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ENERGY HARVESTING FROM VEHICLE USING PIEZO ELECTRIC PLATES

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Abstract

In our project Piezoelectric Power Generation from Tires, mechanical energy generated by vehicle's wheel due to the contact on the road is converted into electric energy by piezoelectric effect. Piezoelectricity is the electric charge that accumulates in certain solid material (notably crystal, certain ceramic and biological matter such as bone, DNA and various proteins) in response to applied mechanical stress. The aim of this project is to make power generation more sustainable, economic and ecological by utilizing the advancement in the technology. Converts waste and unused vibration mechanical energy from vehicle's tire into electrical energy. So, therefore on our project we are going to use piezo electric patches inside the wheel rim. In real time when the Tire is in contact with the road and the pressure of the vehicle's weight, generates the electricity by the piezo electric patches. But, in our project we are going to fabricate an iron frame which consists of Tire with pedal and chain mechanism. In this project we are applying the weight manually and Arduino monitor's the voltage and weight on LCD display.

Keywords: Adapter Power supply, Arduino Microcontroller, LCD with driver, Piezo electric plates, Force sensor, Hx711 amplifier, Voltage measuring circuit,
Iron frame, Tire, Pedal, Chain, Bearings.

1. Introduction

As piezo energy harvesting has been investigated only since the late 1990s, it remains an emerging technology.
Piezoelectricity was discovered in 1880 by French physicists Jacques and Pierre Curie. The piezoelectric effect is understood as the linear electromechanical interaction between the mechanical and the electrical state in crystalline materials with no inversion symmetry.

Piezoelectricity is found in useful applications such as the production and detection of sound, generation of high voltages, electronic Frequency generation, microbalances, and ultrafine focusing of optical assemblies. It is also the basis of a number of scientific instrumental techniques with atomic resolution, the scanning probe microscopies. Most piezoelectric electricity sources produce power in the order of milli watts, too small for system application, but enough for hand-held devices such as some commercially available self-winding wristwatches. One proposal is that they are used for micro-scale devices, such as in a device harvesting micro-hydraulic energy. Acquire a charge when compressed, twisted or distorted are said to be piezoelectric.
When vehicles move on the road, the piezoelectric materials under the road are vibrated due to vehicle suspension in the tires that force the road and produces electricity in large amount. The power generated from the piezo electric sensor is given as input to the microcontroller and displays voltage and weight on the LCD.

2. LITERATURE SURVEY

In 2015 a group of engineers from the **University of Wisconsin-Madison** certainly started a course. Along with help from Chinese collaborators they developed a nanogenerator that harvested energy from a car's rolling Tire friction. Sound familiar?

Said nanogenerator was reliant on what's known as the triboelectric effect. Cut through the jargon and you'll learn this refers to the electric charge occurring from the 'contact or rubbing' together of two different objects. All clear? Stick with us.

Well, the triboelectric effect in this scenario harnesses energy from the changing electric potential of the pavement and a car's wheels.

When the part of a Tire encasing a small electrode comes into contact with the ground, the combination produces an all-important electrical charge. Genius.

To demonstrate their theory the university's engineers used a toy car fitted with LED lights no less. When Tire and 'pavement' synced up, the lights flashed as planned and a world of opportunity presented itself.

Sumitomo clearly drew inspiration from these early experiments and supersized them. But they're not alone in attempts to claw back energy.

Four years ago **Audi** poured millions into a suspension system intended to convert jolts from bumps into electricity.

More recently **Hyundai** have announced it will be incorporating solar panels into the new Sonata Hybrid.

Perhaps this is the new norm. Indeed, according to a Sumitomo press release it's merely the start of something big.

"Moving forward, we will continue working to advance this research with support from the Japan Science and Technology Agency", it confirmed.

The advancement of self-driving technology ratchets up expectations and means we demand more from our vehicles than ever before. So, the next time you change your Tires, be sure to see check their capabilities as well as their tread.

2.https://patents.google.com/patent/US6291901 B1/en , A method and device for generating electrical energy from the rotation of a wheel of a vehicle is disclosed. The device is disposed within a pneumatic tire and includes a coil housing having an interior chamber with a coil disposed thereabout, which is aligned for receiving a magnet within the chamber. The magnet is mounted within a magnet housing which has a first end aligned for reception in the groove of the coil housing, and a second end in communication with the interior wall of a tire. As the tire rotates, the tire deflection causes relative motion between the magnet and the coil generating electricity.

3. Implementation:

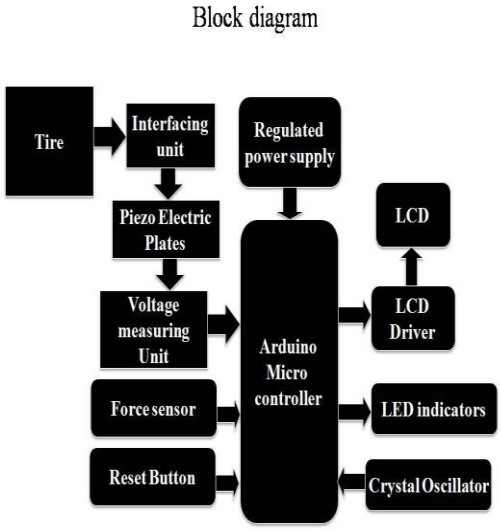

Fig1: Block diagram

Now days the power cutting is increased, so we require power supply to save power supply to recharge mobile or some other electronics appliance. So we are using power supply from foot/vehicle tire pressure energy.

The main idea of this project is "Generating power from vehicle tire pressure energy using Piezo electric effects and monitor voltage, weight on LCD display.

We can use vehicle tire pressure for power generation energy from **moving vehicles.**

We will mount this piezo plates into the tire. Tire is fixed to the metal frame with pedal and chain drive setup. When the user rotate the pedal, pressure is applied the Tire and it will generate the voltage with the help of piezo electric effect and it will read by arduino through voltage measure ment circuit and display the voltage and weight values on LCD module. The arduino ide studio software is used

to dump the embedded code into the microcontroller.

4. Related Work:

The brief introduction of different modules used in this project is discussed below:

4.1. ARDUINO UNO:

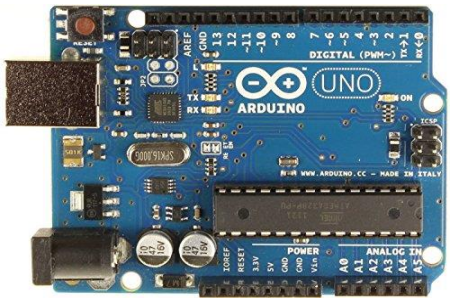

FIG2: Arduino UNO

The Arduino Uno is a microcontroller board which has ATmega328 from the AVR family. There are 14 digital input/output pins, 6 Analog pins and 16MHz ceramic resonator.

USB connection, power jack and also a reset button is used. Its software is supported by a number of libraries, that makes the programming easier.

4.2 LCD display:

Fig3: LCD display

One of the most common devices attached to a micro controller is an LCD display. Some of the most common LCD's connected to the many microcontrollers are 16x2 displays. This means 16 characters per line by 2 lines respectively. In this monitors the generated voltage from Tire, weight on LCD display.

4.3 Load cell:

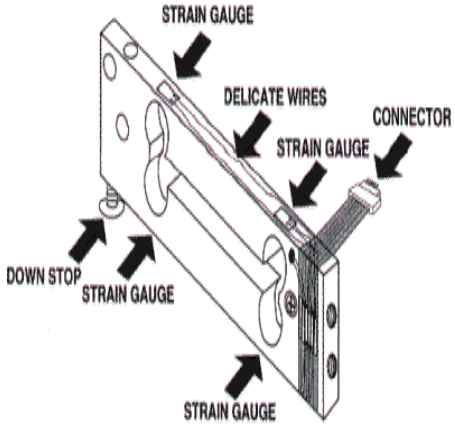

Fig4: Loadcell

There is a strain gauge load cell, which is a mechanical element of which the force is being sensed by the deformation of a (or several) strain gauge(s) on the element.

4.4 Piezo sensor:

Fig5: piezo sensor

A **piezoelectric sensor** is a device that uses the piezoelectric effect to measure pressure, acceleration, strain or force by converting them to an electrical charge.

A piezoelectric transducer has very high DC output impedance and can be modeled as a proportional voltage source and filter network. The voltage V at the source is directly proportional to the applied force, pressure, or strain. The output signal is then related to this mechanical force as if it had passed through the equivalent circuit.

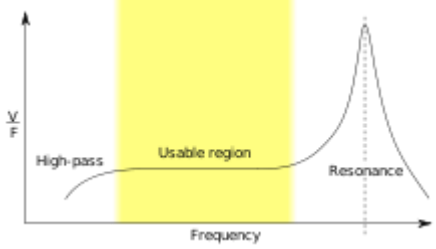

Fig:6 Frequency response of a piezoelectric sensor; output voltage vs applied force

A detailed model includes the effects of the sensor's mechanical construction and other non-idealities. The inductance L_m is due to the seismic mass and inertia of the sensor itself. C_e is inversely proportional to the mechanical elasticity of the sensor. C_0 represents the static capacitance of the transducer, resulting from an inertial mass of infinite size. R_i is the insulation leakage resistance of the transducer element. If the sensor is connected to a load resistance, this also acts in parallel with the insulation resistance, both increasing the high-pass cutoff frequency.

4.5 Piezo Tire:

Fig7: piezo Tire

In this we are connecting 40 piezo plates in parallel and series also mounted all this piezo plates into the Tire.

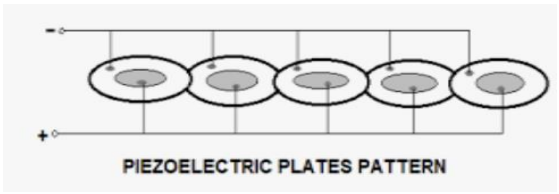

Fig8:Piezo electric plates

4.6: Pedal :

Fig9: pedal

The pedals were attached to a crank driving a sprocket that transmitted power to the driven wheel by means of a roller chain.

4.7. SPROCKET AND CHAIN DRIVE:

Fig10: sprocket and chain drive

This is a cycle chain sprocket. The chain sprocket is coupled with another generator shaft. The chain converts rotational power to pulling power, or pulling power to rotational power, by engaging with the sprocket.

4.8 Frame:

Fig11: Mild steel metal

In this project we go to fabricate a 1 feetx2feet metal frame using mild steel material.

5. Results:

The project "**Energy Harvesting from Vehicle Using Piezo Electric Plates"** was designed a power generated system from vehicle Tires using piezo electric sensors and displays the voltage and weight on LCD.

Fig12: Fabrication Setup

Fig13: Output voltage, weight display on LCD

6. ACKNOWLEDGEMENT

We would like to thank all the authors of different research papers referred during writing this paper. It was very knowledge gaining and helpful for the further research to be done in future.

7. CONCLUSION:

The Piezo Electric Power Generation from Tires is working with satisfactory conditions. We can able to understand the difficulties in maintaining the tolerances and also the quality. We have done to our ability and skill making maximum use of available facilities Thus we have developed a "Piezoelectric Power Generation from Tires" which helps to design an energy harvesting system.

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