iJRASET
International Journal For Research in
Applied Science and Engineering Technology

# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

**Volume:** 11 **Issue:** IV **Month of publication:** April 2023

**DOI:** https://doi.org/10.22214/ijraset.2023.50545

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue IV Apr 2023- Available at www.ijraset.com

# Advanced Footstep Power Generation System Using RFID for Charging

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***Abstract: The advanced footstep power generation system using RFID for charging is a sustainable and innovative system designed to generate electricity from the footsteps of individuals using RFID technology. This system consists of a footstep power generator, an RFID reader, and a charging unit. The footstep power generator converts kinetic energy from footsteps into electrical energy, which is then stored in a battery. The RFID reader identifies the individual and sends a signal to the charging unit to provide power to the individual's electronic device.This system can be implemented in public places such as airports, shopping malls, and parks to provide a convenient and sustainable source of energy for charging electronic devices. The use of RFID technology ensures that only authorized individuals can access the charging unit, and it prevents unauthorized access.***

## I. INTRODUCTION

The global demand for energy has been on the rise, and the majority of our energy comes from non-renewable sources that are limited and harmful to the environment. Hence, renewable energy sources have become increasingly important, and one of the sustainable energy sources that have received attention is kinetic energy harvesting. The advanced footstep power generation system using RFID for charging is one such innovation that uses kinetic energy harvesting to generate electricity from footstep pressure through RFID technology.

The system consists of a footstep power generator, an RFID reader, and a charging unit. The footstep power generator harnesses kinetic energy from footstep pressure, which is then converted into electrical energy and stored in a battery. The RFID reader identifies the individual and sends a signal to the charging unit to provide power to the individual's electronic device.This system can be implemented in public places like malls, airports, and parks to provide a sustainable and convenient source of energy for charging electronic devices. The use of RFID technology ensures only authorized individuals can access the charging unit, which promotes security and privacy.

The system promotes the use of renewable energy sources, reducing the carbon footprint, and providing a cleaner environment. Moreover, it eliminates the need for carrying multiple chargers or finding electrical outlets, thus promoting convenience. This paper will explore the technical aspects, advantages, and potential applications of the advanced footstep power generation system using RFID for charging.

## II. LITERATURE SURVEY

Srinivasan and S. J. Bharath, a prototype of an RFID-based footstep power generation system was designed, fabricated, and tested. The system utilized piezoelectric transducers to convert kinetic energy from footstep pressure into electrical energy, which was then stored in a battery. The RFID reader identified the individual, and the charging unit provided power to the individual's electronic device. The study concluded that the system could provide a sustainable and convenient source of energy for charging electronic devices in public places.

Another study by S. S. Bhattacharjee et al. proposed an integrated system that combines piezoelectric-based footstep power generation with RFID technology for energy-efficient access control. The system utilized a footstep power generator, an RFID reader, and an access control unit. The study concluded that the system could provide a sustainable and efficient source of energy for access control in public spaces.

In a study by Y. Wu et al., a footstep power generation system that utilized triboelectric nanogenerators and RFID technology was proposed. The system generated electricity from footstep pressure, which was then stored in a supercapacitor. The RFID reader identified the individual, and the supercapacitor provided power to the individual's electronic device. The study concluded that the system could provide a sustainable and efficient source of energy for charging electronic devices in public places.

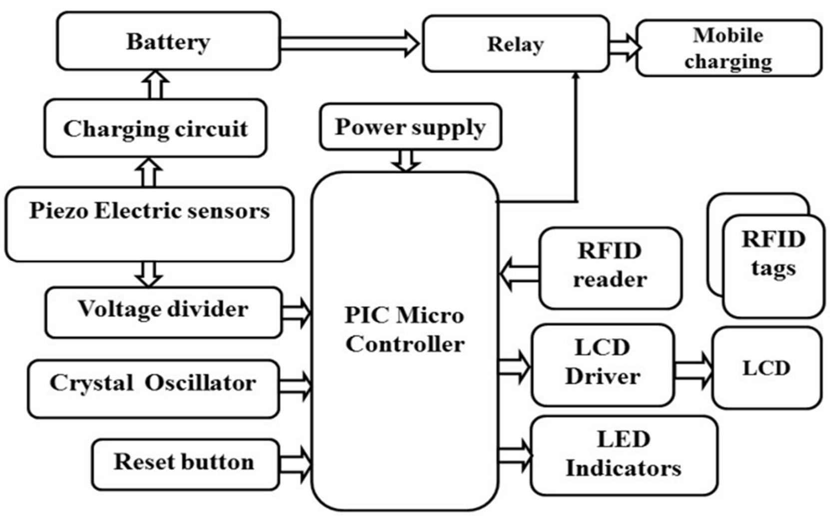
### *A. Existing System*

There are some existing systems that incorporate both footstep power generation and RFID technology for identification and access control. One example is the Smart Floor system, which was developed by researchers at the University of Grenoble Alpes in France. This system uses a network of piezoelectric sensors embedded in the floor to generate electricity from foot traffic, and it also incorporates RFID technology for identification and access control.The Smart Floor system is designed for use in public spaces such as airports, train stations, and shopping malls. When a person steps on the floor, the piezoelectric sensors generate electricity, which is then stored in a battery. The RFID technology is used to identify the person and determine if they are authorized to access the charging station. If the person is authorized, the charging station provides power to their electronic device

### *B. Proposed System*

The proposed system of advanced footstep power generation using RFID technology is designed to generate electricity from foot traffic and use RFID technology for identification and access control. The design can be implemented with PIC microcontroller. The interfaced devices to the PIC microcontroller are RFID reader, LCD module, voltage divider with piezo electric sensor setup is interfaced to the PIC microcontroller. Microcontroller continuously reads the voltage from piezo electric sensors through voltage divider circuit and display the voltage on LCD module. To charge the mobile phone battery user need to shows the TAG in front of the RFID reader it is authorized the system allows the user mobile for charging with the help of USB otherwise not possible.

### *C. Block Diagram*

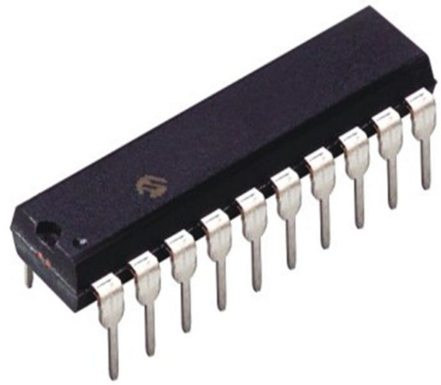



## III. IMPLEMENTATION

The implementation of the advanced footstep power generation system using RFID for charging involves the following steps:

1) *Design and Construction of the Footstep Power Generator:* The footstep power generator can be designed and constructed using piezoelectric materials or electromagnetic induction principles. The generator should be able to convert the kinetic energy of footsteps into electrical energy.
2) *Integration of RFID Technology:* An RFID reader and antenna should be integrated into the system to identify and authenticate authorized users. The database of authorized users should also be established and linked to the RFID reader.
3) *Design and Construction of the Charging Unit:* The charging unit should be able to manage the generated electrical energy and provide a charging output for electronic devices. The charging unit should also have an interface for users to interact with.
4) *Installation of the SYSTEM:* The system can be installed in public spaces such as airports, shopping malls, or parks. The footstep power generator can be integrated into the flooring, and the RFID reader and charging unit can be installed nearby.
5) *Testing and Maintenance:* The system should be tested for efficiency, reliability, and safety. Regular maintenance should be carried out to ensure that the system is functioning optimally.
6) *Monitoring and Data Collection:* Data on energy generation, usage, and user behavior can be collected and analyzed to optimize the system's performance and identify areas for improvement.

## IV. PIC MICROCONTROLLER



PIC microcontrollers are commonly used in a wide range of embedded control systems due to their ease of use, low cost, and versatility. In the context of advanced footstep power generation using RFID charging, a PIC microcontroller could be used to manage various aspects of the system. One possible use of a PIC microcontroller in this system is to control the charging process. The microcontroller could monitor the voltage and current levels of the charging circuit, and adjust the charging current as needed to prevent overcharging and optimize the charging efficiency.

## V. PIEZOELECTRIC SENSORS

Piezoelectric sensors can be used in advanced footstep power generation systems to convert the mechanical energy generated by footstep impacts into electrical energy. These sensors generate voltage when they are subjected to mechanical stress, such as pressure or vibration, and this voltage can be used to charge a battery or power an electronic device.

In the context of RFID charging, piezoelectric sensors could be integrated into the footstep generator to capture the energy generated by footstep impacts and convert it into electrical energy. The sensors could be placed in strategic locations in the generator to capture the maximum amount of energy, and the voltage generated by the sensors could be conditioned and regulated using a power management circuit before being used to charge the RFID tags. They are typically most effective at generating voltage when subjected to high-frequency mechanical vibrations, which may not be present in all footstep impacts.

Additionally, the voltage generated by piezoelectric sensors can be quite low, which may require the use of multiple sensors or additional amplification circuits to generate a usable amount of electrical energy

## VI. SOFTWARE TOOLS

### *A. PIC-C compiler for Embedded C Programming.*

PIC-C is a compiler used for programming Microchip PIC microcontrollers in embedded C. It has libraries and debugging tools for easy development and generates optimized code for better performance. It helps developers create code that interacts with the hardware of the embedded system.

### *B. PIC kit 2.*

PICkit 2 is a programmer used for loading or dumping code into Microchip PIC microcontrollers. It is a cost-effective solution for programming and debugging PIC microcontrollers, supporting a range of devices and interfaces. It allows developers to easily program their PIC microcontrollers, making it an essential tool for embedded system development.

### *C. CAD Software*

Computer-aided design (CAD) software can be used to create and visualize the physical design of the footstep generator and other components of the system. CAD software can also be used to simulate the performance of the system under different conditions, allowing designers to optimize the design for maximum efficiency.

### *D. Circuit Design Software*

Software tools such as Altium Designer, Eagle PCB Design, and KiCad can be used to design and simulate the electronic circuits that will be used in the system. These tools can help designers to optimize the circuit layout for minimum size and maximum efficiency, and to simulate the performance of the circuit under different conditions.

### *E. Microcontroller Programming Software*

Software tools such as MPLAB X IDE, Arduino IDE, and Atmel Studio can be used to program the PIC microcontroller that will be used to control the system. These tools provide an integrated development environment (IDE) for writing and debugging code, and may also include libraries and examples for common tasks.

1) *Simulation Software:* Simulation software such as MATLAB or Simulink can be used to simulate the performance of the system under different conditions, such as different footstep frequencies, weights, and charging loads. This can help designers to optimize the system design and to predict its performance in the real world.

## VII. ADVANTAGES

1) *Renewable Energy:* The system generates electricity using a renewable source of energy - the kinetic energy generated by people walking or running. This makes the system environmentally friendly and sustainable.
2) *Cost-effective:* Once the system is installed, it can generate electricity without any additional cost, as it uses a free source of energy. This can be particularly beneficial in areas where access to electricity is limited or unreliable.
3) *Low Maintenance:* The system requires minimal maintenance, as it has no moving parts and is designed to be durable and long-lasting.
4) *Versatility:* The system can be installed in a variety of locations, including busy city streets, public transportation hubs, and sporting venues. This makes it a versatile source of renewable energy that can be easily integrated into urban environments.
5) *Increased Safety:* The system can also improve safety in public spaces by providing better lighting, which can reduce the risk of accidents and crime.
6) *Reducing Carbon Footprint:* As the system generates electricity using renewable energy, it reduces the carbon footprint and helps to reduce the dependence on non-renewable energy sources.
7) *Promotes Physical Activity:* The system encourages physical activity by providing a fun and interactive way for people to generate electricity while walking or running. This can promote a healthier lifestyle and reduce the risk of obesity-related diseases.

## VIII. DISADVANTAGES

1) *Limited Output:* The amount of electricity generated by the system may be limited, depending on the number of people passing through the area and their speed of movement. This means that the system may not be suitable as the sole source of power for large buildings or facilities.
2) *Installation and Maintenance Costs:* While the system may be cost-effective in the long run, there may be significant upfront costs associated with the installation and maintenance of the system. This can make it difficult for some organizations or municipalities to justify the expense.
3) *Weather-dependent:* The system may be affected by adverse weather conditions, such as rain, snow, or extreme temperatures, which could reduce its efficiency or cause it to stop working altogether.
4) *Noise Pollution:* The installation of the system may create additional noise pollution in public spaces, which could be a concern for some people.
5) *Security Concerns:* The system may be vulnerable to theft or damage, particularly in areas with high levels of vandalism or crime. This could result in additional costs for repair or replacement.
6) *Potential for Accidents:* The system may pose a risk of tripping or falling for people who are not paying attention or who have mobility impairments. This could create liability issues for municipalities or organizations that install the system.

## IX. APPLICATIONS

1) *Transportation:* Footstep power generation systems can be installed in train stations, airports, and bus stops to generate electricity from the footsteps of commuters, reducing energy costs and promoting sustainability.
2) *Public Spaces:* Footstep power generation systems can be installed in public parks, plazas, and other gathering places to provide lighting or power for public amenities, such as benches or fountains.
3) *Sports and Entertainment Venues:* Footstep power generation systems can be installed in stadiums and sports facilities to generate electricity from the movements of spectators during events, reducing energy costs and promoting sustainability.
4) *Schools and Universities:* Footstep power generation systems can be installed in schools and universities to generate electricity from the footsteps of students and staff, reducing energy costs and promoting sustainable practices.
5) *Shopping Centers:* Footstep power generation systems can be installed in shopping malls and centers to generate electricity from the footsteps of shoppers, providing a sustainable source of energy for the mall.
6) *Hospitals and healthcare Facilities:* Footstep power generation systems can be installed in hospitals and healthcare facilities to generate electricity from the footsteps of patients, visitors, and staff, reducing energy costs and promoting sustainable practices.

## X. CONCLUSION

In conclusion, the advanced footstep power generation system that uses RFID charging has the potential to revolutionize the energy industry. It offers a sustainable and cost-effective way to generate electricity from human footsteps, and it can be utilized in various applications across different sectors. The combination of pizo sensors and PIC microcontrollers helps to optimize the energy generation process, making it more efficient and reliable.

### A. Future Aspects

Advancements in materials science: Future developments in materials science could lead to the creation of new materials that can capture even more kinetic energy from footsteps, resulting in more efficient power generation.

Integration with other technologies: The advanced footstep power generation system could be integrated with other technologies such as IoT, artificial intelligence, and machine learning to optimize energy generation, reduce waste, and minimize costs.

Increased adoption: As people become more aware of the need for sustainable energy sources, there could be increased adoption of advanced footstep power generation systems in public places, such as airports, train stations, and shopping malls.

Expansion to new applications: The system could be expanded to new applications, such as in wearable devices or in the automotive industry, where it could be used to power sensors and other low-power devices.

Improved storage capabilities: Future advancements in energy storage technologies could lead to better and more efficient storage of energy generated by the footstep power generation system, reducing the need for backup power sources.

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