Enhanced Footstep power generation system with RFID charging capabilities

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Abstract — As with energy demand, the country`s population is developing rapidly. At the same time, energy waste is growing in diverse ways. Therefore, the principle answer is to interpret this power without delay right into a useful form. In this step strength technology project, power is generated from human footsteps and utilised to power the battery. Energy conserved in batteries may be used to power the cellphones with RELAY. The device includes an Arduino IDE, USB cable, OLED and RFID card. The design, which uses a microcontroller to monitor voltage and charge a connected battery, enables user to keep track of voltage. You can add 3 new customers. When all users enter the device, the device clears the map panel and connects to the charger. By default, all users are given 5 minutes of load time. With that, the relay will turn on and the charger will turn on to charge the phone. If the customer wants to interrupt the loading process, they will have to pull the field again. To prevent loading, the downtime is credited and the swipe card is displayed again. Swipe a card and you may see for a particular card every 5 minutes.

Keywords — Piezoelectric Sensors, Arduino, Atmega 328 Microcontroller, Rfid Reader, Rfid Tag.

I. INTRODUCTION

Innovative solutions that minimize energy loss and meet the growing demand for power are critical in an era dominated by rapid population expansion and escalating energy consumption. We have built a project that paves the way for a sustainable future in which human footfall power is directly harvested and effectively transformed into usable energy. The unique idea behind the proposal is to use this harvested energy to charge mobile devices, including cellphones, resulting in an advanced and environmentally responsible charging solution. This project revolves around a dynamic system that combines human movement with advanced technology. Through the use of an Arduino IDE, USB cable, OLED display, and RFID card technology, this system is able to record and store foot motion energy while also assuring its responsible and smooth use. The effective surveillance of voltage levels and charging procedures made possible by the incorporation of these components finally results in a creative and environmentally responsible approach to power management. This project simplifies user experiences by offering RFID cards for effortless device charging, going beyond simply gathering energy from footsteps. Devices can be charged concurrently by multiple users, each with a specified time limit. When required, users can simply halt the charging process. To improve user interaction, an OLED display provides real-time updates on the amount of charge left, keeping the system well-organized and user-friendly.

II. LITERATURE REVIEW

Footstep power generation has garnered significant interest as a potential renewable energy source. This review examines a collection of studies focusing on the utilization of footstep energy for power generation, as well as the application of piezoelectric technology in energy harvesting.

1. This paper discusses the energy storage features of a piezogenerator are discussed in this work, explaining

how it operates and its potential for energy harvesting.

2. This paper discusses the use of permissions as a mechanism to protect identity in RFID (Radio-Frequency Identification) environments. RFID technology is widely used for various applications, including access control and asset tracking. The authors propose a simple method to enhance security by controlling who can access RFID data. This work is relevant to the field of RFID security and access control.
3. This paper discusses the research detailed design analysis of piezoelectric energy-harvesting devices., aiming to optimize the generation of higher electrical power. It may discuss the technical features of the coupled piezoelectric-circuit finite element approach as well as its ramifications.
4. This paper discusses the feasibility and challenges of footstep power generation. It may discuss the potential of this approach as a sustainable energy source.
5. This paper presents an RFID-based attendance management system. Such systems are commonly used in educational institutions and workplaces to automate attendance tracking. The authors describe the design and implementation of their system, highlighting the advantages of RFID technology for accurate and efficient attendance management.
6. This paper discusses the study explores the concept of harvesting power from human footsteps. It most likely describes the transfer of mechanical energy from footstep impacts into electrical energy and its potential applications.
7. This paper explores the concept of generating electrical power from footstep energy in urban areas. It addresses the need for sustainable and alternative energy sources in densely populated urban environments. The authors discuss the feasibility of using footstep energy and its potential applications for urban energy generation.
8. This paper discusses power generation from staircase steps, suggesting methods to capture and convert energy from people walking on stairs. It may present novel approaches to staircase-based energy harvesting.
9. This paper may provide additional insights or advancements in footstep power generation methods. It could discuss efficiency improvements or unique aspects of their proposed approach.
10. This study delves into the use of piezoelectric transducers for footstep power generation. The authors may discuss the underlying principles of piezoelectricity and its application in harvesting energy from footstep vibrations.
11. This paper discusses the use of electromagnetic principles for footstep power generation. The authors may explain how electromagnetic methods, involving magnets and coils, can be used to generate electricity from mechanical motion.
12. This paper introduces a novel methodology for generating electricity from footsteps. It may highlight the unique aspects of the proposed method and discuss potential benefits.
13. This paper likely focuses on the generation of electrical power from footsteps, discussing the practicality and potential applications of the method. It could contribute to the overall understanding of footstep energy harvesting.
14. This appears to be a thesis that focuses on power sensing using piezoelectric sensors. Mechanical energy is converted into electrical energy using piezoelectric sensors and find applications in various fields, including structural health monitoring and energy harvesting. The thesis likely delves into the theory, design, and practical applications of power sensing using piezoelectric sensors.

III. METHODOLOGY

A. BLOCK DIAGRAM

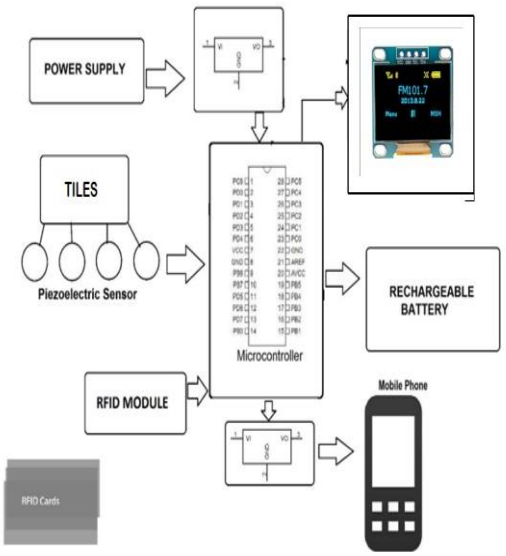

Fig. 1.Block diagram

B. FLOW CHART

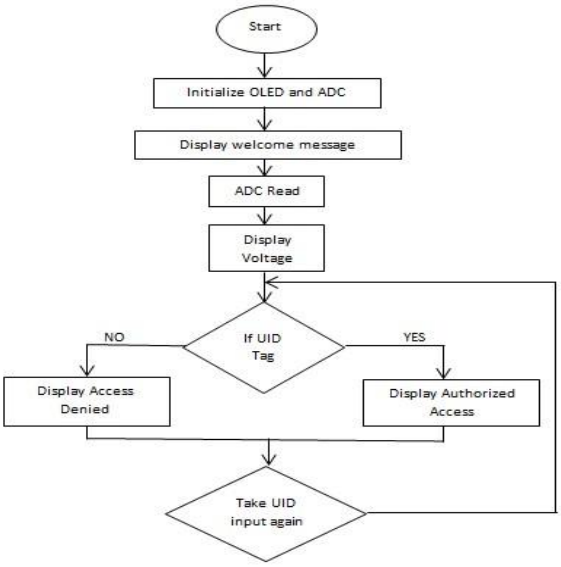

Fig. 2. Flow Chart

C. CIRCUIT DIAGRAM

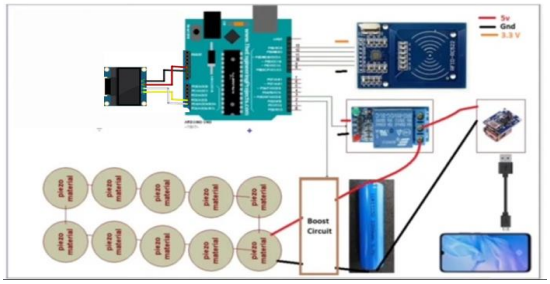

Fig. 3. Circuit Diagram

Colorful styles were used to complete this exploration, including data collecting, data analysis, and data interpretation.

STEP 01: Data Gathering: This was concentrated with acquiring information that backed in the design's completion. When it comes to the design and perpetration of the system, the data gathered is pivotal.

STEP 02: Examination of Data: The data is mathematically examined to gain the useful actions that are salutary to the design.

STEP 03: Simulation and Circuit Design: Proteus software was used to model the circuit once the system was designed.

D. SYSTEM DESIGN AND IMPLEMENTATION

The System is divided into three major corridor:

1. Input
2. Processing
3. Affair

1) A plate of piezoelectric chargers serves as the input block. When force is applied to the piezoelectric transducers, mechanical energy is transformed to electric energy. The generated electricity is latterly transferred to the processing block.

2) The processing block is made out of a single-concluded diode and an Arduino UNO. This unit samples, amplifies, and directs the current created by the input block before transferring it to the affair unit. 3) The affair block is made up of a battery that stores the current and an TV that displays the results.

E. SYSTEM DESCRIPTION

1. *PIEZOELECTRIC SENSOR:* The crystalline structure of Piezoelectric Material. It belongs to the ferroelectric material family. PVDF and PZT are the most widely used piezoelectric materials. It is critical to choose the finest piezoelectric material for obtaining higher output voltage under varying pressures. Fig.4 shows the Piezolectric sensors.

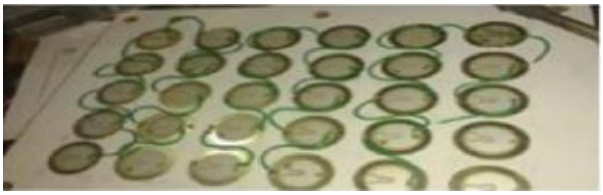

Fig.4: Piezoelectric Sensor

2. *ARDUINO UNO MICROCONTROLLER:* Arduino is a free and open-source electrical system development platform. A hardware programmable circuit board (also known as a microcontroller) and a piece of software known as an IDE (Integrated Development Environment) that runs on the computer and is used to write and upload computer programmes to the physical board are both included. Arduino UNO board is shown in Fig.5.

• Operating Voltage : 12V
• Input Voltage: 7V- 12V
• SRAM 2 KB
• EPROM 1 KB

Fig.5: Arduino UNO Microcontroller

3. *LITHIUM ION BATTERY:* The use of lithium - ion battery for advanced step power generation system is to store the electric energy generated by the piezoelectric detectors when people walk on them. It is shown in Fig.6. The piezoelectric detectors convert the mechanical stress from the steps into electric voltage, which can be used to charge a battery.

Fig.6: Lithium Ion Battery

4. *OLED DISPLAY:* The use of OLED in advanced step power generation system is to display the power status, battery cycle, or any detected issues of the battery. OLED as depicted in Fig.7 is an abbreviation for organic light-emitting diode, which is a display technology that uses tone- illuminating pixels to produce high - quality images and colors.

Fig 7: OLED Display

5. *RELAY MODULE:* This design uses an Arduino microcontroller to control a relay that connects the battery to a USB mobile phone charging point. The relay shown in Fig.8 is actuated by an RFID card that identifies the authorized stoner and allows for a limited charging time. The relay also disconnects the charging point when the stoner wants to stop the charging process or when the battery is low.

Fig. 8: Relay Module

6. *RFID:* An enhanced step power generation system can use RFID technology to control the access to the charging unit. The charging unit consists of a USB harbor age where a stoner can connect their device to charge it from the battery. The stoner needs to have an RFID card that contains their information and authorization law. The RFID anthology scans the card and verifies the stoner identity and access level. However, the relay switches on and allows the current to flow from the battery to the USB harbor age, If the stoner is authorized. The stoner can also set a time limit for the charging process, and the relay will switch off automatically when the time is over. The RFID card RFID tag are shown in Fig. 9.

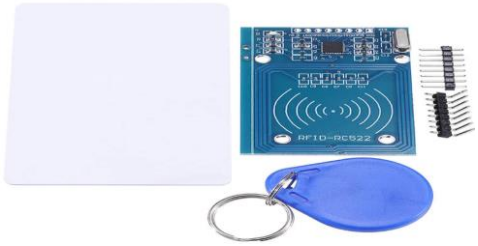

Fig. 9: RFID

IV. RESULTS AND DISCUSSIONS

We used an 8 piezo sensor in 1 square foot as depicted in Fig.10 and Fig.11. Because the power generated by piezo sensors fluctuates with step, we get a minimum voltage of 1V and a maximum value of 10.5V each step. A single person's weight pressure was averaged at 50Kg. Taking the steps of a 60Kg single person as an example, the average calculation is that it takes 800 steps to increase the 1600 pC charge in the battery. To increase $1.92*10^3$ pC in a battery, the total number of steps required is (8*800) = 6400. We took an average of two steps in one second because we would be implementing our idea in a populated region with footstep as a source. Time required for 6400 steps = 6400/(60*2) = 53 minutes. (Approximately). For a 50 kg person following readings are observed:

Table 1: Statistics

Picocoulombs of Charge (pC)	Avg No. of Steps
1600	813
3200	1623
6400	3221
12800	6329

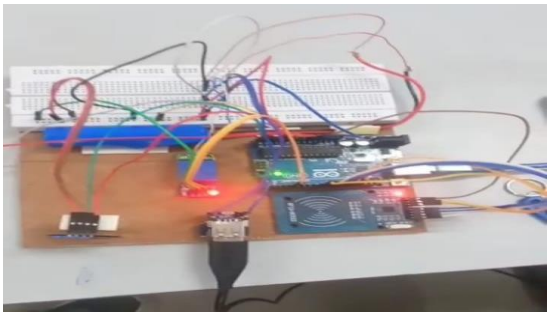

Fig. 10: Result

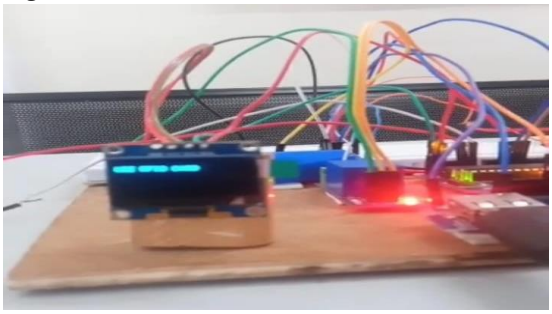

Fig. 11: Result

V. CONCLUSION

The proposal has been tried and tested, and it is the most conservative, practical vitality answer for ordinary folks in our nation. When control accessibility is restricted or non-existent in remote regions, this can be employed for some applications. India's enormous population makes energy management a critical concern for a growing country. Based on the power connected to the piezoelectric sensor, we may drive both alternating current and direct current loads with this task. By decreasing control demand without polluting the environment, this method allows for efficient power generation in highly inhabited places. In reality, just 11% of renewable energy sources contribute to our well-being. We will not only be able to address the energy issue if this project is done, but we will also be able to be able to make significant global environmental changes. But as it is a complex system it is difficult to maintain. Regular Maintenance will ensure reliable output.

VI. ACKNOWLEGEMENT

We thank our project guide who guided us throughout the project with his valuable insights and advice. His encouragement and unwavering support were instrumental in helping us stay focused and motivated. We would want to extend our heartfelt appreciation to everyone who helped make this endeavour a success. We are grateful to everyone who has helped us create this project and hope it will benefit all.

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