Energy Harvesting Using Vehicle Tyres

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ABSTRACT - In this project, a system is utilized to capture energy from the tires of a vehicle. This is achieved through the utilization of special materials known as Piezoelectric materials and a dynamo. As the vehicle's tire moves, it generates force that is typically wasted. However, a method has been devised to harness this energy and convert it into electricity. The tire undergoes various motions such as bouncing, vibrations, and forces when navigating uneven terrain or during braking and acceleration. This system has the capability to harness all such movements and convert them into electrical power. With its potential applications in the automotive industry and beyond, this innovation presents an exciting prospect.
Keywords - Energy Harvesting, Piezoelectric effect, Piezoelectric material, dynamo, Poly-crystalline ceramics, Tires, Power generation.

I.INTRODUCTION

With the developing and growing world, there is also a growing call for electricity supplies. With the growth in demand, there is a growth in the situation within the depletion of assets used to generate power traditionally. Society is growing new alternative non- conventional methods which can be gaining a lot of popularity in these days. Many famous and successful strategies are Solar cells, Wind electricity, hydroelectric strength, and biogas plant life. With the ever developing Automotive enterprise and the arrival of Hybrid Electric vehicles and EVs, a lot of energy is required to mobilize them.

In this project, they used Piezoelectric to capture energy from the motion of car tires. When the tire moves, it creates vibrations and forces, like when you brake or go over bumps. They turn that movement into electricity. This technology has many possibilities for harvesting energy in cars and other areas[1].

This paper explains the efficiency of power generation using piezoelectric materials depends on the material properties, the magnitude of the mechanical stress or vibrations, and the design of the piezoelectric device. Researchers continue to explore and improve this technology for a wide range of applications, including energy harvesting from everyday activities[2].

This paper explains how piezoelectric materials can be used in Electric Vehicle (EV) tires to generate electricity. The idea is to place layers of piezoelectric material around the edges of the tire. When the EV is moving, these materials can produce electricity because of the pressure they experience from touching the road. The results of this concept indicate that by placing piezoelectric material around the tire's perimeter, we can generate electricity. This electricity can be stored in a battery and used to extend the EV's driving range beyond its initial single charge. The chosen piezoelectric material is Polyvinylidene fluoride (PVDF), a type of polymer with strong and beneficial properties[6].

This paper explains that piezoelectricity for power generation has significant potential, especially in low-power and remote applications where other energy sources may not be feasible. However, the technology is still evolving, and successful implementation often requires careful consideration of materials, design, and application-specific factors[7].

Piezoelectric fabric with a mixture of dynamo performs a primary function in solving this problem. The vibrations and undulations from the vehicular motion can be converted into electric energy with the use of the piezoelectric effect. Tires of the vehicle are subjected to every day and shear loads, this load can be used because of the supply of mechanical strain for the piezoelectric cloth. The dynamo offers a self-sustained supply of electricity without the need for external power resources, making it useful in situations wherein strength is needed.

II.PROPOSED METHOD

The proposed solution of implementing piezoelectric and dynamo systems in e-vehicles offers significant potential to enhance energy efficiency, extend range, and improve overall performance
By capturing and converting mechanical energy from vehicle motion and friction, these systems contribute to sustainable and efficient electricity generation.

COMPONENTS USED PIEZOELECTRIC

A piezoelectric sensor is a device that uses the piezoelectric effect to measure changes in pressure, acceleration, temperature, or force by converting them into an electrical charge or voltage. Piezoelectric materials, like quartz or certain ceramics, generate an electric charge when mechanical stress or vibration is applied to them and can also deform when an electric field is applied.

Piezoelectric sensors are commonly used in various applications, such as accelerometers for measuring acceleration, pressure sensors for detecting pressure changes, and in vibration sensors for monitoring mechanical vibrations.

FULL WAVE BRIDGE RECTIFER

A full-wave rectifier is an electronic circuit that converts alternating current (AC) into direct current (DC) by allowing current to flow in one direction. Unlike a half-wave rectifier, which uses only half of the AC waveform, a full-wave rectifier uses both the positive and negative halves of the AC waveform to produce a smoother and more continuous DC output.

Full-wave rectifiers are commonly used in power supplies for electronic devices and in various applications where a consistent and steady source of DC power is needed. They are more efficient and effective in converting AC to DC compared to half-wave rectifiers.

TYRE

Tires can be used for energy generation through a process called "piezoelectric energy harvesting." Piezoelectric materials can convert mechanical deformation, like the compression and deformation of a tire as it rolls over the road, into electrical energy. Research and development in this area continue, and there is potential for using piezoelectric tire technology to supplement the energy needs of various systems in transportation and infrastructure. However, challenges such as efficiency, cost-effectiveness, and durability need to be addressed for widespread adoption.

BLOCK DIAGRAM

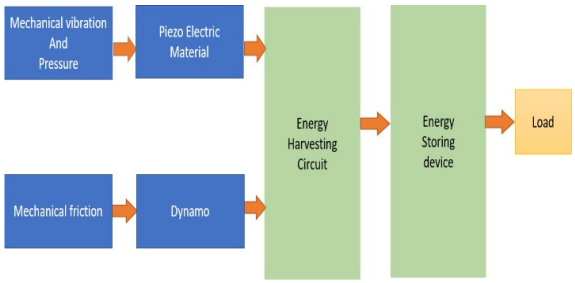


Fig.4.1 Block Diagram

BLOCK DIAGRAM

Mechanical Vibration and Pressure Input:

At the beginning of the system, there is a source of mechanical vibration and pressure. This could be, for example, vibrations from machinery, pressure fluctuations, or any other mechanical disturbances in the environment.
Piezoelectric Element:
The mechanical vibrations and pressure are directed to a piezoelectric element. Piezoelectric materials generate electrical charges when subjected to mechanical stress. In this case, the mechanical vibrations and pressure act as the stressors.
Dynamo with Mechanical Friction:
In parallel to the piezoelectric element, there is a dynamo that also receives mechanical input. However, in this case, the input is in the form of mechanical friction. The dynamo converts mechanical energy into electrical energy through electromagnetic induction.
Energy Harvesting Circuit:

The electrical outputs from both the piezoelectric element and the dynamo are then fed into an energy harvesting circuit. This circuit is designed to process and combine the electrical outputs efficiently.

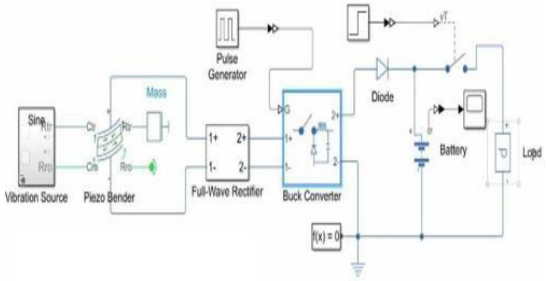
Energy Storage Device:

The combined electrical energy from the energy harvesting circuit is directed to an energy storage device. This device, such as a capacitor or a rechargeable battery, is used to store the harvested energy for later use.

Load for Working Purpose:

When there is a demand for electrical power, the stored energy is released from the energy storage device and supplied to a load. The load represents the device or system that needs electrical power to perform a specific task or function.

SIMULATION DIAGRAM



HARDWARE RESULT

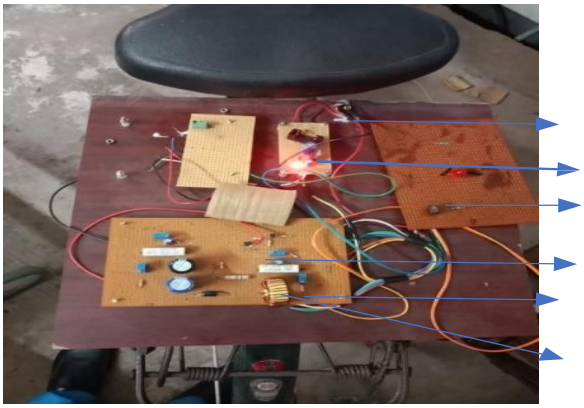


Fig. Hardware Image

While energy harvesting from vehicle tires using piezoelectric sensors and dynamos shows promise, achieving consistent and efficient results requires addressing challenges like durability and cost. Successful outcomes hinge on optimizing the system for real-world conditions and ensuring a balance between energy generation and practical implementation.

III.CONCLUSION

In this project, we have used a piezoelectric material which is going to detect the vibrational or constraint force and gives voltage as result. The output will be in the form of AC supply (Alternating Current) which is then converted into DC supply (Direct Current) with the help of rectifier circuit. The generated DC voltage is given to the Booster circuit which will increase the current rating and the voltage is parallelly decreased as voltage is inversely proportional to the current.

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