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Footsteps Power Generation Using Piezo Electric Material

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ABSTRACT: Electricity usage is expanding at an exponential rate. This research introduces an energy storage concept that utilizes human movements like skipping and running. It recommends harnessing human locomotion energy, which, despite being extractable, is largely wasted. This innovative footstep power production system employs piezoelectric sensors placed beneath a platform to generate voltage from footsteps. The sensors are arranged to maximize output voltage, which is then directed to a monitoring circuit. The generated energy is stored in batteries for convenient later use. This model is especially suitable for India, which has a large pedestrian population. This method of generating and storing energy promotes an environmentally responsible approach to energy production and the development of clean, green energy.

KEYWORDS: Piezoelectric sensors, Electricity, Footsteps power Generation.

I. INTRODUCTION

Now a day's energy is one of the most important issues around the world. Especially in India energy crisis is a big problem. Renewable energy sources can be a great media to solve this energy crisis problem in India. As we know natural resources will finish one day. That's why researchers are trying to introduce substitute energy sources from nature that must be green and not harmful for the environment. Energy harvesting is defined as capturing minute amounts of energy from one or more of the surrounding energy sources. Human beings have already started to use energy harvesting technology in the form of windmill, geothermal and solar energy. The energy came from natural sources, termed as renewable energy.

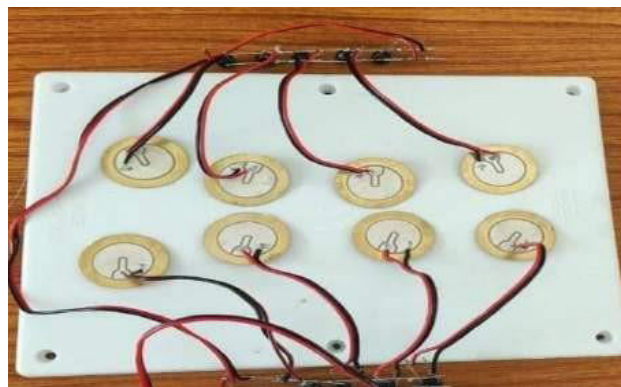


Fig.1: Piezoelectric Sensors

A piezoelectric sensor is a sensor that generates a mechanical strain when an external force is applied or a deformation

occurs when a voltage is applied to the sensor. The piezoelectric sensor is applied in various purposes in many industries and used widely such as medical industries, automobile industries, and information communication industry. This piezoelectric sensor determines the energy level from the external force condition, and it is expected to collect high energy in the ocean where the main external force is expected to be collected.

Since the piezoelectric effect generated by the MLCC (multilayer ceramic capacitor) differs from that of the widely used polarized PZT, it is necessary to carefully examine what results are obtained depending on the state of the input signal and the MLCC. However, in this study, since unimorph-type PZT is installed in duplicate, energy collection and trend analysis are easier. As the coastal structures used in the experiment, caisson-type breakwater was applied to perform the normal function of the port facility since it effectively reduces the high waves in deep water depth. Particularly, it is possible to produce energy by wave by attaching the device to the upper part of the front side of the breakwater where high wave, the main external force, intensively influences. A device and a panel attached to the structure.

II. PROBLEM STATEMENT

Now a day's energy is one of the most important issues around the world. Especially in India energy crisis is a big problem. Renewable energy sources can be a great media to solve this energy crisis problem in India. As we know natural resources will finish one day. That's why researchers are trying to introduce substitute energy sources from nature that must be green and not harmful for the environment.

III. LITERATURE SURVEY

The study conducted in [1] discusses the literature highlights the increasing importance of alternative energy sources in addressing power demands. The paper focuses on energy harvesting through piezoelectric sensors from human footsteps, converting wasted mechanical energy into electricity. To enhance power output, the study suggests connecting Piezo sensors in series/ parallel combinations. The proposed technology finds applications in various settings, offering a sustainable solution for mobile charging, LED lighting, and more. The integration of a microcontroller (ATMega328P) monitors and displays real-time voltage status, making this approach practical for diverse purposes in the evolving power sector. The power sector is giving many changes in order to maintain an effective power flow. Even though renewable or non-renewable energy sources are present in the power market, some countries could not overcome the power demand due to an increase in the human population. In order to avoid such issues, power can be generated using alternating techniques

The study conducted in [2] utilizes the literature discusses an innovative concept: generating electricity from human footsteps using piezoelectric transducers. These devices convert mechanical energy from walking into electrical energy. Implemented in a series-parallel configuration, the transducers are applied to wooden tiles resembling walking surfaces. This approach holds potential for practical deployment in high-traffic areas, pedestrian pathways, or fitness equipment, providing a sustainable means to power low-consumption devices. Electrical energy is important and had been demand increasingly. A lot of energy resources have been wasted and exhausted. An alternative way to generate electricity by using a population of human had been discovered when walking, the vibration that generates between the surface and the footstep is wasted. By utilizing this wasted energy, the electrical energy can be generated and fulfill the demand. The piezoelectric transducer is connected in series-parallel connection. Then, it is placed on the tile that been made from wood as a model for footstep tile to give pressure to the piezoelectric transducers. This tile can be placed in the crowded area, walking pavement or exercise instruments. The electric energy that generates from this piezoelectric tile can be power up low power appliances.

This study [3] presents the review utilizes this paper explores designing a road energy harvester using piezoelectric transducers, aiming for an eco-friendly energy source without disrupting ecosystems. Utilizing Proteus Software, it compares circuit configurations, highlighting a 4 Series 2 Parallel connection for a voltage doubler as the most effective, generating 6.634 V. This paper describes the design of energy harvester from the road using piezoelectric transducer for creating a clean energy source without disturbing any existing ecosystem. In this paper, the piezoelectric sensors are used as a key element in generating electricity. Piezoelectric sensors that conduct for converting kinetic energy to electricity have placed vibrations from the movement of vehicles and humans as the main focus of the project. Simulation by Proteus Software is used to determine the circuit connection for converting an alternative current (AC) to

direct current (DC).

This study [4] Electricity usage is expanding at an exponential rate. This research recommends making use of human locomotion energy, which, despite being extractable, is largely wasted. This research presents an energy storage concept that employs human movement, skipping, and running as energy. The piezoelectric sensors are used in this innovative footstep power production system. The piezo sensors are positioned below the platform to generate a voltage from footstep. The sensors are arranged in such a way that maximum output voltage is generated, which is then sent to our monitoring circuitry. This energy is then stored in the batteries and can be used whenever it is convenient. A model like this is near suitable for India, which has a large pedestrian people. This method of generating charge and storing it for later use encourages an approach to energy creation and the development of clean green energy. Keywords: Piezoelectricity, Plates, Footsteps, Power Generation, Electricity. This research addresses the escalating demand for electricity by proposing the utilization of human locomotion energy, often wasted. The innovative footstep power production system employs piezoelectric sensors beneath a platform, converting footstep pressure into voltage. The strategically arranged sensors maximize output voltage, feeding into monitoring circuitry and subsequently storing the energy in batteries for convenient use. Tailored for densely populated pedestrian areas like India, this approach promotes environmentally responsible energy creation, contributing to the development of clean and sustainable energy solutions.

This study [5] the electrical power consumption is increasing exponentially. Therefore, the need of a fool-proof and economically viable power generation and distribution system demands a certain interest. This paper proposes utilization of human locomotion energy which, although extractable goes mainly to waste. This paper proposes a model that uses human walking, jumping and running as a source of energy and store it for essential use. Such a model in a demography that of a country like India which has such a huge pedestrian population. This paper illustrates a method for harvesting this human locomotion energy with the use of piezoelectric sensor and demonstrates an application with the stored energy Le to charge a mobile phone securely using RFID. The ground reaction force (GRF) exerted from the foot, when converted to voltage by piezoelectric sensors is capable enough to power up a device. Successive exertion leads to aperiodic voltage build up which with proper circuitry can be used to charge a storage battery. The power produced by this technique can also be employed in basic application such as street lighting, notice boards, gyms and other areas of public domain. It also promotes green energy and environment friendly approach towards energy generation. In this paper we have provided the basic concept and design details of this model and a basic implementation of the same.

IV. MODEL DESCRIPTION AND WORKING

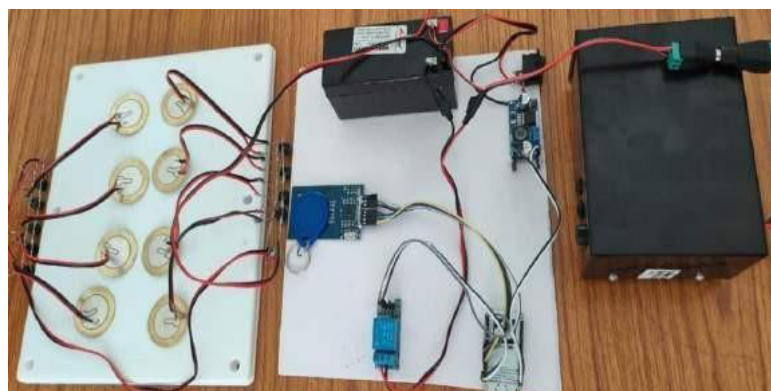


Fig.2 :Model setup of Footsteps power generator system using piezo electric material

When the person walks on the steps he transfers his energy in a form of impact, vibration, sound etc. Piezoelectric sensors which will be connected in series and parallel combination tap this mechanical energy and convert into electrical energy. The polarity of charge depends upon whether element is under compression or tension as a result of applied force. If the element is subjected to an applied compressive force its polarity will be positive and due to applied tensile force it will be negative. This element generates the electrical charge. The produced output is in the variable form so bridge rectifier is used to convert AC into DC.

The piezoelectric disks form the core of the energy harvesting system. When a person steps on a disk, the pressure induces a mechanical stress that generates an electrical charge. By connecting ten piezoelectric disks in series, the system can produce a higher cumulative voltage, improving the overall efficiency of energy conversion. The series connection ensures that the voltage output from each disk adds up, resulting in a combined output sufficient to charge a 12V battery. The electrical energy generated by the piezoelectric disks is in the form of alternating current (AC) due to the nature of mechanical pressure variations. To store this energy in a battery, it needs to be converted to direct current (DC). A bridge rectifier, composed of four diodes, is used to rectify the AC voltage into DC voltage. The rectifier's output is then smoothed using a capacitor to eliminate voltage fluctuations, providing a steady DC voltage suitable for battery charging. The rectified voltage from the bridge rectifier may not be directly suitable for charging the 12V battery, depending on the output voltage of the piezoelectric disks. A DC-DC converter is employed to adjust the voltage to the appropriate level required by the battery. By maintaining optimal charging conditions, the charge controller ensures the longevity and reliability of the battery. The 12V battery serves as the storage unit for the harvested electrical energy. By storing the energy generated from footsteps, the system can provide a reliable power source for various applications, even when no immediate foot traffic is present. The stored energy can be used to power electronic devices through an inverter, making it a practical solution for renewable energy utilization.

The Node MCU microcontroller is a crucial component of the smart control system. It interfaces with the RFID reader, which detects RFID cards presented by users. When an authorized RFID card is detected, the Node MCU processes the signal and activates a relay connected to the inverter. This automation allows only authorized users to access the stored energy, enhancing the security and efficiency of the system. The Node MCU can be programmed using the Arduino IDE, enabling easy customization and expansion of the system's functionalities. The inverter converts the DC voltage stored in the 12V battery to AC voltage, which is required by most electronic devices. By providing a standard AC output, the inverter allows the harvested energy to be used for charging mobile devices, powering small appliances, and other applications. The inverter is controlled by the Node MCU, ensuring that it is only activated when an authorized user is detected by the RFID reader.

V. RESULT AND DISCUSSION

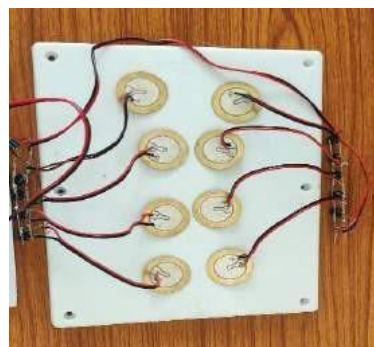


Fig.3: The series-parallel connection of piezoelectric sensors

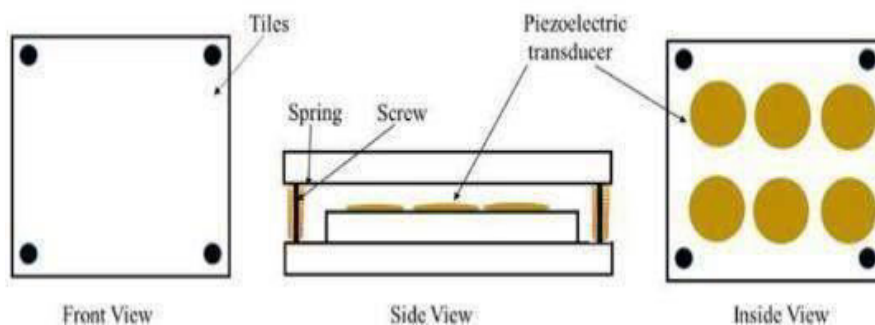


Fig. 4: Model of piezoelectric tile with 8 cell of piezoelectric material



Fig.5: Developed model of footsteps power generation using piezoelectric material

The footstep electricity generation system successfully demonstrates the feasibility of using piezoelectric disks to harness mechanical energy from footsteps. The generated energy is effectively stored in a 12V battery and can be used to power electronic devices through an inverter. The integration of a Node MCU and RFID reader provides a smart control system, ensuring that only authorized users can access the stored energy. The system's performance depends on several factors, including the number and sensitivity of piezoelectric disks, the efficiency of the bridge rectifier and voltage regulation components, and the capacity of the battery. Future improvements could focus on optimizing these components, increasing the energy harvesting efficiency, and expanding the system's scalability for larger applications.

The efficiency of energy harvesting is influenced by the sensitivity of the piezoelectric disks and the amount of mechanical energy applied. In high-traffic areas, where footsteps are frequent and forceful, the system can generate a substantial amount of energy. However, in low-traffic areas, the energy output may be lower, necessitating additional strategies to enhance energy capture. The 12V battery provides a reliable means of storing the harvested energy, ensuring that it is available for use even when foot traffic is minimal. The battery's capacity and the charge controller's efficiency are critical factors in determining the overall system performance. Ensuring optimal charging conditions and preventing energy loss during storage are essential for maximizing the system's effectiveness. The Node MCU and RFID reader integration adds a layer of intelligence to the system, allowing for automated and secure access to the stored energy. By enabling only authorized users to activate the inverter, the system ensures efficient use of the harvested energy and prevents unauthorized usage. This smart control mechanism can be further enhanced with additional features, such as data logging and remote monitoring, to provide comprehensive management of the energy harvesting system. The footstep electricity generation system can be scaled up for larger applications by increasing the number of piezoelectric disks and optimizing the energy storage and control components. Potential applications include powering streetlights, public charging stations, and other urban infrastructure. By integrating renewable energy harvesting with smart technology, the system can contribute to sustainable urban development and reduce reliance on conventional energy sources.

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