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FOOTSTEP POWER GENERATION AND MOBILE CHARGING USING RFID

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Abstract: The Footstep Power Generation System with RFID-Based Charging is an innovative renewable energy solution designed to convert human footsteps into electrical power. This system utilizes piezoelectric sensors or electromagnetic generators embedded in the flooring to capture kinetic energy from pedestrian movement. The generated energy is then rectified, stored in a rechargeable battery or supercapacitor, and used for charging electronic devices. To ensure secure and controlled access, an RFID-based authentication system is integrated, allowing only authorized users to utilize the stored power. A microcontroller (Arduino/ESP32/Raspberry Pi) processes RFID tag data and activates a relay switch to enable charging when an authorized user scans their tag. An LCD/OLED display provides real-time feedback on authentication status and power availability. This system is ideal for smart cities, public spaces, transportation hubs, and educational institutions, where high foot traffic can be leveraged for sustainable energy harvesting. The project promotes energy efficiency, eco-friendly power generation, and secure energy distribution, reducing dependence on traditional electricity sources. Future enhancements could include IoT-based monitoring, cloud authentication, and mobile app integration to further optimize its usability and efficiency

Keywords: Piezoelectric, renewable resources

I. INTRODUCTION

As the demand for electricity continues to rise with the growing population, there is a pressing need for alternative and sustainable energy sources. One innovative solution is harvesting the mechanical energy generated from human footsteps. This project presents a footstep power generation system that converts kinetic energy from walking into electrical energy using piezoelectric or electromagnetic mechanisms. The generated energy is stored in a rechargeable battery and can be used to charge electronic devices like mobile phones.

To ensure secure and controlled access, the system integrates an RFID-based authentication module. Only authorized users with valid RFID cards can access the charging facility. An ATmega328 microcontroller (via Arduino platform) controls the RFID authentication, relay switching, and time-based charging. An LCD display provides real-time feedback, such as user status and remaining charging time. This project not only promotes clean energy but also introduces an intelligent way of managing power usage in public or remote areas.

II. LITERATURE SURVEY

The Advanced Footstep Power Generation System using RFID for charging is a smart and eco-friendly solution designed to harness electricity from human footsteps. It integrates a footstep power generator, an RFID reader, and a charging unit. As people walk over the platform, their kinetic energy is converted into electrical energy and stored in a battery. When an individual with an authorized RFID tag approaches the system, the RFID reader identifies the user and signals the charging unit to provide power for their electronic devices. This system can be deployed in high-traffic public areas like airports, shopping malls, and parks, offering a sustainable and convenient method for charging while ensuring that only registered users have access to the energy through secure RFID authentication.[1]

The Advanced Footstep Power Generation System is an innovative solution that captures kinetic energy from human footsteps to produce electricity. It features integrated RFID technology for effortless device charging and smart lighting control.

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As people walk over the embedded piezoelectric sensors, the system converts their movement into electrical energy, which is allows authorized users to access charging facilities and also manages the lighting system to enhance energy efficiency. Designed for public spaces, this eco-friendly system supports sustainable energy use, minimizes dependence on conventional power sources, and contributes to a greener future.[2]

The "ML-Assisted Footstep Power Generation using Piezoelectric Sensors" system presents an innovative method for capturing kinetic energy from human movement using piezoelectric sensors. These sensors utilize the piezoelectric effect to efficiently convert the mechanical pressure from footsteps into electrical energy, helping reduce energy waste and meet growing power demands. The system proposes deploying a widespread sensor network along walkways, integrated with an RFID-based mobile charging feature for added convenience. A key advancement in this approach is the use of Machine Learning (ML) to optimize energy generation by intelligently adjusting the resistance of the piezoelectric elements. ML algorithms are also employed to analyze daily foot traffic data and determine the optimal number of footsteps needed to meet energy requirements in specific locations. This data-driven strategy ensures smart placement of power generation units based on real-world usage patterns. Particularly suited for high-footfall areas in countries like China and India, this technology offers a sustainable and efficient energy solution that could transform urban energy harvesting and promote greener cities.[3]

The "Advanced Footstep Piezoelectric Power Generation for Mobile Charging Using RFID" system is designed to address India's growing energy demands by converting everyday human activities, such as walking, into electrical energy. Utilizing piezoelectric materials, the system captures the mechanical energy from footsteps and stores it in a battery for later use. This stored power is then used to charge mobile devices through an RFID-based access system. The setup includes components like the Arduino UNO R3, RFID sensors and cards, an OLED display, and is controlled by an ATmega 328p microcontroller. When powered on, the system enters a registration mode, allowing users to register up to three different RFID tags. Once registered, users can swipe their RFID card and connect their devices to begin charging. The system operates on a credit-based model, where the amount of energy a person generates through walking determines the credits available for charging, promoting both sustainability and user engagement.[4]

The "Smart RFID IoT-Enabled EV Charging System" is designed to support the growing use of electric vehicles by providing a secure, efficient, and automated charging solution. This system features an RFID-based authentication mechanism to ensure authorized access and incorporates IoT functionality for real-time monitoring and smart management of the charging process. At its core is an Arduino Uno microcontroller, which interfaces with components such as an RFID reader for user verification, a voltage sensor to track battery status, and a relay module to manage power delivery. An OLED display shows live charging updates, while a buzzer notifies users when charging is complete. With components including a 12V battery, RFID tags, relays, and sensors, this system offers a robust and user-friendly approach to EV charging, ensuring adaptability and reliability in modern electric mobility infrastructures [5]

The "Electric Vehicle Charging System Using RFID and IoT for Enhanced User Experience" is an advanced solution designed to make EV charging more efficient, secure, and user-friendly. It integrates an IoT platform for real-time monitoring and remote control, while secure transactions are handled seamlessly through an automated payment system. Vehicles are identified via RFID tags, which trigger automatic charging, and a relay module ensures safety by cutting off power after a predefined time to prevent overcharging. The system uses MQTT protocol for fast data transmission and MySQL for scalable data management. A mobile application dashboard allows users to track charging and discharging in real-time, view graphical battery status, and receive email notifications after each recharge. With features like energy usage tracking, account balance updates, and visual monitoring, this system enhances the user experience and promotes the adoption of electric vehicles by offering a smart, sustainable, and reliable charging infrastructure.[6]

The Advanced Footstep Power Generation System harnesses the mechanical pressure from walking or running and converts it into electrical energy using the piezoelectric effect. This energy can either be stored or used immediately to power small electronic devices or support existing power grids. Designed for scalability and easy integration, the system is ideal for high-traffic public areas such as airports, train stations, and shopping malls, where the cumulative footsteps can generate a significant amount of renewable energy. To enhance efficiency, the system incorporates advanced control algorithms and real-time monitoring that track footstep patterns, energy output, and power usage. This adaptive approach ensures optimized energy harvesting, making it a smart and sustainable solution to reduce fossil fuel reliance and promote environmental responsibility.[7]

The Advanced Footstep Power Generation System using RFIDs presents a modern and sustainable method for energy harvesting by combining piezoelectric technology with RFID integration. As individuals walk, the system captures mechanical energy from their footsteps and converts it into electrical power, which is then stored in batteries or supercapacitors. The RFID modules allow for user identification, enabling personalized tracking of energy contributions.

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This harvested energy can be utilized for various applications, including powering lights, IoT devices, and smart infrastructure in urban environments, promoting renewable energy use and enhancing the efficiency of smart city systems.[8]

The conference paper on "Footstep Power Generation Using Arduino Uno" explores a non-conventional approach to electricity generation through piezoelectric materials. As individuals walk or run, the mechanical pressure creates deformations in piezoelectric components, which are then converted into electrical energy via the piezoelectric effect. This energy is processed by the Arduino Uno, which regulates the output, and the generated voltage is displayed on an LCD screen. In this project, the system achieved a maximum voltage of 8.29V, which was successfully stored in a battery and used to charge a mobile phone. The study highlights the potential of this footstep-based power generation method as a valuable and sustainable energy source in today's energy-conscious world.[9]

The paper titled "Modeling and Design of a Prototype Footstep Power Generating Machine" introduces a non-conventional approach to electricity generation by developing and analyzing a footstep-powered system. The design includes key components such as a connecting rod, gears, a U-shaped shaft, and an alternator, all engineered to produce power whenever force is applied through footsteps. Using Autodesk Inventor, both static and fatigue analyses were performed, revealing a yield strength of 207 GPa, with a high factor of safety—12 for the spring and 6.58 for the footboard. Standard manufacturing methods were used to construct the prototype. Experimental results demonstrated an output of 0.912W, a voltage of 1.52V, and an overall efficiency of 21% under the influence of an average human weight of 62 kg. The predictive model also showed a strong correlation, with a root mean square value exceeding 0.9, indicating the system's reliability and practical potential.[10]

III. CONCLUSION

The footstep power generation system using RFID technology offers an innovative and eco-friendly solution to harness energy from human movement. By converting mechanical energy from footsteps into electrical power, this project demonstrates a sustainable way to generate electricity in high-footfall areas like railway stations, malls, or schools. The integration of RFID allows the energy generated to be tracked and utilized for personalized charging, ensuring efficient use and accountability

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