



GENERATION OF ELECTRICITY FROM ROADS BY USING PIEZOELECTRIC SENSORS

¹Pravin Wale, ²Chetna Patil, ²Aditya Thakare, ²Ajeta Vinchurkar, ²Purvi Pagare

¹Asst. Professor, ²Student of Bachelor of Engineering,

¹Civil Engineering,

¹Sinhgad Institute of Technology and Science, Narhe, Pune, India.

Abstract: This study has been undertaken to investigate the self sustainable and Ecofriendly model that has been suggested to implement the Power Generation Unit from Road Transport By using the Piezoelectric Sensors, which will convert the pressure and mechanical energy from the vehicles into electrical energy and making a Prototype for the same.

Key Words: Self sustainable, Piezoelectric Sensors, Prototype.

I. INTRODUCTION

In the today's world the importance of Electricity has become a source of living one cannot even imagine living a life not even one day without electricity. Also the pollution and environmental calamities have been reached its zenith, So keeping in mind the growing population and generation of electricity in a very ecofriendly way without causing any harm to the environment, it urges one to create or substantiate for helping out the country by developing a working idea which will implement and help in fulfilling the needs of the people. So for this, a study for generating electricity from some ecofriendly sources and reduce the scarcity of electricity. The growing transport or the number of traffic on the roads have been causing a lot of pollution, emmissions of various fuels and gases are harmful to the living beings, it can cause various fatal problems. So why not using this traffic as a source for generating energy. How this can be done so far is explained in this paper. The traffic on roads generate a lot of energy in the form of kinetic & pressure energies which can also be termed as mechanical energy. This mechanical energy from the vehicles can be used to generate electrical energy by providing a power generation unit in the form of piezoelectric sensors which converts the pressure energy into electrical energy. In this paper, we have suggested a Prototype model which will actually prove that this idea of developing electrical energy can be achieved in a real world.

II. MOTIVATION

As the reports says, that India is the Second largest road network in the world, which contributes over approximate 6000000 km. The government of India aim to construct an additional of 18637 km of expressway by the year 2022. The National Highway Authority of India (NHAI) which is responsible for the development and management of the network of over 50000 km of a National Highway out of 115000 km in India. The Maharashtra state itself has 33705 km of state highway which largest than other states. There are various rural areas which face the scarcity of electricity on a large scale, so we are trying to put forth the idea of fulfilling the energy demands, the piezo smart roads can prove a boon to the country and will create a magic of converting pressure energy of moving vehicle into electric current. The model is based on piezoelectricity, which used the piezoelectric sensors of metallic crystals embedded beneath the road asphalt layer. As the vehicle moves over the road, certain pressure is created by it, this pressure energy is absorbed by the sensors and the ceramic disc contains the charges which develops the electrical energy and this electrical energy can be stored in the form of batteries and further can be used for the street lights at night time also can be distributed to the nearby villages.

III. PROBLEM STATEMENT

The Demand for Electricity is increasing Day by Day while the supply in most of the parts of Country is not sufficient. According to the reports, 80 percent of the villages in India doesnt have power supply which is a very tragic situation for the country's growth and economy. So to reduce this gap between the Demand and Supply, we need to lookout for energy generation also keeping in account, no harm is done to the Environment.

In this Project, a self sustainable and Ecofriendly model has been suggested to implement the Power Generation Unit from Road Transport By using the Piezoelectric Sensors, which will convert the pressure and mechanical energy into electrical energy.

IV. METHODOLOGY

4.1. Preparation of Model

- The design of the model consists of a wooden box size 8*10 (inches) around the piezoelectric material, which is underneath the asphalt layer.



- Piezoelectric sensors (4nos) connected in parallel for getting more voltage.



- The input is given in the form of pressure energy and for the output we have the red LED lights. As the red LED light works more efficiently if the voltage is less.
- Over the piezoelectric sensors concrete cube having asphalt layer of size 6.5*8 (inches) is casted and placed indicating a road block. This block is placed over the setting of the piezoelectric material.



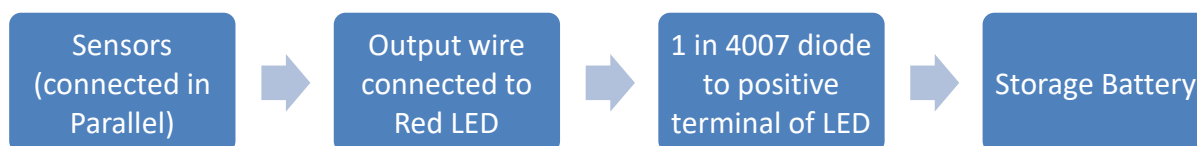
- The Multimeter is provided for checking the voltage generated after pressure is created and the piezo sensors converts it into electric energy.



- Batteries for harvesting the electricity generated and can be further used for street lights and distribution to nearby villages.



4.2. Circuit Diagram



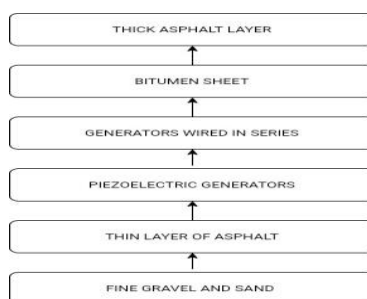
- The outer ceramic disc of sensor is negatively charged and the inner ceramic disc is positively charged.
- The output wire is connected to Red LED light.
- To the one positive terminal of the red LED a 1 in 4007 diode is connected, so that the back voltage of battery should not return to the LED.
- The red LED wire is also connected to a Multimeter for checking the voltage generated at which the light glows.
- The diode is then connected to the battery and the energy is stored.



prototype model

4.3. Construction of Piezoelectric roads

- A layer of fine gravel and sand is to be laid firstly.
- A thin layer of asphalt is laid that acts as a strong base for the generators.
- The piezoelectric generators are placed in a quick drying concrete as per design and they are left for 30 min.
- All the generators are wired in series for getting collective output.
- Bitumen sheet is used for covering the generators that provide a good adhesion of concrete and asphalt.
- And then lastly, the thick asphalt layer is laid that finishes the construction.



CONSTRUCTION OF PIEZOELECTRIC ROADS

4.4. Piezoelectric Sensors

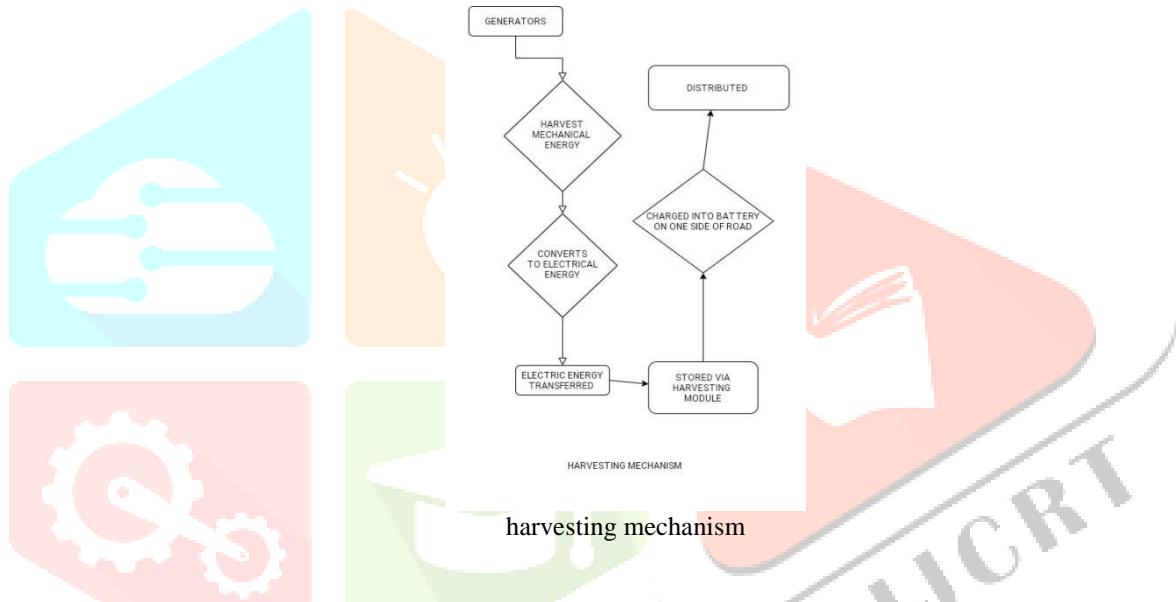
The Piezoelectric Sensors work on the principle of Piezoelectricity. These are made up of ceramic disc which is electrically charged. It has the capacity to convert the pressure coming on them into electricity. They can be embedded beneath the asphalt layer of roads. The voltage can be measured from them and the energy is further transferred to the harvesting module.



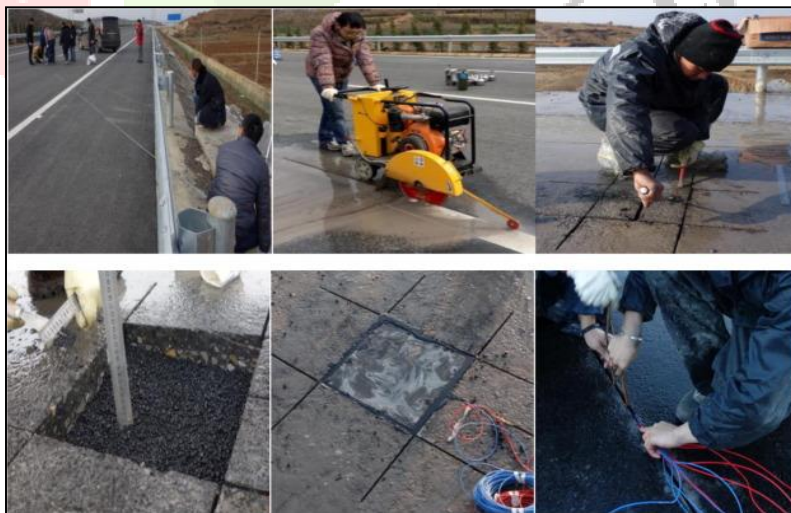
piezoelectric sensors

4.5. Harvesting Mechanism

- The generators harvest the mechanical energy from the vehicles and convert it into electrical energy.
- Electric energy is stored by the harvesting mechanism, then on side of the roads it is charged into batteries
- Then it is distributed from there
- The yield for 1 km of piezoelectric road of one lane, can generate 44000KWh per year.



harvesting mechanism



construction of piezoelectric roads

V. RESULT AND DISCUSSION

Sr.no	Factors	Energy Generated
1.	1 Truck	2000 volts
2.	1 km Piezoelectric road of one lane	44000 kwh per year
3.	1 km stretch of dual carriageway	400 kw

5.1. Cost Estimation for 1km road:

- Size of road : length = 1km = 1000 m, width = 2 m
- Area of road = length*width = 1000*2= 2000 sq.m
- Size of 1 sensor : 1 sq.ft = 0.0929 sq.m
- Gap between two sensors : 1.5 (from each side) = 1.5*2 = 3 m
- Area of road on which sensors been installed : 2000/3 = 666.67 sq.m= 667 sq.m
- No. Of Sensors required for 1 km road = Area of road/size of one sensor
- = (667/0.0929)
- = 7179.76 = 7180 Nos.
- Cost of 1 sensor = 1000 Rs (approx)
- Cost of 7180 sensors = 7180*1000 = 7180000 Rs
- = 70 lakh (approx)

5.2. Power Generation:

- Case study : Hyderabad outer Ring Road Project
- Overall Budget of the Project: 6700 crore
- 8 lane road of 158 km stretch is laid.
- If Piezoelectric road constructed, the budget of project = 1.5 times overall budget
- = 1.5* 6700 crore
- Energy generated from 1 km single lane road = 44000 kwh per year
- Energy generated from 158 km 8 lane road = 158*8*44000 kwh
- = 55616000 kwh energy generated
- Government of India chages Rs. 5 on average per 1 kwh,
- Hence, cost of 55616000 kwh = 5*55616000 = 270000000 crore = 27 crore
- The amount which is invested on this road will get returned in only 4 years.
- This piezoelectric road has an average life of 30 years
- Hence, income generated in the next 26 years would be a profit.

VI. CONCLUSION

- For the four piezo sensors connected in parallel, when pressure applied on the concrete block the amount of energy generated is at **3.8 volt the red LED glows.**
- On field it will require large sensors which will give more energy at **10 times more volt can be generated.**
- The Model satisfies the need and further on field electricity can be generated using the prototype.
- Harvesting energy can prove to be a boon for satisfying the need of electricity in the rural as well as urban areas.
- From the estimation of power generation we can thus conclude tha the energy generated by a dual Carriageway is 40000 kwph .
- Thus, further developments like this could bring a better future and will curb down the cost of energy which can prove to be a great benefit to the country's economy.

VII. ACKNOWLEDGMENT**REFERENCES**

- 1) Aganit Thakur¹, Manisha Dewangan², Priya Lalwani³ [Civil, Columbia Institute of Engineering and Technology, Raipur, (India)], PIEZOELECTRIC ROADS, International Journal of Advance research in science and Engineering, September 2017, vol no. (06), special issue no. (02)
- 2) Md.Saiful Islam¹, Syed Khalid Rahman², Jakeya sultana Jyoti³, Lecturer, EEE department, World University of Bangladesh, Dhanmondi, Dhaka¹, 2 Student, Department of Electronics & Telecommunication Engineering, Rajshahi University of Engineering & Technology, Rajshahi, Bangladesh³, Generation of Electricity Using Road Transport Pressure, International Journal of Engineering Science and Innovative technology, IJESIT, May 2013, Volume 2, Issue 3.
- 3) Hiba Najini and Senthil Arumugam Muthukumaraswamy (Department of Electronic and computer engineering, School of Engineering & physics Sciences, Heriot-Watt University-1294345 Dubai, UAE), Piezoelectric Energy generation from Vehicle Traffic with Technoeconomic Analysis, Hindavi Journal of Renewable Energy, 13 february 2017, Volume 2017.
- 4) Priyanshu Kumar (Electronics Engineering, Aligarh Muslim University, Uttar Pradesh, India) Piezo-smart Roads. International Journal of Engineering Science and Innovative technology, IJESIT
- 5) Vipul Jain (Delhi School of Management, Delhi Technological University) Viability of Solar Roads in India International Journal of Engineering Science and Innovative technology, IJESIT,
- 6) Sanket Manwatkar, Ganesh Singh, Ankit Shukla, Sarvesh Biyani, 2019, Generation of Electricity by Multi Ramp System. Prof. Dharavi Thawari, Sandip Bansode, Mahesh Phule. Electro Kinetic Road Ramp
Elham Maghsoudi Nia, Noor Amila wan Abdulh Zawawi, Balbir Singh, March 2019, Design of Pavement using Piezoelectric Materials.

