Conversion of Sound Energy to Electrical Energy

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Abstract: We all need electricity and when someone asked what its importance then it is much essential that many virtual possibilities are now becoming take the shape of the realistic world only due to the electricity if available abundant. Various approaches are used and commencement of these approaches help at a vast scale to provide or to fulfill the demand of the electricity. Now a day using alternate sources of energy such as sound energy, pressure (in the form of energy) to produce electrical energy. In our project we explore a less popular but useful source of clean energy i.e. Noise (Sound Energy). Waste form of sound energy can be used for some creative purpose. Random unwanted noise can be treated as a source of electrical energy. This project deals with “Conversion of Electrical Energy from Sound Energy”. Sound is known that the technological aspects are increasing at a faster pace. But the utilization of technologies are very low in various sectors. It is known that the sound pollution is increasing in urban cities due to traffic. So here we propose a system where the sound signal is gathered using Piezo electric sensors and the obtained waves are used for production of electrical energy.

Keywords: Abundant, Sound energy, Electrical energy, Piezo electric sensor.

1. Introduction

Renewable energy technique is the process of converting available ambient energy into usable electrical energy through the use of a particular material or transduction mechanism. According to the law of conservation of energy “Energy can neither be created nor destroyed, but it can be converted from one form of energy into another form of energy”. In energy, harvesting technology, extracting unused or wasted energy from our environment and then converting such energy into usable energy has received considerable research interest. Electricity can be produced in a number of ways. Electricity can be formed from various sources such as Wind energy, Tidal energy, solar energy etc. But in this project we convert sound energy to electrical energy. Since sound energy is a mechanical energy which travels in the form of a wave, and mechanical wave is an oscillation of pressure which requires a medium to travel i.e. it could not travel through vacuum as it need medium. The sound waves displace back and forth between the potential energy of compression or lateral displacement strain of the matter and the kinetic energy of the oscillation. Sound which is tolerable by human ears has frequency ranging from about 20 Hz to 20,000 Hz. In air at ordinary temperature and pressure, the equivalent wavelengths of sound waves range from 17 m to 17 mm. The efficiency of the transducers and several such devices is quite low and cannot be utilized for practical applications. Thus, the major area to focus is how we can enhance the performance of the electricity formed by conversion of sound energy. Waste form of sound energy can be changed and used for some productive purpose. Random sound energy or unwanted noise round us can be dealt with as a source of electrical power after their efficient conversion by the use of suitable transducer.

2. Block Diagram

Here we used microcontroller as the main operator of the system. It is responsible for displaying the decibel measured on site. LCD or Liquid Crystal Display shows the information gathered by the microcontroller. It displays the decibel reading and its corresponding voltage; Sound Detection Sensor is being used to gather input. The information from the sensor is the
basis of the display on the LCD wherein, Piezo module collects the sound waves or sound energy to be used and convert it into electricity. 1k Potentiometer is connected to LDR and Arduino to adjust the intensity of the LDR. So, therefore the Arduino software or Arduino IDE and the software or codes loaded in the microcontroller based on the LDR value. Therefore, it is essential for the device to perform its purpose.

### 3. Circuit Diagram

![Circuit Diagram](image)

#### A. Description

In this system ATMega 328P microcontroller is used. Two sensors, one for sensing the sound and another for sensing the pressure, are used in the circuit. For sensing the pressure multiple piezoelectric sensors are used. When the sound and pressure energy is sensed by the sensors then this energy is converted into the electrical energy. Output of the sensors is given to the voltage regulator block and rechargeable battery.

### 4. Working

The process flow of the conversion of sound energy to electrical energy by system is as follows.

1. Sound or Noise is harvested by piezo module in the form of sound wave or signals. The captured sample is used for the display of the LCD.
2. The Piezo module flap back and forth due to the pressure when stress is applied on it, that makes converts the signal to electrical current.
3. The converted current passes through the amplifier to get amplified to a higher values.
4. The amplified voltage is given to a battery through charge controller where it limits the rate at which electric current is added or drawn from electric batteries.
5. The current from the battery is supplied to two different sections of the device: USB port or load and Arduino board. The USB port produce 5v output that can be used to charge phone or smart watches. Arduino supplies power to the LCD and sensor to run.
6. Based on the LDR value, the relay operates as a switching device to the load.

### 5. Flow Chart

![Flow Chart](image)

#### A. Algorithm

Step 1: Input Sound energy
Step 2: Read measured values from sound sensor
Step 3: If sound is detected for some range then it displays on LCD and converts it into Electrical energy and stores in Battery, Else it again measures values from sound Sensor.
Step 4: If light is detected through LDR then Relay closes its contacts i.e. OFF Position, if not detected, relay opens its contacts and supplies the voltage to loads.

### 6. Hardware

#### A. Arduino Nano

![Arduino Nano](image)

The Nano is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6
can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. Each of the 14 digital pins can be used as an input or output, using pin Mode(), digital Write(), and digital Read() functions. They operate at 5 volts. Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller on the board is programmed using the Arduino software or Arduino IDE i.e. Arduino programming language (based on Wiring) and the Arduino development environment (based on Processing) to run the assembled hardware.

B. Piezoelectric Sensor

A piezoelectric sensor, also known as a piezoelectric transducer, is a device that uses the piezoelectric effect to measure changes in pressure, acceleration, temperature, strain or force by converting these into an electrical charge.

C. Sound Sensor

The FC-04 sound sensor module is a very sensitive sound detection module for the price. The sound sensor is one type of module used to notice the sound. This sensor is capable to determine noise levels within DB’s or decibels at 3 kHz 6 kHz frequencies.

The electricity generation experiment was done by using a Piezo module which in turn made up of piezoelectric actuator that extract sound wave energy. The PTZ coated with a thin silver layer on the top as one electrode, and the brass is used as the bottom electrode. Piezo module is made by placing a piezoelectric actuator on the oscillometer design i.e., piezoelectric actuator is placed between foam sheet and hacksaw blade. This electricity, which is in the form of voltage signal, is measured using a voltmeter or oscilloscope. The cost of the crystal shown in Fig. 7. is very less as compare to other actuator. The overall cost for proposed system is around 5K.

8. Results

We conducted the experiment on proposed system to determine the minimum and maximum electrical outputs. The Table shows the results of sound harvested to produced electric voltage.

<table>
<thead>
<tr>
<th>S. no.</th>
<th>Sound in dB</th>
<th>Voltage in volts</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>75</td>
<td>0.70</td>
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<tr>
<td>2</td>
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<td>0.75</td>
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<tr>
<td>4</td>
<td>90</td>
<td>0.80</td>
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<tr>
<td>5</td>
<td>95</td>
<td>0.90</td>
</tr>
<tr>
<td>6</td>
<td>95</td>
<td>0.95</td>
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<tr>
<td>14</td>
<td>120</td>
<td>2.00</td>
</tr>
</tbody>
</table>

9. Advantages

1. Due to conversion from the sound to the electric energy it is the possible to use energy in abundant.
2. It can be implemented easily.
3. More reliable and efficient.
4. It helps in the reduction of CO2 at vast scale.
5. The electric energy is the cleanest energy.

10. Future Scope

In near future if we are able to use this kind of energy then it will cause revolution in the field of the renewable sources of energy. Due to development of new sources like sound we can overcome the deficiency of electricity that we are facing in the
developing countries across the world.

With the advancement of this technology we can also imagine the charging of various battery operated devices such as our mobile phones just by making a call to a friend and talking. The mobile devices will literally satisfy their name as they will be-come quiet portable without much concern about their battery life.

Its other application field includes the lightening of the street lamps and traffic lights just by extracting the sound energy of the noise that is produced by the vehicles on the road. In this way we are not only able to reduce the noise pollution and but also utilize it as a source of electricity.

Also in the industries with the mechanical forte where very huge amount of the noise is produced as result of functioning of heavy machineries this sound can be trapped and can be used to run the low power machines used in production process.

11. Conclusion

The results show that the sound energy in ambient environment is successfully harvested and stored by the designed energy harvesting module. Vibrations can be measured in any environment and converted into this equivalent circuit. In this project, new method of harnessing the piezoelectric energy has been developed. The output power of piezoelectric transducer only extracted at 20 dB to 170 dB, but it is often lowest and not appropriate to power up other devices. Therefore, with a combination of a power source for different interface circuits such as rectifier and voltage Amplifier circuit are used in order to extract the ambient energy. The Amplifiers designed have produced the best results in terms of extracting the most ambient vibrational energy. In order to produce the best proficiency and output power, the circuit has been designed and developed according to the ambient-source, characteristics, PZT materials and load constraints. The energy harvesting system is capable to apprehending even minute amounts of stress and vibrations, then converting them to electric power sufficient to run low-power electronic systems. By using of piezoelectric materials, positive results are obtained. With further advancement in field of electronics, better synthesized piezoelectric materials and better selection of place of installations, more electricity can be generated and it can be viewed as a next promising source of generating electricity.

This project therefore show that the proposed technique used to harvest sound wave energy is relevant and has great potential in terms of converting free energy into useful energy. Hence, employing environmental energy sources as an alternative to electrochemical battery, which has a finite lifespan, can be an excessive advantage to these sources in powering low consumer electronic devices and green environment.

References