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I. ABSTRACT

Everywhere a person goes, some amount of energy is used by them. Since time is immemorial energy is needed for the well-being and sustenance of our lives. The utilization of waste energy used in the foot power is very much useful and important for place where there will be a huge crowd each day. When the flooring is engineered with piezoelectric technology, the electrical energy produced by the pressure is captured by floor sensor and converted to an electrical by piezo transducer, then stored and used as a power source. This power source is used in home application, crowded areas like railway station, street light, school and colleges.

II. INTRODUCTION

The demands of electricity are increasing day by day and its use has become so advanced and applicable in the present lifeline of a human being. The arising value of new technology each day demands more power of electricity.as the population of human beings is increasing day by day and hence the energy demand is increasing linearly. This technology is on simply based on a principle called the piezoelectric e effect, in which certain materials have the ability to build up and electric charge from having pressure and strain applied to them. Now, piezoelectricity is generally referred to as having the ability of some materials to generate an electric potential in responds to the applied pressure on them. So, the piezoelectric material can converts the exerted pressure into and electric current. The main component of this project is piezoelectricity, where the piezoelectric effect is understood as the linear electromechanically interaction between the mechanical and the electrical state in crystalline materials with no inversion symmetry.

The system generates voltage using footstep force. The system serves as a medium to generate electricity using non-conventional sources (force) and /store/use it. The project is designed to be useful at public places like railway stations where a lot of people keep walking through all day. At such places these systems are to be placed at any entry points where people travel through entrance or exits and they have to step on this device to get through. These devices may then generate a voltage on every footstep and when mounted in series they will produce a sizeable amount of electricity. For this purpose, we here use piezoelectric sensors that use piezoelectric effect in order to measure acceleration, force, pressure by its conversion into electric signals. We here attach a voltmeter in order to measure its output and small led lights for demonstration. We also use a battery and weight measurement unit for better demonstration of the system.

III. INITIATIVE

Our project is all about saving human energy and converting it to electrical energy. Day by day, the population of the country is increasing and the requirement of the power is also increasing at the same time the wastage of energy is also increased in many ways. So reforming this energy back to usable form is the major solution. This project is used to generate voltage using footstep force. This project is useful in public places like theatres, railways station, shopping malls, temples, school, college, hospital, etc. so, these systems are placed in public places where people walk and they have to travel on this system to get through the entrance or exist. Then this system may generate voltage on each and every step of a foot and for this purpose, piezoelectric sensor is used in order to measure force, pressure and acceleration by its change into electric signals. This system uses voltmeter for measuring output, led light, weight measurement system and a battery for better demonstration of the system.

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 India and 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 four LEDs. In each case, there would be a sub-flooring 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-ofconcept device to a large-scale Crowd Farm would be expensive, but it certainly sounds a great option.

PIEZOELECTRICITY: A MEANS OF ENERGY HARVESTING METHOD

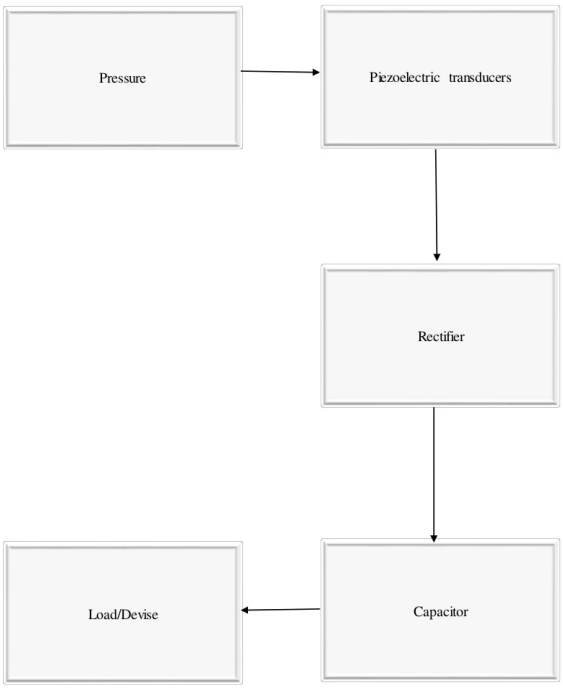
Piezoelectricity has arose as a way to harvest energy. The array of piezoelectric crystals is laid under the pavements. The voltage produced can be utilized to charge batteries. It is to be noted that scientist at the Hull University worked on converting motion in to electrical energy. Japan has installed piezoelectric tiles in Tokyo's busiest stations. They noted that the footsteps of an average person whose weight is 60 kg is able to yield 0.1 watt/sec.

It has also been reported that there is a 3×5 feet panel a product of Digital Safari Greenbiz Company which is capable of producing 17.5 watts/step.

PIEZOELECTRIC PRINCIPLE

When stress is applied to a piezoelectric crystal an electrical energy is produced across the material. There are two kinds of piezoelectric effect, namely direct effect and indirect piezoelectric effect. When mechanical stress is applied and electric potential is developed it is termed as the direct piezoelectric effect on the other hand when due to the application of electrical field there is deformation in the material it is termed as the indirect piezoelectric effect. when an electric field is applied. The examples of some piezo materials are Quartz, PZT, $PbTiO_3$, PLZT, PVDF, $BaTiO_3$, $PbZrO_3$, etc.

IV. BLOCK DIAGRAM & METHODOLOGY



EXPLANATION

According to the literature survey, piezoelectric materials produce ac voltage. When the pressure is applied on the face of the piezoelectric element then it generates the ac voltage and is sent to the rectifier. Then the function of the rectifier is to achieve full wave rectification. Thus transforming the ac voltage to dc voltage. The rectifier is a bridge circuit made by diodes. The dc voltage is stored in a capacitor in the subsequent stages. The stored energy can be effectively used for various applications. Sometimes a controller is also attached after the rectifier as it optimizes the power in input to the capacitor. Super capacitors can also be used in place of conventional capacitors. The power can be directly applied to the electrical devices or can be a supplement of main power supply. One can determine the effectiveness of a system by comparing the input energy to the output results. However, when the amount of output energy produced versus input energy is high then the level of efficiency is also high.

AMOUNT OF POWER GENERATION DETAILS

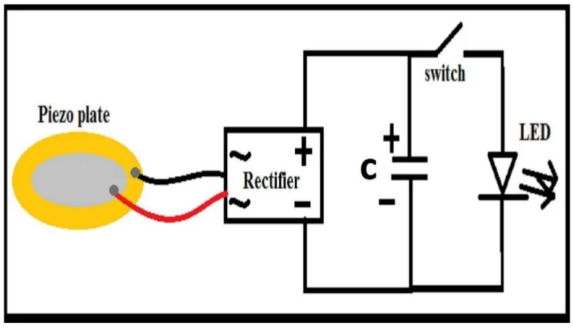
It is reported in literature, that when a piezoelectric tile is used for the flooring purposes then each slab is capable of producing 2.1 watts/hour in a football area if the stepping rate is 4-10 seconds. Based on testing it is found that walking 5 hours will generate enough electricity to lighting a bus stops continuously for over 12 hours. The energy produced is stored in Lithium Polymer Batteries. To light a low energy LED, 5% of the energy produced by a footstep is sufficient. The energy produced by piezoelectric elements is extremely low. The electrical energy produced by a piezoelectric crystal is about 2-3 volts. To increase the voltage, we can use a boost converter circuit which enhances it to 12 volts. To feed it further to any device we can use an inverter circuit. A boost converter or a step-up-converter is a is capable of converting high DC voltage from low DC voltage in input. It has two modes of operation, namely continuous and discontinuous mode

CONNECTIONS OF THE PIEZOELECTRIC ELEMENT

The piezoelectric elements can be connected with each other by two ways. These are by series or parallel connection. Three piezoelectric elements are connected in series and parallel combination. The current versus voltage graphs can be drawn for each case and analysed. According to the literature study, it is observed that the in a series connection the voltage is good, but the current is poor while it was exactly the opposite in the case of the parallel connection i.e. the current was good and the voltage is poor. Thus, we can use both the series connection as well the parallel connection according to our application. . But in the series connection, the voltage does not increase in linear fashion may be owing to the non-linearity of the system's total internal impedance.

When connected in series, then equivalent capacitance of 3 piezoelectric discs is as follows,

1/Ceq= 1/C1+1/C2+1/C3
Again,
Q= C×V
Veq/Q= V1/Q+V2/Q+V3/Q
Therefore,
Veq= V1+V2+V3
Also,
the following formula is used to calculate the voltage of a piezoelectric material
V= Sv ×P×D
Where V is the piezoelectric generated voltage (in Volts), Sv stands for voltage sensitivity of the material (Volt ×meters / Newton), P is the pressure (N/m2) and D is the thickness of material (in meters).



Proposed Circuit To Generate Power From Piezoelectric Transducer Using Rectifier Diodes, Capacitor.

V. HARDWARE SPECIFICATIONS

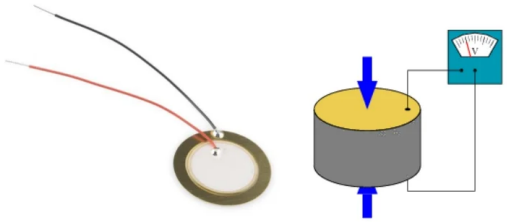
- Piezo Electric Sensors
- Multimeter
- Breadboard or PCB
- LED's
- Jumper Wires
- Footstep Body
- Capacitors
- Diodes
- Chargeable battery

VI. DETAILED EXPLAINATION OF COMPONENTS

- PIEZOELECTRIC SENSOR:

A piezoelectric sensor is a device that uses the piezoelectric effect, to measure changes in pressure, acceleration, temperature, strain, on force by converting them to an electrical charge. The prefix piezo- is Greek for "press" or "squeeze". Piezoelectric sensors are versatile tools for the measurement of various processes. Pierre curie discovered the piezoelectric effect in 1880.

They are used for quality assurance, process control and for research and development in many different industries it was only in the 1950sthat 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.



Piezoelectric sensor and voltage measuring, generated through the pressuring on 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 and goes up to 10e6 N/m²[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 pyro electricity 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.

- MULTIMETER:

A multimeter or a multitester, also known as a VOM (volt-ohm-milliammeter), is an electronic measuring instrument that combines several measurement functions in one unit. A typical multimeter can measure voltage, current, and resistance. Analog multimeters use a microammeter with a moving pointer to display readings. Digital multimeters (DMM, DVOM) have a numeric display, and may also show a graphical bar representing the measured value. Digital multimeters are now far more common due to their cost and precision, but analog multimeters are still preferable in some cases, for example when monitoring a rapidly varying value.

A multimeter can be a hand-held device useful for basic fault finding and field service work, or a bench instrument which can measure to a very high degree of accuracy. They can be used to troubleshoot electrical problems in a wide array of industrial and household devices such as electronic equipment, motor controls, domestic appliances, power supplies, and wiring systems.

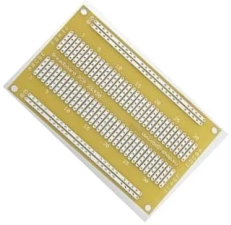
Digital Multimeter for measuring the voltage

- BREADBOARD OR PCB:

A breadboard is a construction base for prototyping of electronics. Originally it was literally a bread board, a polished piece of wood used for slicing bread. In the 1970s the solderless breadboard (AKA plugboard, a terminal array board) became available and nowadays the term "breadboard" is commonly used to refer to these.

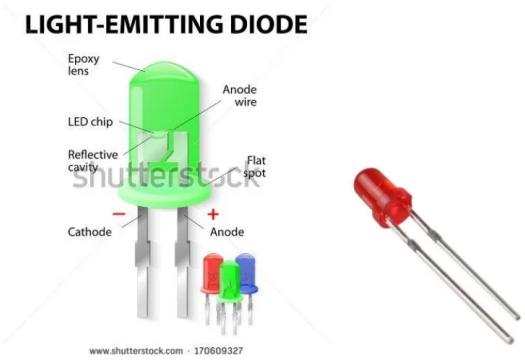
Because the solderless breadboard does not require soldering, it is reusable. This makes it easy to use for creating temporary prototypes and experimenting with circuit design. For this reason, solderless breadboards are also extremely popular with students and in technological education. Older breadboard types did not have this property. A stripboard (Veroboard) and similar prototyping printed circuit boards, which are used to build semi-permanent soldered prototypes or one-offs, cannot easily be reused. A variety of electronic systems may be prototyped by using breadboards, from small analog and digital circuits to complete central processing units (CPUs).

Breadboard & PCB



- LED's:

A light-emitting diode (LED) is a two-lead semiconductor light source. It is a p–n junction diode that emits light when activated.[]When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the color of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor. LEDs are typically small (less than 1 mm2) and integrated optical components may be used to shape the radiation pattern.



- CAPACITOR:

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.

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

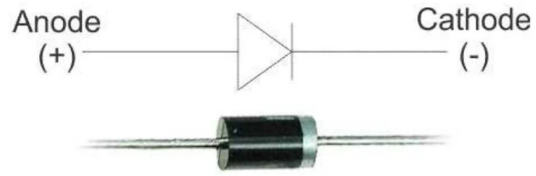
of metallic plates or surfaces separated by a dielectric medium. A conductor may be a foil, thin film, sintered bead of metal, or an electrolyte. The no conducting dielectric acts to increase the capacitor's charge capacity. Materials commonly used as dielectrics include glass, ceramic, plastic film, paper, mica, and oxide layers. Capacitors are widely used as parts of electrical circuits in many common electrical devices. 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.esistor, an ideal capacitor does not dissipate energy. Capacitance values of typical capacitors for use in general electronics range from about 1 pF (10−12 F) to about 1 mF (10−3 F).

A 100 micro-farad 25v capacitor which is used in circuit.

- DIODE:

In electronics, a diode is a two-terminal electronic component that conducts primarily in one direction (asymmetric conductance); it has low (ideally zero) resistance to the current in one direction, and high (ideally infinite) resistance in the other. A semiconductor diode, the most common type today, is a crystalline piece of semiconductor material with a p–n junction connected to two electrical terminals.[5] A vacuum tube diode has two electrodes, a plate (anode) and a heated cathode. Semiconductor diodes were the first semiconductor electronic devices. The discovery of crystals' rectifying abilities was made by German physicist Ferdinand Braun in 1874. The first semiconductor diodes, called cat's whisker

diodes, developed around 1906, were made of mineral crystals such as galena. Today, most diodes are The most common function of a diode is to allow an electric current to pass in one direction (called the diode's forward direction), while blocking current in the opposite direction (the reverse direction). Thus, the diode can be viewed as an electronic version of a check valve. This unidirectional behavior is called rectification, and is used to convert alternating current (AC) to direct current (DC), including extraction of modulation from radio signals in radio receivers—these diodes are forms of rectifiers.made of silicon, but other semiconductors such as selenium and germanium are sometimes used.



A Rectifier Diodes IN4007 which are used in circuit.

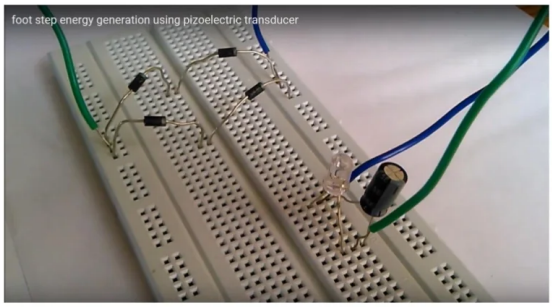
- RECHARGABLE BATTERY:

A rechargeable battery, Storage battery, secondary cell, or accumulator is a type of electrical battery which can be charged with the help of small circuit. This battery is very helpful when the AC power is not there. This battery is used to store the charge which is generated through the circuit.it stores the voltage in DC forms, which can be used later to charge any low voltage device.

A 9v Rechargable battery.

VII. ACTUAL PROGRESSIVE WORK TILL THE DATE

As our project is in progress we have done the testing of the below circuit as shown in the picture. We have used breadboard, a 100uf capacitor, LED, piezoelectric material (piezoelectric transducer), jumper wires, four IN4007 diode to make a bridge rectifier and digital multimeter to measure the voltage which is generated by pressing the piezo material through the circuit.



As shown in the circuit, connections on the breadboard are as,

Four IN4007 diodes are connected as a bridge rectifier.

From the left to the right in clockwise direction there are four junctions at the bridge rectifier

Junction1 (J1), junction2(J2), junction3(J3) and junction4(J4).

Then capacitor is placed to the right of the bridge rectifier and the positive terminal of the capacitor is connected to the J2 with the help of the blue jumper wire, and the negative terminal of the capacitor is connected through the green jumper wire to the J4.

The LED is connected parallel to the capacitor.

Now the positive terminal of the piezoelectric transducer to J1 and the negative terminal of the transducer to J2.

The principle of the piezo electric transducer is that, when the force is applied on piezoelectric material, the output is generated.

Hence, the LED glows….

Generated voltage can be measured with the help of multimeter,

VIII. Expected Result & Discussion Output power

if we install this model into the sole of the shoes then expected power output may be as below

Let,

Mass of pedestrian = 65 kg,

Distance travelled by plate = 10 cm

So,
work done on plate by impact

= weight of body * distance

= 65*9.81*0.1 Nm

= 63.765 J

So,

power output =work done/sec

= 63.765/60 Watts

=1.06275 Watts

It is Like we have used only 3 piezo plate in parallel connected at the installed shoe sole and we are getting likely 1v power output at only 10 cm distance travelled.

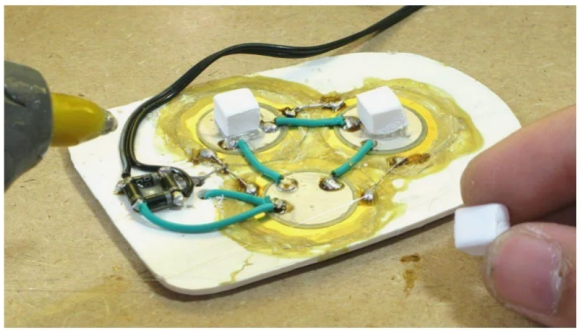
So, if we install this system in shoe sole with the chargeable battery, we can get more output power only through walking.

As we know that our cell phone need 3-5v to charge the battery

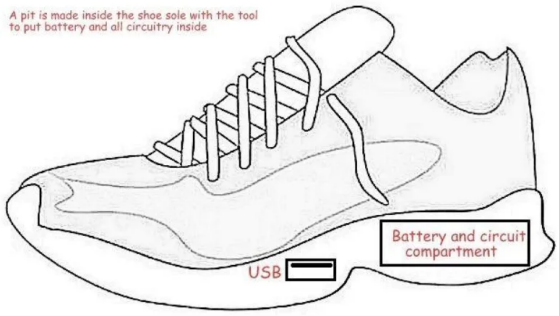
Hence,

We can use the charged battery as a power bank to charge the cell phone by simply walking.

As many steps we walks as the battery charges.



Shoe sole with piezo plates connected in parallel



IX. SCOPE OF THE PROJECT

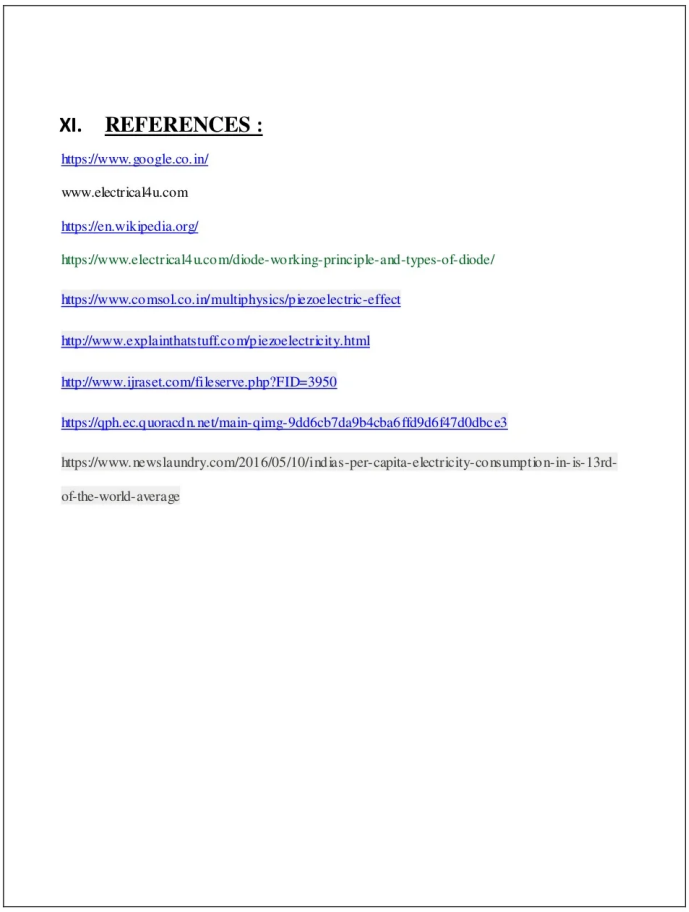
India per capita electricity consumption has been continuously increasing over the years. From 734 kWh in 2008-09, the per capita consumption has reached 1075 kWh in 2015-16, an increase of 46% in 8 years. The per capita consumption has been increasing at an average of 6% every year. The per capita consumption crossed 1000 kWh in 2014-15 for the first time. The highest increase in the per capita consumption during these 8 years has been in 2011-12 where it grew by almost 8%.

Compared to some of the developed countries of the world, the per capita electricity consumption in India is very low. India's per capita consumption is 1/3rd of the world average and is just 10% of that of Australia. It is just 7.5% that of USA and 6.6% of Canada. The per capita consumption in UK also is more than 5 times that of India.

The utilization of energy is an indication of the growth of a nation. For example, World average per capita electricity consumption is 2730 kWh compared to India's per capita electricity consumption of 1000 kWh. india has an installed electricity generation capacity of 30,000MW. One might conclude that to be materially rich and prosperous, a human being needs to consume more and more energy. India is facing serious energy crisis at this time .India as one of the most fastest growing or developing country is lot affected by this energy crisis in the world .The major issue is electric crisis which is known as load shedding India's small manufacturing markets are lot affected by the rise of energy prices. By just placing a unit like the "Power Generation through the footstep", so much of energy can be tapped. This energy can be used for the lights on the either sides of the Roads at schools, colleges, temples and at many other busy places like railway stations and bus stations.

X. CONCLUSION

This paper discusses about the importance of the energy wasted and converted it to renewable energy. It mainly deals with the voltage produced by the force applied through the piezo transducer. demands of electricity are increasing day by day and its use has become so advanced and applicable in the present lifeline of a human being. This method produces electricity with the help of piezoelectric elements that make use of the energy of human footsteps. The capacitor used in the circuit stores the charge for future applications. In order to increase the efficiency of the whole system if super capacitors are used in place of the conventional ones then more charge can be stored than the conventional ones. The super capacitors store and discharge energy without consuming much energy. Thus, the requirement of constant increase of power can be met by installing these systems in heavily packed places. This will undoubtedly not only overcome the energy crises but also build up a healthy surrounding



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