

A Study and Implementation of Electricity Generation System at Toll Tax Road Using Piezo Electric MaterialsNainy Chauhan¹, Muskaan Garg²

B. Tech. Scholar

E-Mail : nainychauhan@gmail.com, 03muskangarg1996@gmail.com**Abstract**

In the present days, electricity and power is the most useful and needy thing for human life. Seeing the need of electricity there is the demand to develop renewable sources for generation of the power as there is a shortage of conventional sources. When vehicles move it produces kinetic energy, which is wasted so without wasting the kinetic energy we can utilize the power which is generated by using a power hump at toll tax. For decreasing the energy demand of global consumption, renewable sources are needed to be developed. This paper presents about the piezoelectric crystals or materials which help to produce electricity from the vibration of car on the road due to which movement of automobiles is proposed. This paper gives us the summary about the sensor which will give a great benefit to the lifetime of fossil fuel which simultaneously helps in preventing the pollution of environment.

Keywords: Energy Generator, Sensor, Pads of Metallic Crystals, Piezoelectric Effect.**1. Introduction**

Nowadays, electricity has given the rise in civilization and thus its demand is increasing day by day. We can't imagine our life without electricity as we are dependent on it for all our daily life, industry and in other uses. We can see traffic on road all over the world is increasing therefore, there is the demand of energy and heavy traffic correlation brings us the demand of electricity and for this piezoelectric material embedded beneath a road can provide the miracle of converting pressure which is exerted by the moving vehicles into electric current. The system is based on piezoelectricity, which uses pads of metallic crystals buried over 100 meters of road to generate electricity when put under the pressure of quickly moving traffic.

Components Used

Pressure sensor, LEDs, Battery, Regulator, Amplifier circuit, Inverter, Resistive load.

Piezoelectricity and Its Effect

The word Piezoelectricity means generating electricity by putting pressure. It is derived from the Greek word 'piezen' which means to squeeze and the electric or 'electron' which stands for the source of electric charge. It was discovered in 1880 by French physicists Jacques and Pierre Curie.

Piezoelectric materials are that produce an electric current when they are placed under mechanical stress. This process is also renewable; if we apply an electric current to this it will actually change the shape. Piezoelectric effect is produced due to change in electric polarization of the materials due to applied stress which leads to the production of electric current. It is a reversible process it can occur in 2 ways:

- 1) Direct piezoelectric effect
- 2) Converse piezoelectric effect

Direct piezoelectric effect is when mechanical stress is applied on the crystals, spaces between positive and negative charges are altered due to which polarization is caused and electric field is produced.

In converse piezoelectric effect the applied external field exerts pressure on the charges and hence produces elastic strain due to which the dimensions of the crystal changes.

2. Working

When vehicle stops at toll tax area for paying toll tax then due to the weight of the vehicle the piezo electric material which is placed on the road will be compressed. Due to which when there will be force applied the energy will be generation in the form of electricity which will be stored in the storage for this generation of electricity no external input or energy is required. This generated electricity is enough to operate the systems and lighting of the toll tax area.. The energy exerted from the vehicle movement is used to overcome the resistance, increasing the energy. When the vehicle moves on the road, the road deflects vertically. The only source for harvesting electricity is the part of mechanical energy which is the total energy of the vehicle. In this when the vehicle will be put on the piezoelectric crystals material it will give us the rise in generation of electricity and that generated charges are the source for the electric energy.

3. Working of Piezoelectric Sensor for Smart Roads

The application of mechanical stress on piezo material is equal to the the amount of electric current or voltage is produced. This effect can be used in harvesting energy from the smart roads. When any vehicle moves on the road it produces very small vertical deformations and the vibration on the road. Increasing demand of the electricity forces us about harvesting the energy from the vehicles which is wasted and the traffic on the roads has also increased to certain level. Sensors are to be placed under the road and protected with layer when the vehicle travels on the road it will exert pressure on the device and piezosensors are to be generated with electric current which is a combination with electric generator to produce electricity. The efficiency of electric generation depends on the properties of materials that are used in the sensor.

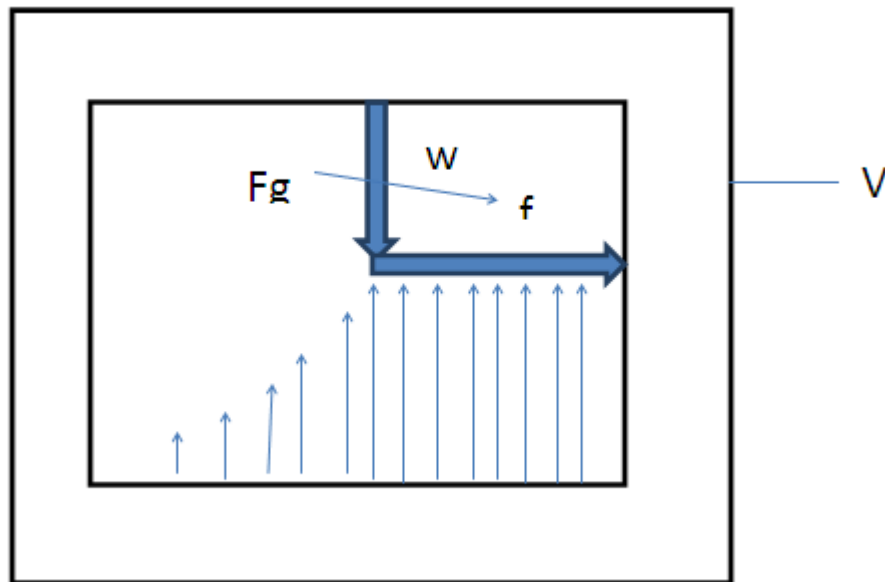


Figure 1: Production of Electricity from Roads

Advantages

- 1) Sensor will give a great benefit to the society and the life of fossil fuel will be increased.
- 2) Energy produced from sensors will be used in street lights, houses.
- 3) Power generated from these sensors will be eco-friendly as there will be no wastage of power.

4. Result

We have implemented this idea in a small project which is generating the electricity for glowing the LED'S and charging the 4 Volt battery as shown in following figure.

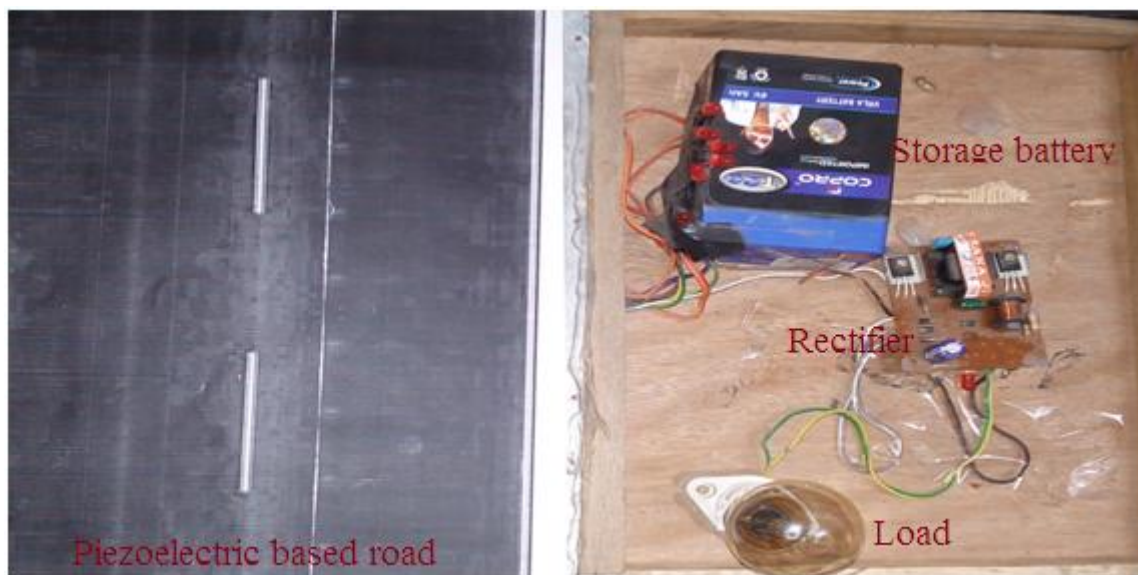


Figure 2: Project on electricity generation using piezoelectric material

5. Conclusion

In this paper, we have discussed about the consumption of energy whose demand is increasing rapidly. The vibrated energy can be harvested to produce electricity using piezoelectric effect. And in this paper we conclude by the result that it can be used in the form of electricity for lightning purpose and for the system use. So there is no need to bring electricity from the substation for toll tax area. Thus this is one of the renewable energy sources for electricity generation.

6. References

- [1]. Shubham Aggarwal, Abhinav Sharma et al. "Piezopotential energy harvesting on airport runway using piezoelectric devices" Innovation in technology conference, 2014.
- [2]. Aqsa abbasi et al. "Application of piezoelectric materials in smart roads and MEMS PMPG Power generation with transverse mode thin film PZT" International Journal of Electrical and Computer Engineering (IJECE) Vol. 3, No. 6, December 2013, pp. 857~862.
- [3]. Jacques and Pierre Curie (1880) "Development par compression de l'électricité dans les cristaux à faces inclinées" (Development via compression, of electric polarization in hemihedral crystals with inclined faces), Bulletin de la Société minéralogique de France, vol. 3, pages 90-93.
- [4]. Chang Liu, "Piezoelectric Sensing and Actuation", Foundation of MEMS, Second Edition, India, Pearson, 2012
- [5]. Holler, F. James; Skoog, Douglas A; Crouch, Stanley R (2007). "Chapter 1". Principles of Instrumental Analysis (6th Ed.). Cengage Learning. p. 9. ISBN 978-0-495-01201-6.
- [6]. Harper, Douglas. "Piezoelectric". Online Etymology Dictionary.

- [7]. Gautschi, G (2002). Piezoelectric Sensorics: Force, Strain, Pressure, Acceleration and Acoustic Emission Sensors, Materials and Amplifiers. Springer.
- [8]. J. Krautkrämer and H. Krautkrämer (1990). Ultrasonic Testing of Materials. Springer.
- [9]. Garnett E. Simmers Jr., Henry A. Sodano Center for Intelligent Materials Systems and Structures, Mechanical Engineering Department, Virginia.
- [10]. Starner, T., 1996, "Human-Powered Wearable Computing," IBM Systems Journal, Vol. 35, pp. 618.
- [11]. Stephen R. Platt, Shane Farritor, and Hani Haider "On Low-Frequency Electric Power Generation With PZT Ceramics".
- [12]. V. Hugo Schmidt, "Piezoelectric energy conversion in windmills," in Proc. Ultrasonic Symp., 1992, pp. 897–904.