Piezoaura

Introduction:

Our Project aim is to produce electricity by using mechanical stress. With the increasing integration of digital tools in education, the on electricity to power smart devices, interactive boards, and internet connectivity is growing. The challenge is to create a reliable, sustainable, and cost-effective energy solution that can support regardless of location.

In the quest for efficient energy solutions, piezoelectric technology offers a promising approach to harnessing mechanical energy from everyday activities. The piezoelectric effect, reliance where certain materials generate electrical energy in response to mechanical stress, has the potential to power electronic devices through simple actions such as pressing a button. This project explores the application of a piezoelectric button to capture mechanical energy and convert it intoelectrical power suitable for practical use.

Electricity usage has become an essential aspect of modern life, powering nearly all aspects of our daily activities, industries and technologies. The demand for electricity continues to grow with the expansion of urbanization, technology and industries. Global electricity consumption has steadily increased over the years due to population growth, industrialization and technological advancements. According to the International Energy Agency (IEA), global electricity demand rose by about 6% in 2021, with further increase projected as economy's recovery.

In the sports and fitness industry, athletes frequently experience muscle strain, stress, and fatigue during training and competitions. While there are various pain relief methods available, most rely on external power sources and may not be convenient or portable during active sessions. Additionally, athletes are constantly seeking innovative ways to manage stress, improve recovery times, and maintain hand strength, all while optimizing energy usage in a sustainable manner.

Description:

This project focuses on the design and implementation of a piezoelectric energy harvesting system that efficiently converts mechanical energy into usable electrical power. The system employs a piezoelectric button to generate alternating current (AC) when pressed. This AC is subsequently rectified into direct current (DC) using a converter. The DC power is stored in a lithium-ion battery, which provides a reliable energy source. The stored energy is then utilized to power a 134N3P module, designed as a charging station for mobile devices and other electronic gadgets. This approach demonstrates a practical method for harnessing and storing mechanical energy, offering a sustainable solution for powering electronic devices through an innovative use of piezoelectric technology. Additionally, integrated vibration sensors provide therapeutic benefits as pain relievers, offering a green, self-sufficient alternative to conventional battery-powered systems and promoting sustainability in wearable technology.

Piezoelectric materials are widely used in various industries. They are crucial in devices such as pressure sensors, accelerometers, and energy harvesters. In medical technology, they are integral to ultrasound imaging, while in consumer electronics, they enable precise control in actuators and vibration-based sensors. The piezoelectric effect is also explored for its potential in renewable energy, converting mechanical vibrations into electrical power, making it a key technology in the development of self-powered systems.

Solution:

This process occurs mainly by using the piezo button which generates electricity (AC current) with the help of applied mechanical stress. Later, by using AC to DC converter it is converted to DC current and used to charge devices, is supplied to Lithium-ion battery which stores it. The stored energy is then used to power a 134N3P module which can be substantial is used as power bank for charging mobiles. Additionally, integrating vibrating sensors provides benefits as pain relievers and more. The following is the working process step-by-step:

1. Energy Generation
2. AC to DC Conversion
3. Energy Storage
4. Powering Devices
5. Operation continues

1. **Energy Generation**: When the piezoelectric button is pressed, it converts mechanical stress into alternating current (AC) through the piezoelectric effect.

2. **AC to DC Conversion**: The AC is converted into direct current (DC) using an AC-to-DC converter to make the energy suitable for storage and use.

3. **Energy Storage**: The DC power is stored in a lithium-ion battery due to its high energy density and efficiency.

4. **Powering Devices**: The stored energy powers a 134N3P module, which charges mobile devices and other electronics**.** Adding vibration sensors to the module provides benefits as pain relievers and many.

Project Details:

Components:

- Piezoelectric Button
- AC to DC Converter
- Lithium Ion Battery
- 134N3P Module
- Vibration Sensors
- Form Board
- Connectors And Wiring

1. Piezoelectric Button: When pressed, the piezo button generates an alternating current (AC) through the piezoelectric effect. The amount of current generated would be small, but multiple buttons presses or enhancements could accumulate sufficient energy.

2. AC to DC Converter: The generated AC from the piezo button would be routed through an AC to DC converter. This could be a rectifier circuit that ensures a smooth DC output, which is essential for charging a lithium-ion battery.

3. Lithium-Ion Battery: The converted DC power would charge the lithium-ion battery. Given that lithium-ion batteries require a controlled charging voltage and current, you would need a charge controller to safely charge the battery without overcharging or damaging it.

4.134N3P Module: This battery module, consisting of 134 cells arranged in 3 parallel configurations, would store the energy. The stored energy could then be used to charge mobile devices, likely requiring a step-down voltage regulator to adjust the output voltage to the necessary level for mobile charging (usually 5V for USB devices).

This system is an efficient way to utilize piezoelectric energy for small-scale applications like mobile device charging. The challenge lies in optimizing the energy generated from the piezo buttons and ensuring stable, efficient charging of both the lithium-ion battery and mobile devices.

5. **Form Board:** Foam board (also known as foamcore) is a lightweight, rigid material made from a foam center (typically polystyrene) sandwiched between two layers of paper or plastic. It is commonly used for various applications in design, art, and presentation due to its ease of use and versatility.

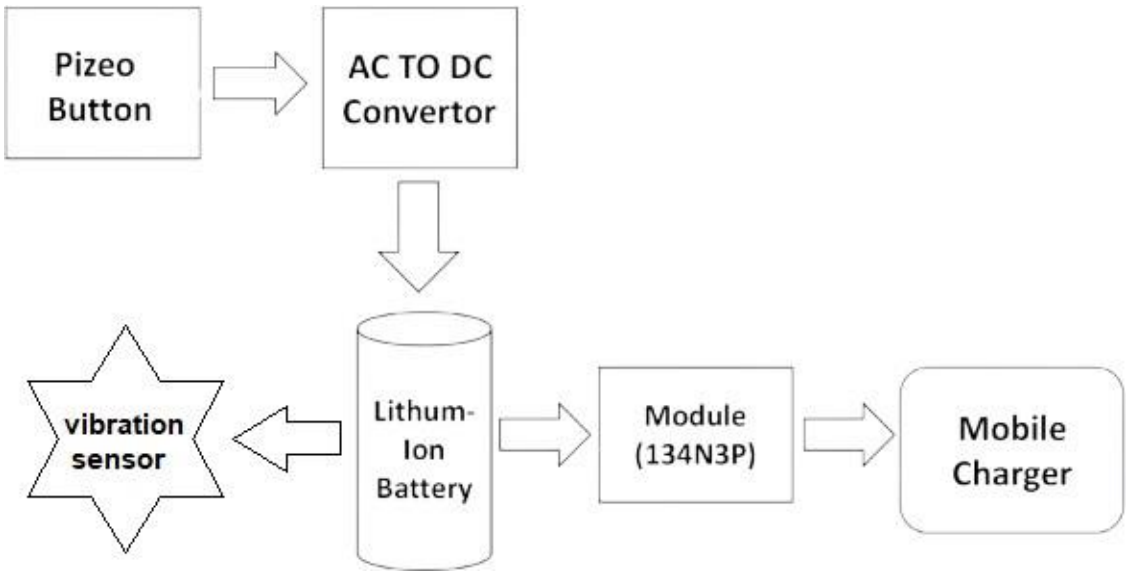
6. Connectors And Wiring:

Wire Type: Use thin-gauge wires (24-30 AWG) for connecting the piezo button since the current produced is very low. Ensure the wires are flexible and can handle repetitive pressing without breaking.

Connectors: Solder the wires directly to the piezo button's output terminals or use micro connectors like JST connectors for easier connection and disconnection.

7. **Vibration Sensors:** Vibration sensors are devices used to measure the oscillation or vibrations of an object. They detect changes in motion and can be used to monitor equipment health, safety, and performance.

Block Diagram:



Working Principle:

1. Rectification: The first step in converting AC to DC is rectification, which uses diodes or rectifiers to allow current to flow in only one direction, converting the AC signal to a pulsating DC signal. Half-wave rectifier: Uses a single diode to block half of the AC waveform. Full-wave rectifier: Uses multiple diodes (e.g., a bridge rectifier) to convert both halves of the AC waveform.

2. Smoothing/Filtering: The pulsating DC output is not ideal for most applications. A capacitor is often used to smooth the output, reducing fluctuations and providing a more stable DC voltage.

3. Voltage Regulation: In some converters, a voltage regulator is added to maintain a constant DC output voltage despite fluctuations in the input voltage or load.

4.Charging: When charging, lithium ions move from the cathode to the anode through the electrolyte, where they are stored.

5.Discharging: During use, lithium ions flow back from the anode to the cathode, releasing energy to power devices.

Key Features:

1.Piezo Button:

a) Durability: Since piezo buttons have no moving mechanical parts, they are highly durable and resistant to wear and tear.

b) Sensitivity: These buttons can detect even slight pressure or touch, offering a highly responsive interface.

c) Waterproof/Weatherproof: The absence of mechanical parts allows them to be sealed, making them resistant to moisture, dust, and extreme weather.

d)Applications: Commonly used in industrial controls, kiosks, medical devices, and environments that require robust, long-lasting buttons.

2.Lithium-ion Battery:

a) High Energy Density: Li-ion batteries can store more energy per unit weight compared to other rechargeable batteries, making them ideal for portable electronics.

b) Lightweight: Lithium is a lightweight material, contributing to the overall reduced weight of the battery**.**

c) Low Self-Discharge: Li-ion batteries lose their charge more slowly when not in use compared to other rechargeable battery types.

d) Rechargeable: They can be recharged hundreds to thousands of times, making them more cost-effective over time.

Advantages:

- Long lifespan due to fewer mechanical components.
- Can be made with anti-vandal properties.
- Sustainability
- Early fault detection
- Reduced energy cost
- Portable
- Low maintenance
- Energy storage efficiency
- Emergency applications
- Low noise
- Minimal heat production
- Easily Customizable
- Safety monitoring

Social Impact on Humanity:

By integrating piezoelectric technology with modern energy storage solutions, this project aims to demonstrate an innovative method of energy harvesting and storage. The successful implementation of this system could offer a sustainable means of powering electronic devices, contributing to the broader goal of reducing reliance on conventional power sources and enhancing the efficiency of energy utilization. The Piezo Pulse Energy Unit has the potential to create a significant social impact particularly within the sports, fitness, and wellness communities like,

- Stress Boosters
- Household Applications (Bells, Alarms)
- Emergency Power Supply
- Rechargeable massage devices
- Health Equipment
- Portable power banks
- Wearable fitness devices

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