Noise vibration transformation into Electrical Energy

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Abstract

Due to increasing numbers of electrical devices because of the increase in energy consumption by increase in population and high living standards, harvesting for non-polluting as well as renewable energy source is necessary. Lot of mechanical forces and other energy which is available at each step of human life can be convert from mechanical energy to electrical energy. Unwanted sound (noise) can damage physiological health and cause other health issues. Number of vehicles have been increased due to the recent development in urban cities and high living standards. Use of the Piezoelectric crystal is one of the advantageous methods which can convert the vibrations or pressure into the electrical energy. Use of piezo ceramic for converting mechanical energy into electrical energy is shown in this paper at various transportation locations and heavy traffic areas.

Keywords- Piezoceramic, Electrical Energy, Noise, Transportation area.

1. Introduction

Because of the incremental demand of electricity day by day with increase in the population, generation of electrical energy is the more vital factor in the power system. It is known that the power generation can be done with the help of many different techniques. Majority of the techniquies for electrical energy generation are fuel operated methods developed by the professional experts. Electricity is the most versatile and newest energy source that we have. The use of electricity at homes and businesses for not much more than a hundred years. Now a days with many buildings generating their own renewable electric power the electricity could play a different role in our future with compare to our past. The word "Energy Harvesting" means the generation of energy from sources such as ambient temperature, vibration or air flow. The self-sufficient energy supply for small electric loads such as sensors or radio transmitters can be supplied by converting the available energy from the environment. With the help of piezoelectric effect Kinetic energy can be converted into electrical energy. The vibrations or shock generated by any sound waves or by mechanical means can be converted into electrical energy by using Piezo elements. The piezoelectric effect is a molecular phenomenon that can be observed at the macroscopic level as a change in electric potential that is created when a piezo element is squeezes or deforms. When placed under stress, such kind of materials like quartz, salt, and even sugar would generate a voltage up to some level. These materials have a characteristic crystal structures formed from a lattice of molecules with asymmetric dipole moments that responses to mechanical pressure applied or possessed. Thus, they were named piezoelectric crystals from the Greek word piezo meaning “press”. It was found that, the crystals would vibrate when a current was passed through them. Sound can be generated by piezo crystals and depending on the waves from the voltage given. This was applied first in 1900s early in submarine sonars. As increasing interest in the unique power of sound the relationship with sound was expanded. Depending upon this

principle phonographs and radios were invented that revolutionized society by utilizing quartz crystals in their electronic components. By using suitable electronics devices, this effect can be used for creating a self-sufficient energy supply system. Areas where a power supply via cable is not possible and the use of batteries and the associated maintenance expenditure are not desired, this could be the particular interest. By using piezo ceramic material the electricalenergy can be generated from sound energy or noise at different transportation locations and at heavy traffic area.

2. Piezoelectric Effect

Piezoelectric Effect is the effect which has the ability of certain materials for generating an electric charge in response to application of a mechanical stress to that material in this paper it is in the form of vibration. The Piezoelectric word is derived from the Greek word piezein, which means to “squeeze”, and piezo, which is Greek for “push”. One of the distinctive characteristics of the piezoelectric effect is that this effect is reversible, it means that the materials which exhibit the direct piezoelectric effect (meaning- the generation of electricity when stress is applied) also same materials exhibit the converse piezoelectric effect (meaning- the generation of stress when an electric field is applied). When piezoelectric materials are placed under mechanical stress, a shifting of the positive charges and negative charges centres in the materials take place, which then results in an external electrical field. When reversed, an outer electrical field either stretches or compresses the piezoelectric material. The principle of piezoelectric effect is very useful in many applications in which there is the involvement of the production and detection of sound, generation of high voltages, electronic frequency generation, microbalances. It is also the basis of a number of scientific instrumental techniques with atomic resolution, such as scanning probe microscopes (STM, AFM, etc.). The piezoelectric effect also has its use in more mundane applications as well, such as acting as the ignition source for cigarette lighters.

3. Experimental Setup

3.1 Designing Components of circuit

To generate the electricity from the noise at different locations desighnings components are Sound detection by Microphone, Piezoceramic material to covert noise vibration to electric energy, Battery for storing energy converted, Bridge board used for proper inter connection were used.

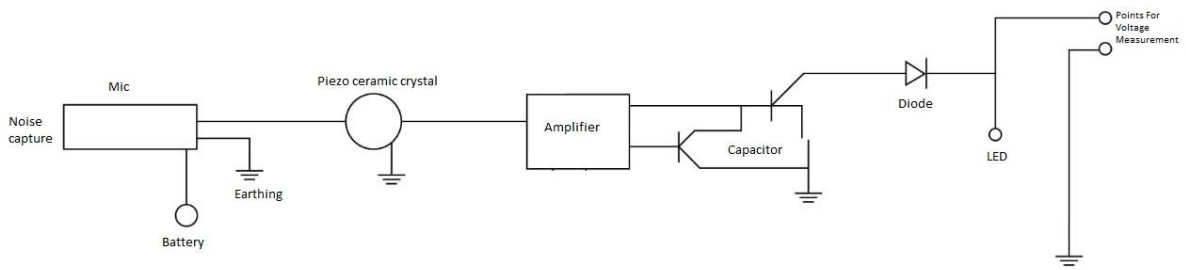


Figure No: 1

3.2 Locations of Experiments

The locations for the given experiments are four crosses of Vadodara city in Gujrat, India wich are highly traffic area in peak hours in the morning 9:30 to 11:30 am(+5:30 IST) and in the evening 17:30 to 19:30.Areas are Mandvi Cross, Dandiya Bazar Cross(22.299661 and 73.194627), Akota Cross(22.297717 and 73.176500) and Havmore Cross(22.301728 and 73.165748) (with the latitude and longitude) and bus depot. Because of the heavy traffic in the peak hours the noise generated was quite high and the experiments were done.

3.3 Procedure of Experiments

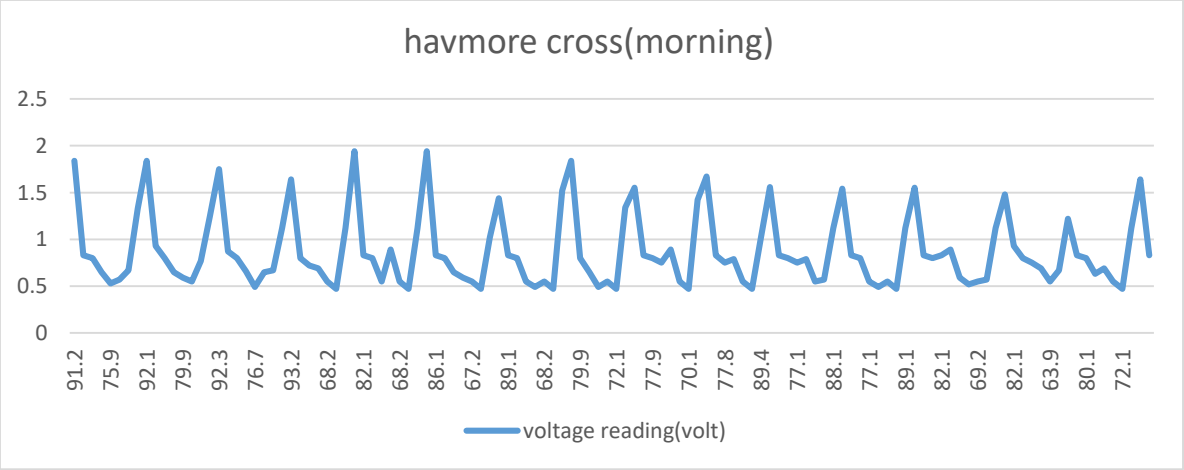
Sound level meter SL-1352 was used for the experiment to measure the noise level at given locations for given peak hours (morning and evening). The circuit (shown in fig 1.) was connected to the Digital multimeter DT830D. The noise readings were taken every minute for 2 hours in both peak hours at every locations. The voltage generated was measured with help of multimeter according to its noise data taken by the Sound level meter.

4. Results and Discussion

Voltage observed at different location with help of multi meter were collected and graphs were plotted according to the data. The results were shown in the graph forms which were plotted for voltage observed according to the noise generated at different locations by experimental setup. Different location includes four crosses and bus station.

4.1 Havmore Cross

The readings observed at hevmore cross (22.301728 and 73.165748) are given in fig 2 in the morning and in fig 3. evening. For morning, wind speed 4 mph, the maximum noise reading observed was 93.2 dB and minimum was 63.9 dB, with voltage generation of 1.64 volt and 0.54 volt respectively. The minimum and maximum voltage generation were 0.45 volt and 1.90 volt. For evening, wind speed 4.5 mph, the maximum noise reading observed was 92.9 dB and minimum was 65.2 dB, with voltage generation of 1.64 volt and 0.55 volt respectively. The minimum and maximum voltage generation were 0.47 volt and 1.94 volt.



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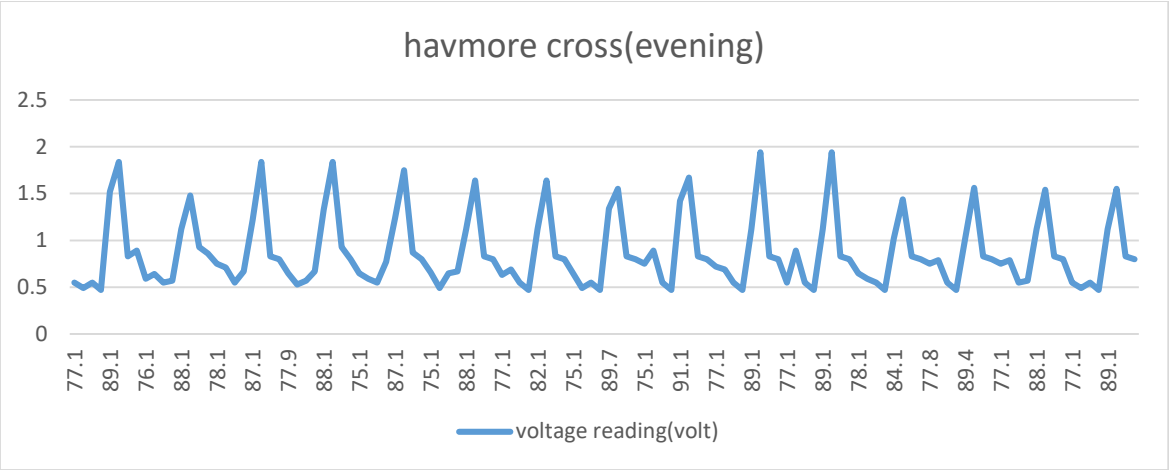

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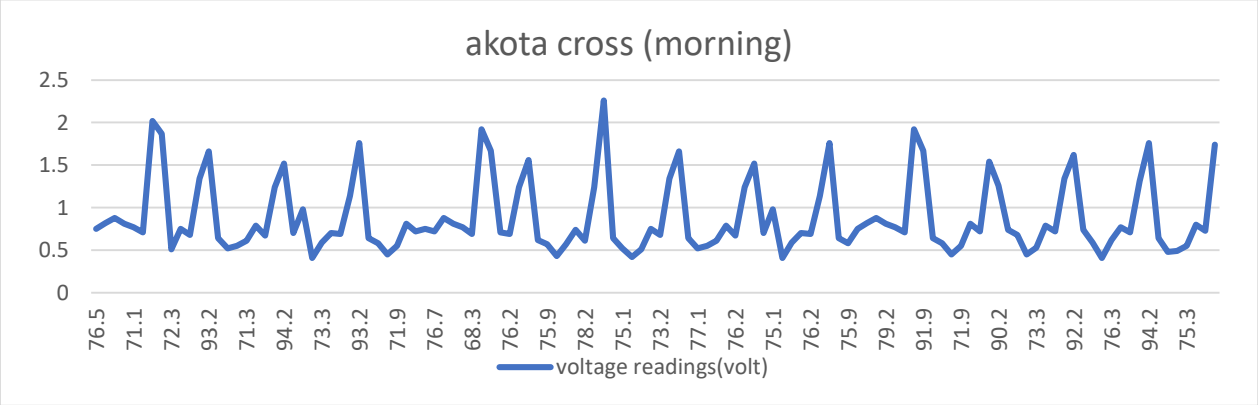
4.2 Akota Cross

The readings observed at akota cross (22.297717 and 73.176500) are given in fig 4 in the morning and in fig 5. evening. For morning, wind speed 2.5 mph, the maximum noise reading observed was 97.9 dB and minimum was 64.1 dB, with voltage generation of 1.92 volt and 0.42 volt respectively. The minimum and maximum voltage generation were 0.42 volt and 2.26 volt. For evening, wind speed 4 mph, the maximum noise reading observed was 98.9 dB and minimum was 62.1 dB, with voltage generation of 2.02 volt and 0.42 volt respectively. The minimum and maximum voltage generation were 0.41 volt and 2.26 volt**.**



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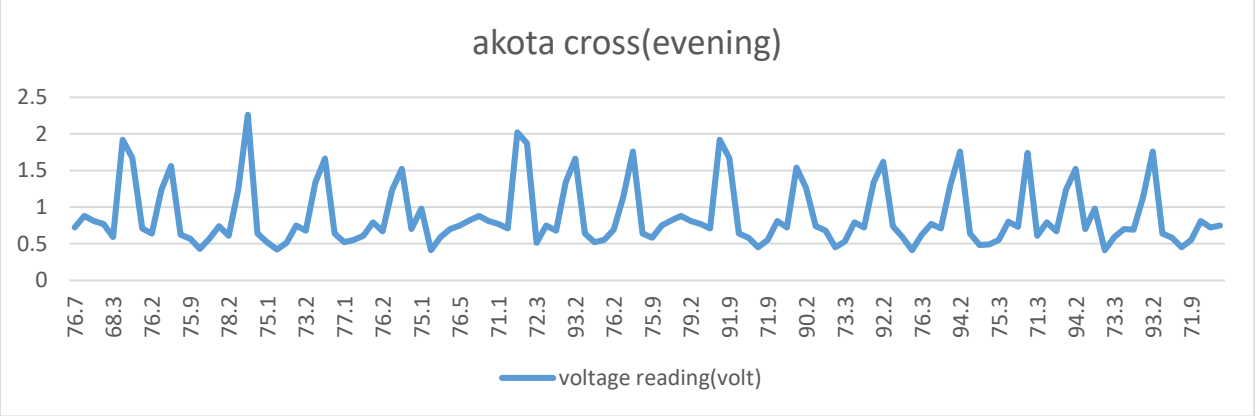

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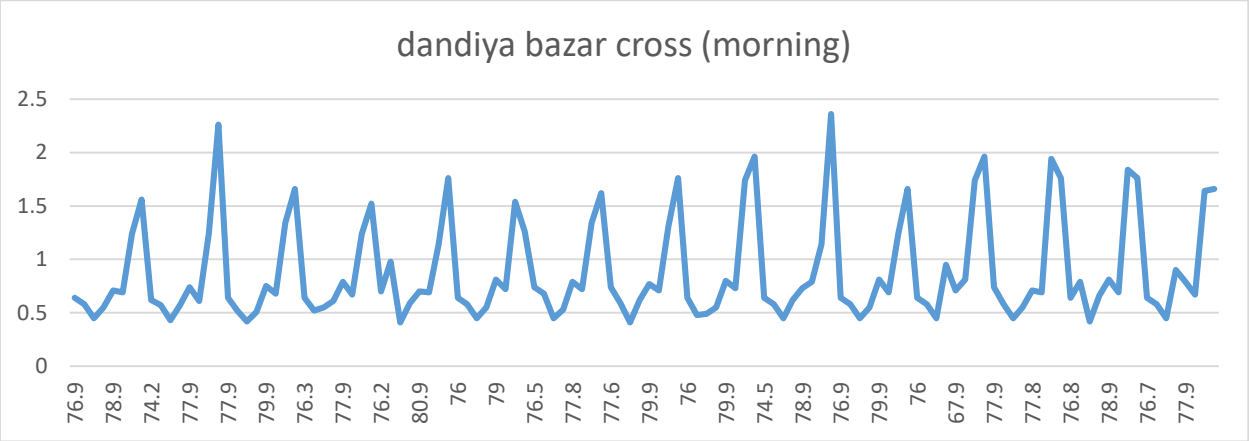
4.3 Dandiya Bazar Cross

The readings observed at Dandiya Bazar Cross (22.299661 and 73.194627) are given in fig 6 in the morning and in fig 7 evening. For morning, wind speed 3.5 mph, the maximum noise reading observed was 98.7 dB and minimum was 62.3 dB, with voltage generation of 2.36 volt and 0.41 volt respectively. The minimum and maximum voltage generation were 0.41 volt and 2.36 volt. For evening, wind speed 4 mph, the maximum noise reading observed was 96.2 dB and minimum was 63.6 dB, with voltage generation of 2.25 volt and 0.42 volt respectively. The minimum and maximum voltage generation were 0.41 volt and 2.33 volt.



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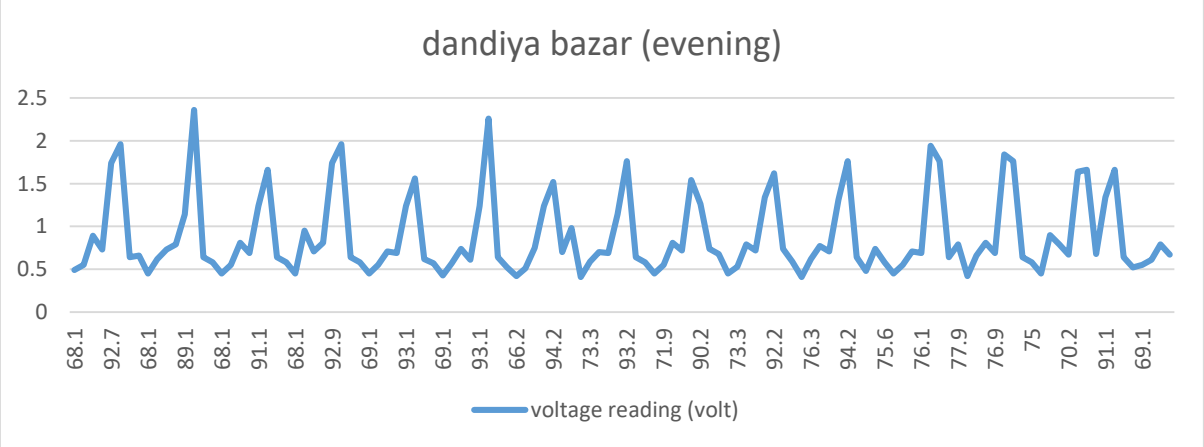

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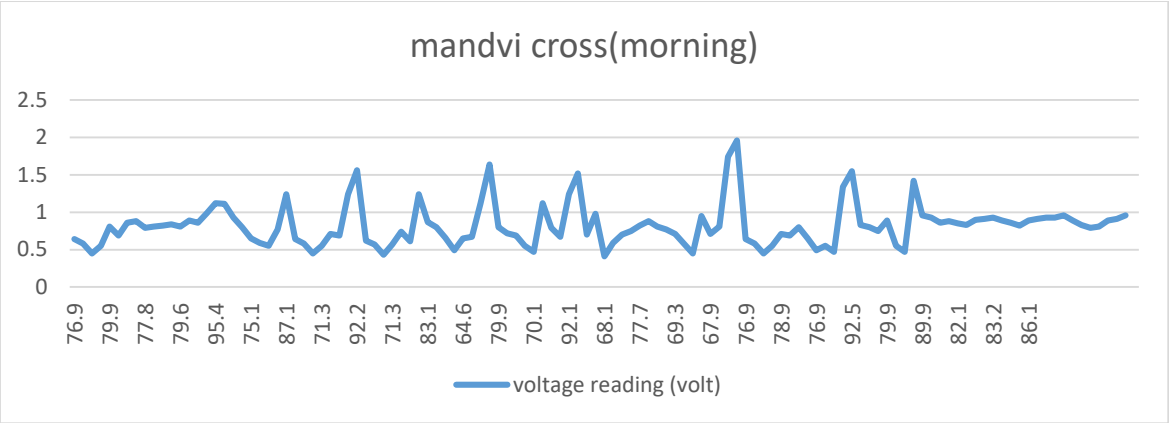
4.4 Mandvi Cross

The readings observed at Mandvi Cross (22.299953 and 73.210756) are given in fig 8 in the morning and in fig 9 evening. For morning, wind speed 3.7 mph, the maximum noise reading observed was 99.5 dB and minimum was 64.6 dB, with voltage generation of 1.91 volt and 0.46 volt respectively. The minimum and maximum voltage generation were 0.41 volt and 1.96 volt. For evening, wind speed 4.1 mph, the maximum noise reading observed was 101.2 dB and minimum was 66.1 dB, with voltage generation of 2.85 volt and 0.92 volt respectively. The minimum and maximum voltage generation were 0.47 volt and 2.85 volt.



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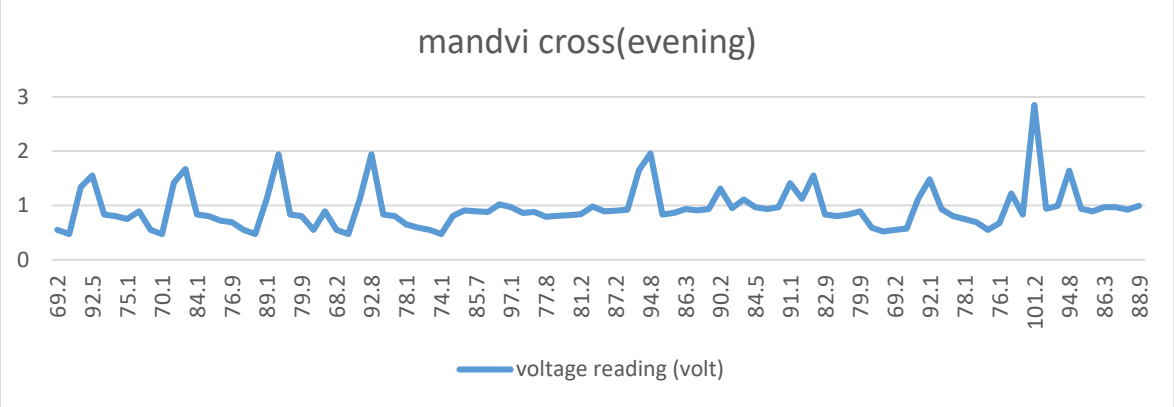
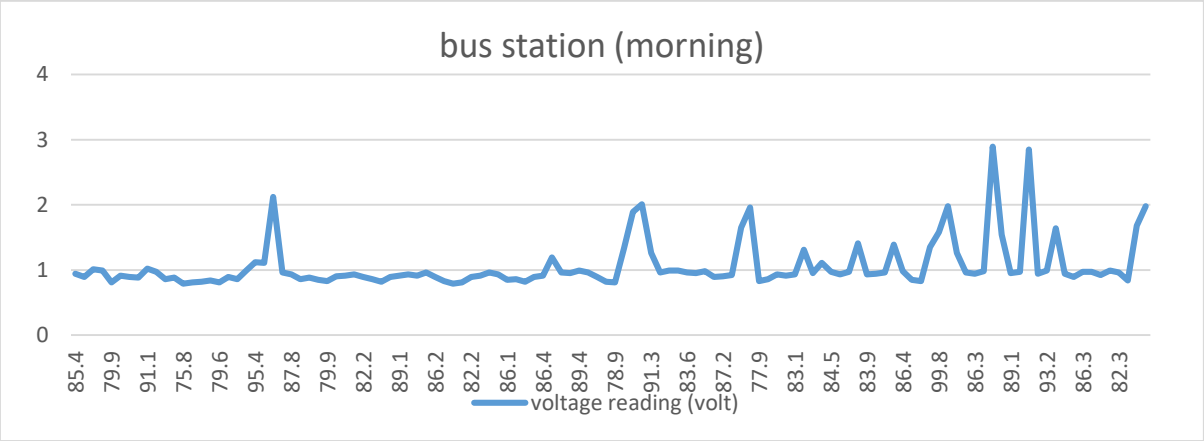


Figure No: 9

4.5 Bus Staion Vadodra

The readings observed at Bus Station (22.313337 and 73.180862) are given in fig 10 in the morning and in fig 11 evening. For morning, wind speed 4.5 mph, the maximum noise reading observed was 103.6 dB and minimum was 75.8 dB, with voltage generation of 2.01 volt and 0.79 volt respectively. The minimum and maximum voltage generation were 0.79 volt and 2.89 volt. For evening, wind speed 5 mph, the maximum noise reading observed was 105.9 dB and minimum was 77.1 dB, with voltage generation of 2.56 volt and 0.82 volt respectively. The minimum and maximum voltage generation were 0.81 volt and 2.89 volt.



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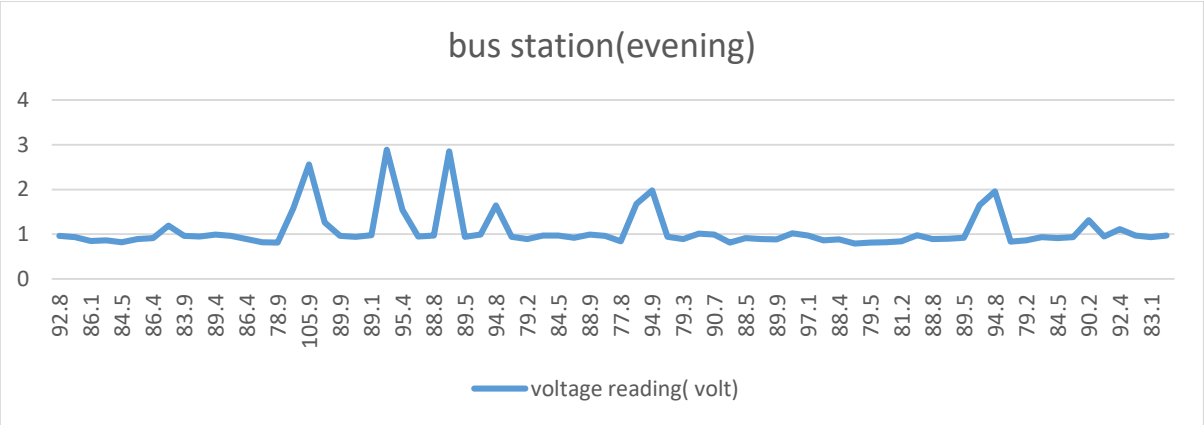

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5. Conclusion

This study concludes that sound energy systems must be implemented to overcome increasing electricity crisis. The performance of the piezo ceramic crystals for voltage generation is one of the efficient methods. The voltage generation observed in heavy traffic areas due to noise pollution were in the range of 0.42 volt to 2.89 volt. Proper traffic management and circuit installations at particular location can improve the power generation from piezo ceramic crystals.

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