4.2: parallel combination of piezo electric sensor

High voltage can be obtained by combining piezo's in series, where as connecting them in parallel generated high power for the circuit. A total of seven piezo's where used for one shoe. Four pizeo's where connected in parallel to each other and placed on the upper half of the foot sole, while remaining three where connected in parallel to each other and placed at lower end of the foot. This combination of four and three piezo's where connected in series.

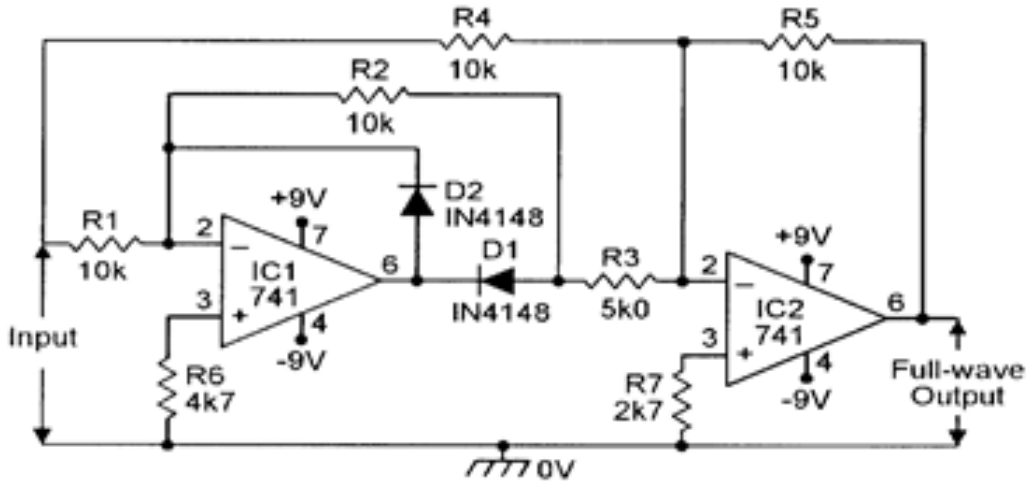

Figure 4.3: Precision Rectifier

Precision full wave rectifier was used to convert piezo's A.C voltage to D.C. It uses Op-amp which requires external power supply to operate. which was not desirable as per aim of project. After the implementation of the circuit it was observed that output voltage generated was 7.5 V with 0.051 nA. The over all power generated was 0.2538 nW. Hence this circuit failed to meet the desired expectations.

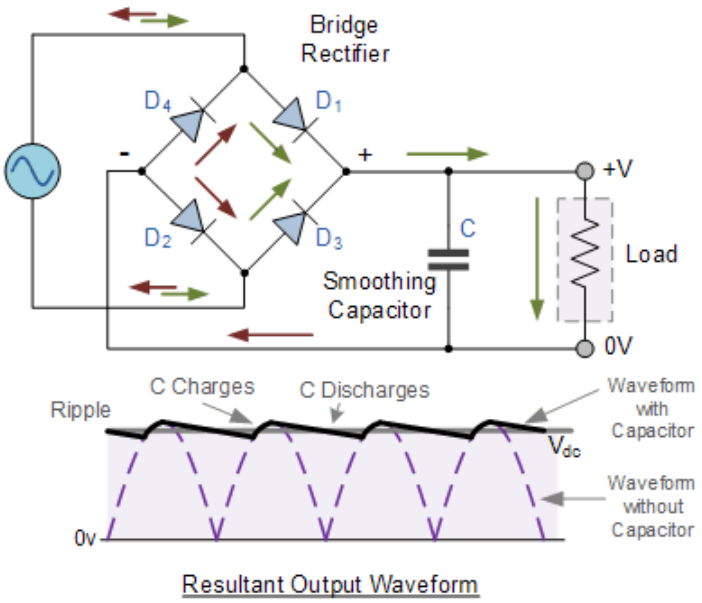

Figure 4.4: Full Wave Bridge Rectifier

Instead of using precision full wave rectifier precision full wave bridge rectifier was use as it rectifies even the smallest AC voltage applied and converts it to the DC voltage. The disadvantage of this circuit was for every diode 0.4 voltage is dropped which is the cutoff voltage of the diode. As no minimum voltage is required for the circuit to be made active and gives the optimum result for the AC rectification precision full wave bridge rectifier was used .

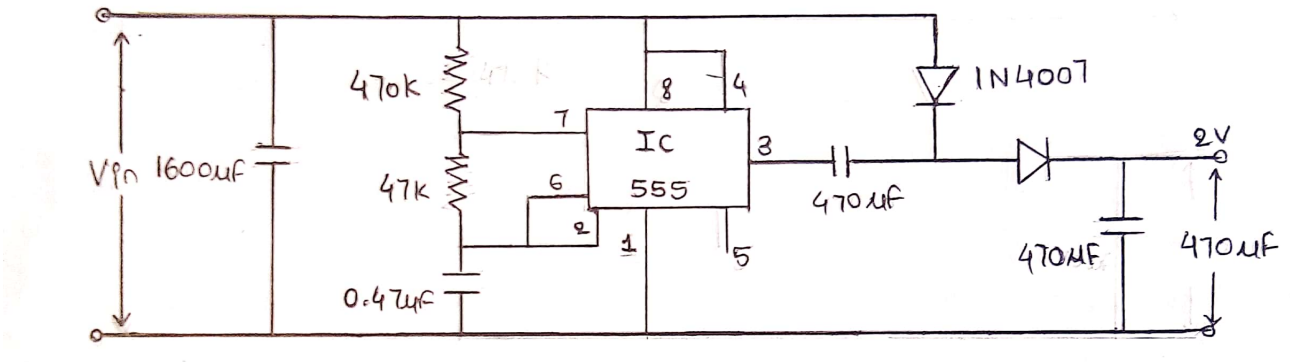

Figure 4.5: Voltage doubler using NE555

Voltage doubler circuit was implemented using IC NE-555 so as to get enhance the voltage supplied by the piezo-sensors and to get optimum output voltage for a mobile phone charging.This circuit helps us in increasing the voltage from 5V to approximately 9.7V. IC 555 works on DC supply but piezo's output in AC, so before supplying it to the circuit we convert it in DC using Bridge rectifier using diodes 1N4007. The output is clipped of by 0.4V per piezo and the output produced was 5V in the maximum pressure condition, the major issue of the circuit is the use of IC 555 which itself uses 5V to operate which was undesirable as it was not the aim of the circuit.

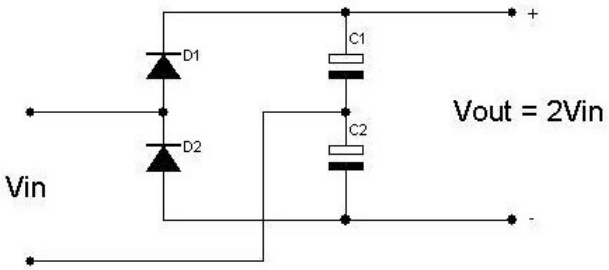

Figure 4.6: Simple Voltage doubler without using NE555

A voltage doubler is an electronic circuit which charges capacitors from the input voltage and switches these charges in such a way that ,in the ideal case ,exactly twice the voltage is produced as at its input. It is the simplest form of these circuits which includes rectifier, which take an AC voltage as input and output a doubled DC voltage.
The switching elements are simple diodes and they are driven to switch state merely by the alternating voltage of the input.DC to DC voltage doublers cannot switch in this way and require a driving circuit to control the switching.

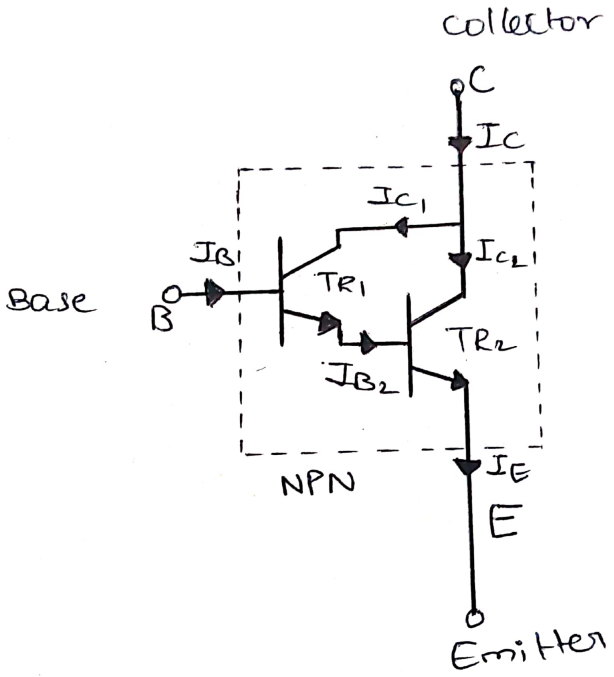

Figure 4.7: Darlington Configuration

A multi-transistor configuration called darlington pair.It is a compound structure of a particular design made by two bipolar transistors. Connected in such a way that the current amplified by the first transistor is amplified further by the second one. Ideally this configuration gives a much higher current gain than each transistor is taken separately. A typical darlington pair has a current gain of 1000 or more. To this circuit a small base current is needed to make the pair switch on.

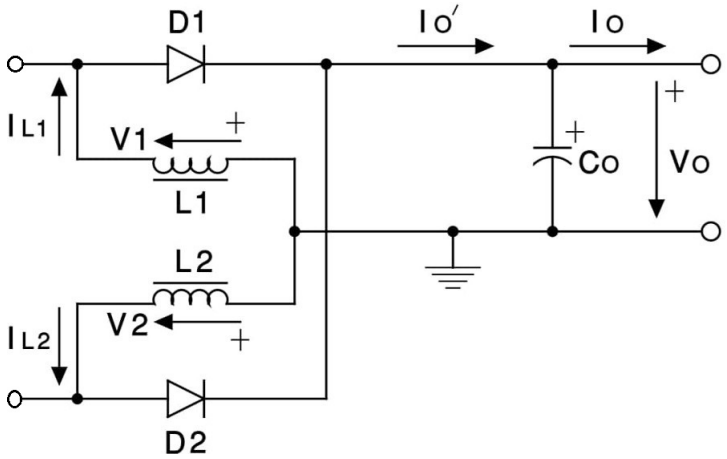

Figure 4.8: Current Amplifier

This circuit was proposed for increasing the value of current as piezos produce 1.2 uA (A.C). Inductor coil which is the component of current amplifier is used in the circuit, while designing the coil the input current plays a prominent role, but the current produce by the input coil is so less that it is not been detected by the coil thus rating were not permissible to drive the circuit and hence amplification of current failed.

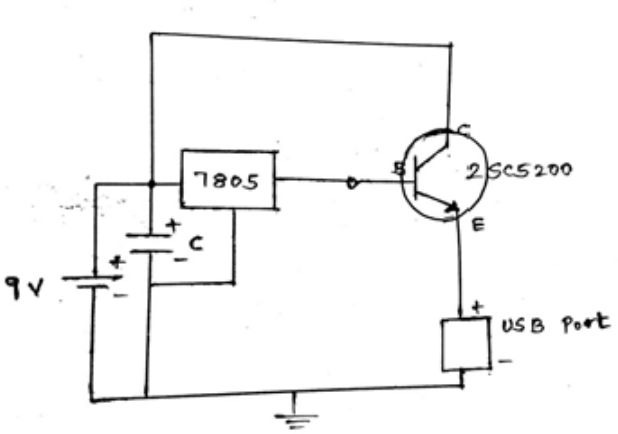

Figure 4.9: Mobile phone charger circuit using transistor

Above circuit was a simple mobile phone charger using a DC battery of 9V and 0.5 mA current which was capable to charge the cell phone , Implemention of this was sucessfull, but when the supply was changed to piezo's, transistor 2SC5200 consumes large amount of current and 1.2 uA was not feasible. Also voltage regulator 7805 step down 9V to 5V ,piezo's are not capable for driving this circuit and no output was drawn from this circuit. This trial also fails.

4.2 Calculations

Voltage developed = **V = Papp * Tp * C**

Where Papp= Pressure applied on piezo,

Tp = Thickness of the piezo and

C = piezo rating Aplication model. The voltage gain depends on the impedances connected.

gain = r * f * ri + 1

Here, rf = resistance in parallel, ri = resistance in series.

Conditions

- The piezoelectric disc used for the experiment had the same piezoelectric constant, C.
- The thickness of the disc was 2 mm and the diameter 20 mm (assuming no manufacturing defect).
- The same person stepped on the piezo all the time.

4.3 Methodology

4.3.1 Voltage generated from piezoelectric sensors due to normal working

4.3.2 Precision Full Wave Rectifier

4.3.3 Full Wave Bridge Rectifier

4.3.4 Simple voltage doubler with using NE555

4.3.5 Simple voltage doubler without using NE555

4.3.6 Darlington Configuration

4.3.7 Current Amplifier

4.3.8 Mobile phone charger circuit using transistor

Chapter 5

Component Specifications

5.1 Piezoelectric Sensor

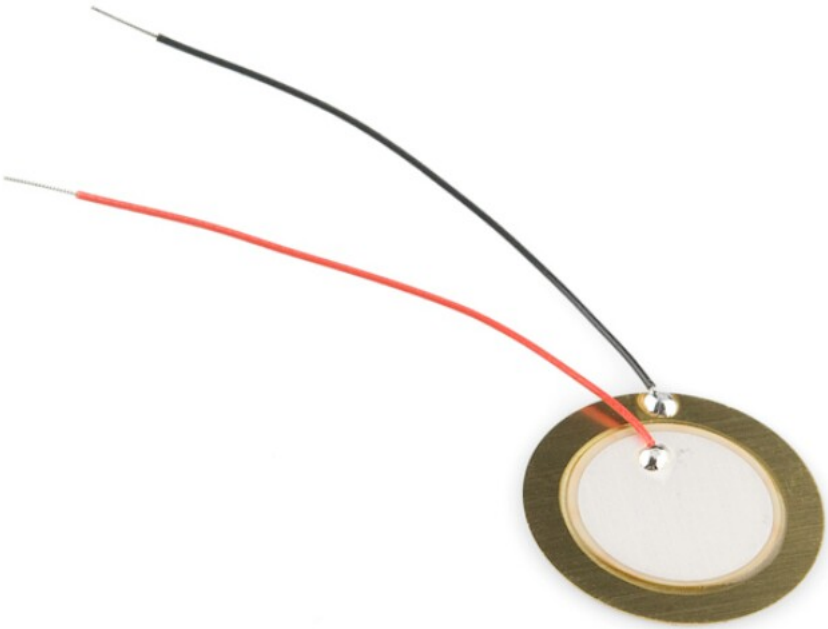

Figure 5.1: Piezoelectric Sensor

Pierre Curie founded the piezoelectric effect in 1880, but it started to be used for industrial sensing application in 1950 **Piezoelectric sensor** is used to convert the mechanical stress into electric charge,it gives AC output.
The ability of a piezoelectric material to covert a mechanical stress into electrical charge is called Piezoelectric effect.piezoelectric effect is reversible effect means when we applied mechanical stress to piezoelectric sensor we get some electrical charge at output which is further feed to the circuit. simply connect a LED to the piezoelectric sensor.

Table 5.1: PIN Description of piezoelectric sensor

Pin Name	Description
Outer circle	This gives Negative output voltage
Inner circle	This gives positive output voltage

Specifications :

- Voltage : 30Vp-p (when maximum pressure is applied)
- Current : 1.2 uA (When maximum pressure is applied)
- Operating temperature : 20C + 60C
- Low Soldering temperature.
- Material : Quartz(mostly used)
- Impedance : 500ohm

5.2 USB Socket And Port

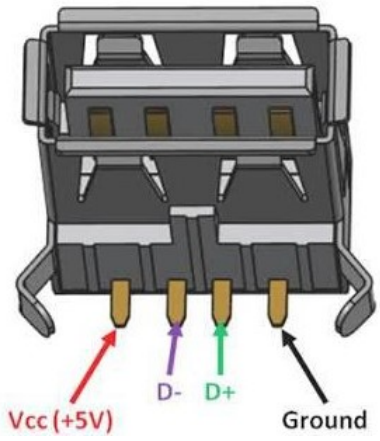

Figure 5.2: Usb Socket And Port

Table 5.2: PIN Description of USB Socket and port

Pin No.	Pin Name	Description
1.	Vcc	This pin should be provided with +5V, through which the device is powered.
2.	D-	Differential pair D-, must be connected to D- of the host for data transfer.
3.	D+	Differential pair D+, must be connected to D+ of the host of data transfer.
4.	Ground	Connected to ground pin of the host.

5.3 Transistor 2SC5200

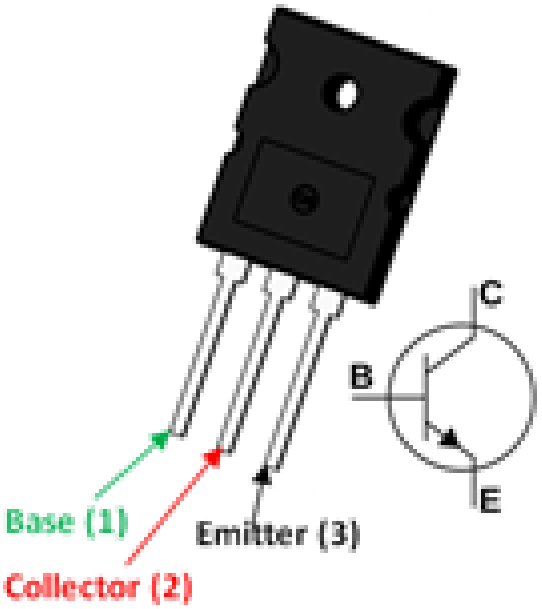

Figure 5.3: Transistor 2SC5200

Maximum Ratings and Electrical Characteristics :

Table 5.3: mobile phone charger circuit using transistor

Characteristics	Symbol	Rating	Unit
Collector-base voltage	VCBO	230	V
Collector-emitter voltage	VCEO	230	V
Emitter-base voltage	VEBO	5	V
Collector current (DC) Note1	IC	15	A
Base current	IB	1.5	A
Collector power dissipation	PC	150	W
Junction temperature	Tj	150	C
Storage temperature	Tstg	-55 to 150	C

Chapter 6

Results

6.1 Combination of piezo's in series

Table 6.1: Combination of 5 piezo's in series (Input taken as pressure provided by every person with different weights)

Sr. No.	Weight of person(kg)	Voltage(V)	Current(uA)
1	55	2	0
2	62	3.2	0.1
3	70	3.8	0.2
4	83	4.67	0.37
5	85	4.8	0.42
6	90	5.1	0.55
7	100	5.6	0.6

6.2 Combination of piezo's in parellel

Table 6.2: Combination of piezo's in parellel (Input taken as pressure provided by every person with different weights)

Sr. No.	Weight of person(kg)	Voltage(V)	Current(uA)
1	55	0.5	0
2	62	1.5	0.1
3	70	2	0.3
4	83	2.5	0.5
5	85	2.65	0.82
6	90	3.5	1.09
7	100	3.6	1.6

6.3 Simple voltage doubler with using NE555

Table 6.3: Simple voltage doubler with using NE555

Input (Vin)	Output(Vo)	Current(uA)
5	5	1.2
7	7.84	Very less
9	13	Very less
12	21	Very less

6.4 Simple voltage doubler without using NE555

Table 6.4: Simple voltage doubler without using NE555

Input (Vin)	Output(Vo)	Current(uA)
5	5	1.2
7	7.84	Very less
9	10.5	Very less
12	13.4	Very less

6.5 mobile phone charger circuit using transistor

Table 6.5: mobile phone charger circuit using transistor

Using DC Supply			Using Piezo with Rectifier		
Vin(V)	Vout(V)	I(mA)	Vin(V)	Vout(V)	I(uA)
9	5	40	12	5	0
9.2	5	40	14	5	0
8.9	5	40	13	5	0

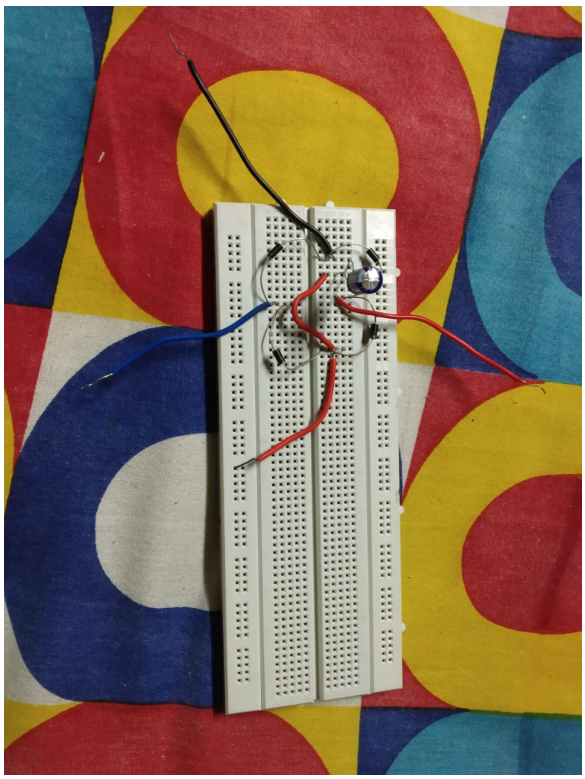

Figure 6.1: Bridge rectifier circuit

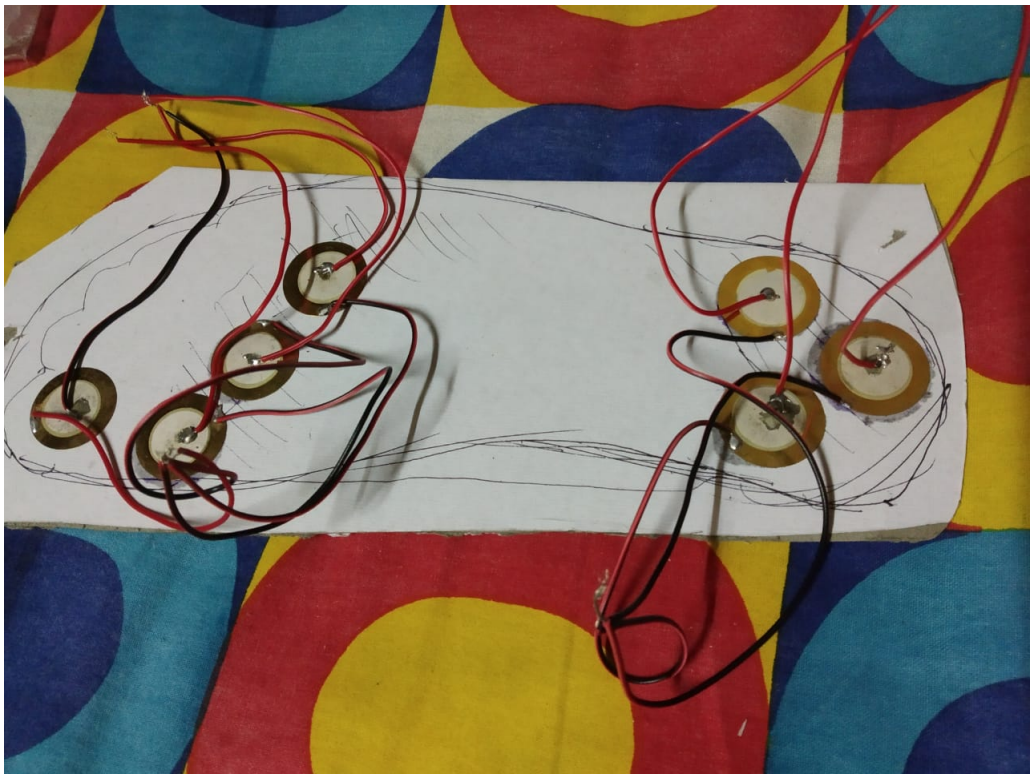

Figure 6.2: Series and parallel combination of piezo electric sensor

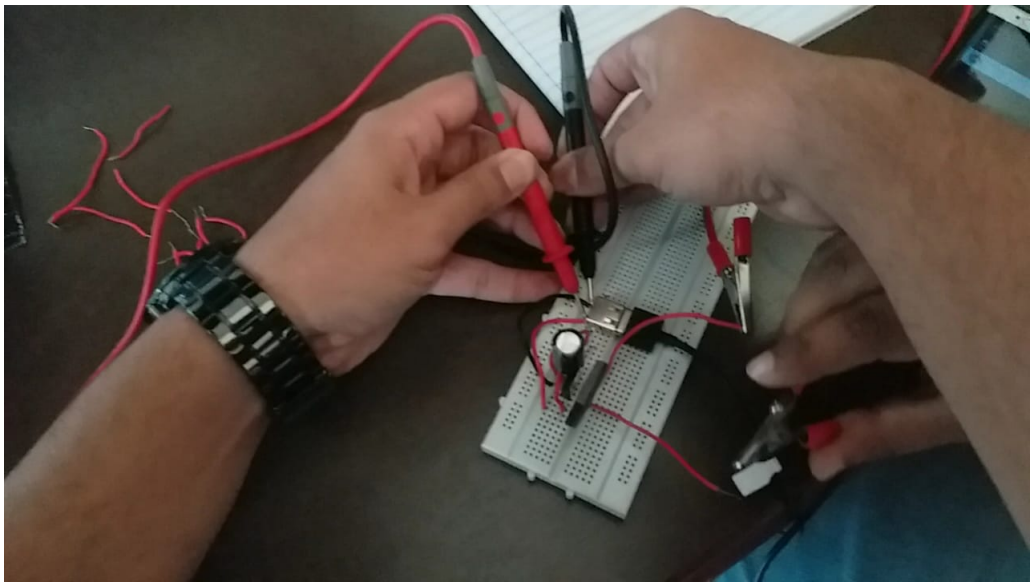

Figure 6.3: Cell phone charging circuit using transistor 2CS5200

Chapter 7

Conclusion and Future scope

7.1 Conclusion

Major component was piezoelectric sensor which provides 1.2 uA current. without current it was very difficult to charge a battery, Also the Voltage and Current generated by sensors were so less to store. The only and difficult condition for generating maximum current viz. 1.2 uA. is to press the middle crystal maximum and pointed pressure is require for that purpose ,unless pressure is wasted. Also various transistors and circuits were implemented but it is seen that transistor follows only the numerical relationship ,it doesn't provide any voltage or current from it self. Hence, Output obtained was not desireable.

7.2 Future scope

- Power generation using spring and rack and pinion arrangement.
- Using A harmonic resonator based triboelectric nanogenerator (TENG).

Bibliography

[1] Phagna Esha Singh,Siddhakar Bhumi,Rami Monika *"Real Time Battery Charging System By Human Walking."*IJIRSET,vol.4,Issue 2,Feb 2015.

[2] Krupal Dhimar,Krishna Patel,Zeel Patel,Nisha Pindiwala *"Foot Step Power Regeneration System."*IRJET,vol. 4,Issue 4,April 2017

[3] Joshi Harshad Naresh Bhai,Mashaddi Mohmad Zaheen Sujauddin,Badyal Gulshan Jivan Singh *"Alternative Form Of Power Generation."*IJSRD,vol. 5,Issue 03,2017