

Piezoelectric Based Electric Energy Generation From Sound Energy

A.Subramaniya Siva , N.Vinothini , S.Sathieshkumar

Abstract—In this paper, we proposed an idea for conversion of sound into electrical energy and there by using it for various applications. The piezoelectric transducer is used here for conversion of sound into electrical energy. The basic principle behind this is piezoelectric effect. When an electrical energy applied across piezoelectric crystal it starts vibrates. Similarly when a vibration created due to sound or mechanical energy applied across piezoelectric crystal, Piezoelectricity is generated. Here, four piezoelectric transducer is connected with sound sensor to produce a output voltage in the range of 3-5Volt. The output voltage is boosted by using booster converter. The voltage is then stored in rechargeable battery and used for application like traffic signal controller. The PIC micro controller is used to provide the operating criteria and time delay for traffic signal controller and relay is used for stating purpose of application

Index Terms - Piezoelectric Transducer, PIC, Sound sensor, Boost Converter, Rechargeable battery

I. INTRODUCTION

The World depends on electricity for each and every second. The 75% of the electricity generated in the world are from fossil fuels and nuclear power plant which in turn affects the environment. Even though it's necessary to fulfill the demand, there are ways to decrease the dependency of them. The environmentally friendly power vitality lessens the reliance of petroleum derivatives in little scale. Consequently, the saddling of sun based, wind and hydro are concentrated. Right now, proposed an environmentally friendly power vitality which has the capacity to acquire change little scale. The saddling of electrical vitality from sound or clamor. Sound is a mechanical type of vitality which travel as wave, mechanical wave that is a swaying of weight this weight made by the sound could be utilized to change. Over it into electric vitality or other type of vitality.

Likewise as indicated by law of thermodynamics mechanical vitality could be changed over into power. Piezo material believers mechanical strain into electric vitality this property of piezo material could be utilized to make a gadget which would have the option to economically change over the sound vitality to electric vitality as piezo material proselyte sound vitality to electric vitality. [1]

Sound vitality is an omnipresent, free, and maintainable vitality source; along these lines, viably extricating and changing over this vitality into electrical vitality can be valuable. Sound waves convey vitality that can make a few components vibrate. The "law of preservation of vitality" expresses that vitality can't be made nor be demolished. Under the thought of this law the innovative mammoths have found various sources to separate vitality from them and use it as a wellspring of intensity for customary use. There are diverse assumed eco-obliging wellsprings of imperativeness that we have found till the present phony time. Some of them are executed to exceptional degree

under the sensible conditions to beat the short run of the essentialness as a result of imaginative impact that has driven the imperativeness needs to its summit. Sun oriented vitality is one in the rundown that surfaced with the wide scope of uses, for example, sun based heaters; solar cookers and it gained success due to its easy implementation. There are various other sources of renewable energy which includes harassing energy form wind, Biomass, Renewable energy sources such as hydropower, solar power and wind power require high financial investments but give lower power output with respect to its cost. [2] Another source nuclear power plant gives a good source of power butte initial setting up and maintains costs are higher than other renewable sources. In recent years, there has been growing interest in harnessing the power of mechanical vibrations and pressure to generate electricity. Piezoelectric materials play a vital role in generating power which range is μW to mW . It is one of the most interesting methods of obtaining the energy surrounding a system is to use piezoelectric materials.[3]

II .METHODOLGY

In the existing paper, the various methodologies for generating electrical energy from sound energy are explained. The first method involves construction of thin film and in turn connect it to a conductor. This setup is placed in between bar magnets. Whenever there is an oscillation produced due to sound or noise, the thin film vibrates and electricity is generated due to fluctuation of conductor in between solid bar magnets. The subsequent technique includes of transformation of sound vitality into heat vitality and there by changing over warmth into electrical vitality.[4] This technique is less effective because of misfortunes. In the third strategy, the piezoelectric transducer is utilized for change of sound vitality into electrical vitality. This technique is productive when contrasted with different strategies. Another route for transformation of sound into electrical vitality is utilizing condenser mic or speaker. The speaker can change over electrical vitality into sound vitality. Thus, it can likewise ready to change over sound vitality into electrical vitality. The Piezoelectric transducer is an electro acoustic transducer use for change of weight or mechanical worry into a rotating electrical power. It is utilized for estimating the physical amount like power, pressure, stress, and so forth. [5]

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III BLOCK DIAGRAM

We proposed a method for harnessing sound energy in a proper way. The sound collector issued here for collecting sound energy from environment or surroundings. [6]The sound collector is a parabolic disc shaped device made of cardboard or any other materials with reflecting surface for improving efficiency. The parabolic disc has the ability to concentrate any form of sound to the focal line of the parabola where the piezoelectric transducer or sound transducer placed. Due to intense concentration of sound waves at a particular point, the piezoelectric transducer vibrates and in turn generates electricity more than conventional methods.[7]

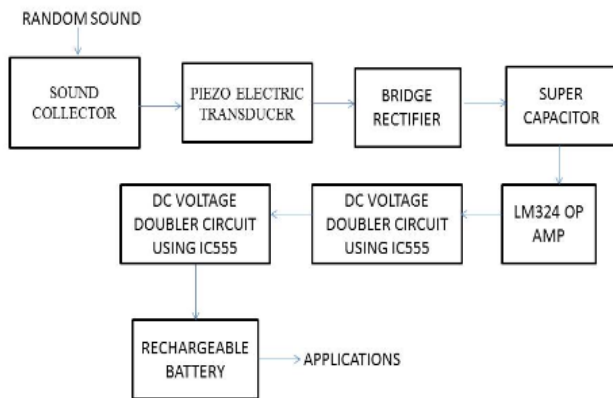


Fig 1: Piezoelectric Transducer Block Diagram

a) Sound Detector:

There are a few kinds of sound sensors (mouthpieces) like powerful receiver, condenser amplifier, lace amplifier, carbon mouthpiece and so on. [8]Our amplifier is dynamic and utilizations enlistment curl situated in the attractive field of a changeless magnet joined to the stomach. [9]At the point when you make a sound, the stomach vibrates and in this way the joined loop moves in the attractive field, creating current.[10]



Fig 2: Sound Detection Sensor

B) Piezoelectric Transducer:

Piezoelectric transducer comprises of quartz gem which is produced using silicon and oxygen masterminded in crystalline structure (SiO₂). For the most part, unit cell (essential rehashing unit) of all precious stone is balanced however in piezoelectric quartz gem it isn't. Piezoelectric gems are electrically impartial. The iotas inside them may not be evenly masterminded yet their electrical charges are adjusted methods positive charges offset negative charge. The quartz precious stone has interesting property of creating electrical extremity when mechanical pressure applied on it along certain plane. [11]The voltage produced

is investigated by putting piezoelectric transducer in a room, close to an uproarious speaker, close and far of bicycle horn and in carpentry workshop..

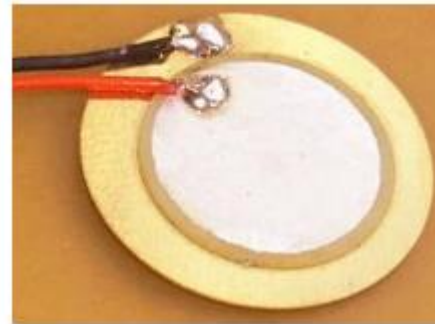


Figure 3: Piezoelectric Transducer

C) Bridge Rectifier:

A Bridge rectifier is an Alternating Current (AC) to Direct Current (DC) converter that rectifies mains AC input to DC output. .Extension Rectifiers are generally utilized in power supplies that give important DC voltage to the electronic parts or gadgets. [12]hello can be worked with in any event four diodes or some other controlled solid state switches. Dependent upon the load current essentials, a proper platform rectifier is picked. Parts' assessments and points of interest, breakdown voltage, temperature ranges, transient current rating, forward current rating, mounting necessities and various examinations are considered while picking a rectifier power supply[13]



Figure 4: Bridge Rectifier

D) Super Capacitor:

A super capacitor (SC), also called an ultra capacitor, is a high-capacity capacitor with a capacitance value much higher than other capacitors, but with lower voltage limits, that bridges the gap between electrolytic capacitors and rechargeable batteries. [14]It typically stores 10 to 100 times more energy per unit volume or mass than electrolytic capacitors, can accept and deliver charge much faster than batteries, and tolerates many more charge and discharge cycles than recharge batteries. Supercapacitors are used in applications requiring many rapid charge/discharge cycles, rather than long term compact energy storage — in automobiles, buses, trains, cranes and elevators, where they are used for regenerative braking, short-term energy storage. or burst-mode power delivery. [15]Smaller units are used as power backup for static random-access memory (SRAM).[11]



Figure 5: Super Capacitor

The electrolyte forms an ionic conductive connection between the two electrodes which distinguishes them from conventional electrolytic capacitors[16] where a dielectric layer always exists, and the so-called electrolyte, e.g., MnO₂ or conducting polymer, is in fact part of [17]the second electrode (the cathode, or more correctly the positive electrode). Super capacitors are polarized by design with asymmetric electrodes, or, for symmetric electrodes, by a potential applied during manufacture.[18]

IV) RESULT ANALYSIS & DISCUSSION:

The output of parabolic calculator is shown above by providing the diameter as 30 c.m and depth as 4 c.m .The focal point is obtained as 14.6 c.m away from the centre of parabolic disc

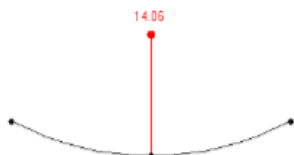


Figure 6 : parabolic measurement

Manually, it's designed as follows:

- STEP 1: Measure the diameter of the parabolic disc.
- STEP 2: Measure the depth of the parabola from the centre by placing it in a rigid surface.
- STEP 3: Calculate the focal point of the parabola by using the below formula.

Where,

- F is the focal line of the parabola.
- D is the diameter of the parabola.
- d is the depth of the parabola.

Thus the parabolic disc is made and transducer is placed on the focal point of it. The surface of the parabolic disc is made reflective and in turn this whole setup is termed as sound collector. The voltage generated is analysed by placing piezoelectric transducer in a room, near a loudspeaker, near and far of bike horn and in carpentry workshop. The decibel is measured with respect to the voltage generated from various environments and tabulated as follows

S.No	DECIBEL (db)	Voltage
1	60	0.29V
2	69	1.2V
3	75	1.7 (Average)
4	Normal Conversion (one Person)	140 mV
5	Bike Horn (80-85 db)	2.4V(near)
6	Car Horn (80-85 db)	200mV to 500mV(far)
7	Carpentry work (81 db)	150-200 mV(little far)

Table 1: Sound of vehicles in Decibel and Voltage Range

The sound collector focuses the sound on the transducer and in turn the transducer converts the sound into electrical energy. The output of piezoelectric transducer is generally dc with ac ripples .Hence; the bridge rectifier is used to remove the dc ripples. The output of rectifier is fed to the EDLC or super capacitor. The super capacitor has the capacity to charge fast and discharge in a slow manner. The super capacitor discharge characteristics is analysed by charging a 5.5 V and 1Farad super capacitor .The super capacitor is charged to a voltage of 4.24 V by connecting it to a dc source for 10 seconds.



Figure 7: Piezoelectric transducer is connected to a L.E.D and in turn glows due to

After seven hours, the discharge characteristics is analysed and noted .The super capacitor still holds a voltage of 2.75 V.The voltage stored in various units of super capacitor is added and the varying input voltage is regulated by using the voltage regulator. The LM-324 operational amplifier act as a voltage regulator and its output is fed to the DC voltage booster circuit. Both single and multistage boosting is done according to the requirement. The regulated and boosted voltage is stored in rechargeable battery and used for various applications. The analyses helps to found the range of decibel where the voltage can be Generated effectively, The voltage generated efficiently if the decibel is in the range of 75-90DB .However ,it's efficiency is further improved by concentrating of train wheel sounds in range of 100-115DB.

V CONCLUSION

Thus by using this proposed method, the green energy is generated efficiently. This generation doesn't affect the environment as fossil fuel does .The surrounding random sound is harnessed effectively by the usage of sound collector. The number of units increased for increasing the output voltage. The condenser mic can be used in series with piezoelectric transducer as hybrid for improving the overall output of the system. This can be implemented in huge crowded areas, railway station, highways and in places where traffic is normally high. By using well designed sound

collectors and high sensitivity piezoelectric transducers, the sound energy is harnessed effectively. We proposed a method for harnessing sound energy in a proper way. The sound collector is used here for collecting sound energy from environment or surroundings. The sound collector is a parabolic disc shaped device made of cardboard or any other materials with reflecting surface for improving efficiency. The parabolic disc has the ability to concentrate any form of sound to the focal line of the parabola where the piezoelectric transducer or sound transducer placed. Due to intense concentration of sound waves at a particular point, the piezoelectric transducer vibrates and in turn generates electricity more than conventional methods.

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