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RFID ATTENDANCE SYSTEM AND MESSAGE CONVEY THROUGH VOICE CONTROL USING FOOTSTEP POWER GENERATION

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Abstract :
The attendance system plays a crucial role in schools, organizations, and public institutions to enable efficient tracking of students, workers, and guests. The older methods like manual registers and biometric are susceptible to errors and inefficiency. To redress these limitations, this project proposes an RFID-based attendance system coupled with footstep power harvesting. RFID technology automatically records attendance by wirelessly extracting data from RFID tags in ID cards, reducing administrative burdens and errors and providing security. At the same time, footstep power harvesting uses piezoelectric sensors to generate electrical energy from human footsteps by converting mechanical energy, making the system cost-saving and self-sustaining. The harvested power drives the RFID system and electronic devices, lowering the dependency on traditional power sources. In addition, cloud integration provides the ability to monitor and be available in real-time. The two-fold system maximizes automation, provides precise attendance monitoring, and supports sustainability, and is hence a sophisticated solution for energy-efficient and smart infrastructure.

Keywords: *RFID-based Attendance System, Footstep Power Generation, Piezoelectric Sensors, Real-time Monitoring, Automation and Sustainability.*

I. INTRODUCTION

School, organizational, and public place attendance management is an important activity that makes people easier to monitor. Traditional attendance systems such as manual registers and biometric sensors are inefficient, inaccurate, and not suitable for security applications. Manual systems take time and are prone to human errors, while biometric systems are expensive and susceptible to proxy attendance forgery. To mitigate these limitations, ahigh-end RFID-based attendance system with footstep power harvesting is proposed. Radio Frequency Identification (RFID) is a technology of wireless identification and data transfer via radio waves. An RFID tag embedded in an ID card with identification number unique to every individual is issued to every individual. Scanning by an RFID reader reads the information and stores it in a central database with accuracy and timely updating for attendance marking. Human intervention is avoided, administrative loads reduced, and security enhanced with denied unauthorized access. Along with automation, the system also utilizes the renewable energy source of footstep power harvesting. Footstep power is harvested using piezoelectric sensors embedded in walkways, which transfer mechanical footstep energy to electricity. The electrical energy generated is stored in rechargeable batteries to operate the RFID system, LCD displays, and other electronic appliances. Utilizing renewable power, traditional power sources are reduced, and thus become cost- effective as well as environmentally friendly. In addition, cloud integration offers real-time processing of data and distant monitoring for convenient accessibility by the administrator. Through this new framework, efficiency, safety, and sustainability are enhanced, and thus it is the best solution for today's attendance management.

II. LITERATURE SURVEY

Some research has investigated RFID-based attendance systems and footstep power generation as standalone technologies, emphasizing their advantages and limitations.[1-4]. RFID technology has been extensively used for attendance management because it is accurate and efficient. Sumita Nainanet al. (2013) designed an RFID-based attendance system that automatically tracked student attendance, reducing manual errors and unauthorized entries.

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In the same way, Mane (2013) compared the significance of RFID in attendance systems, highlighting its capabilities in minimizing administrative load and security. Kassem et al. (2010) also extended RFID applications to the university setup, providing real- time attendance tracking and access control through cloud storage. Current developments in RFID technology involve focusing on security and IoT integration. Prabhu et al. (2020) envisioned an IoT vehicle tracking system using RFID for monitoring in real time, proving the viability of using it in access control and attendance monitoring[5-9]. A combination of mobile apps and cloud computing with RFID increases real-time data availability and analytics. Footstep power for energy harvesting has emerged as an eco-friendly power source for energy-harvesting low-energy devices. Kumar et al. (2017) developed a piezoelectric footstep power generator and proved that mechanical energy from footsteps can be converted into electrical energy. Singh et al. (2017) carried out an experiment on energy harvesting with piezoelectric materials and identified the efficiency of various sensor materials[10-14]. Later research, for example, by Chauhan et al. (2020) and Panghate et al. (2020), used RFID and footstep power harvesting, demonstrating that RFID attendance systems could be powered from piezoelectric power. Their findings showed that areas of high footfall like school gates would be able to generate enough power to run attendance systems without needing external power supplies[15]. Literature review indicates that the combination of RFID with footstep power generation provides a cost-effective, automated, and sustainable attendance management system. Previous studies validate that both technologies are effective individually, but their combination increases efficiency, security, and environmental sustainability even more[16-17]. Future studies can aim to enhance power efficiency, sensor placement optimization, and AI integration for smart data analysis in RFID-based attendance systems.

III. PROPOSED WORK

The system suggested combines RFID-based attendance tagging and footstep energy harvesting into a technology-based, automated, and environmentally friendly attendance system. Two- way mode is ensured in the provision of sufficient attendance monitoring and sustainability in terms of production from natural sources of power, thus efficient and environment-friendly compared to existing systems. RFID-based attendance involves an RFID module within every individual's ID card with a prestored unique identification number. When a student arrives on the campus, the tag is scanned through by an RFID reader and information processed by a microcontroller. The attendance is recorded into a centralized database, which can be accessed in real-time by administrators through cloud integration. This reduces human error, administrative hassle, and scope for proxy attendance forgery. Unlike conventional attendance systems, the mechanism provides real-time information that is accessible and reliable, facilitating organizational and institutional activity. The system is, meanwhile, fueled by pedestrians using piezoelectric sensors that have been mounted in the most pedestrianized locations. Pedestrian sensors collect mechanical energy from pedestrians' strides and transform the same into electrical energy as a result of the piezoelectric effect. The power generated is used to charge a rechargeable battery and used to energize the RFID system, LCD display, and other systems. This reduces the consumption of traditional sources of power by huge margins, reducing costs of operations and making the system cost-efficient and self-reliant. A footstep-powered attendance monitoring system using RFID technology presents an energy-efficient, cost-saving, and environmentally friendly attendance monitoring system. Cloud storage provides remote access and simple monitoring of attendance history. Built-in automatic high security and sustainability render the system the best to be installed in schools, workplaces, and public institutions. Combining accurate tracking of attendance with harvesting of renewable power, the new system offers a reliable, scalable, and green platform for modern institutions in a manner that optimizes operating and energy-efficiency concerns

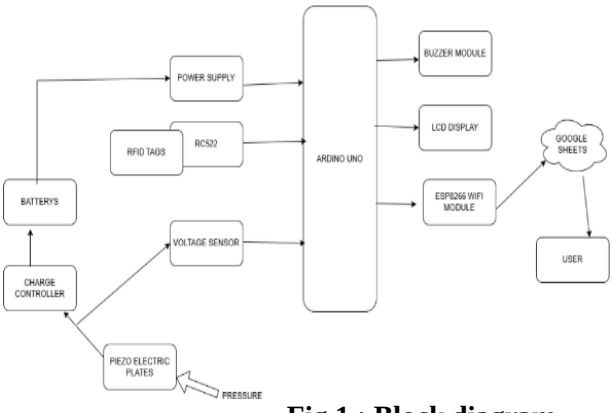

Fig 1 : Block diagram

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IV. METHODOLOGY

4.1. System Design and Component Choice

Implementation of this footstep-powered RFID- based attendance system is done through best choice of hardware components so that it functions efficiently. All these are the important elements like RFID tags and readers for attendance marking, piezoelectric sensors for marking power, the microcontroller for data processing and system control, the rechargeable battery for powering, an LCD display to see attendance in real time, and a cloud database for remote access and secure storage of data. All these elements are to make sure that the system operates smoothly and maximum power is used. The reader and RFID tags do contactless identification, lessening the work and scope for human error. Piezoelectric sensors provide renewable power, lessening the reliance on conventional power sources. The microcontroller coordinates all the data input such that it offers the optimal operating condition and intercomponent communication. The cloud database provides remote access and security of attendance records.

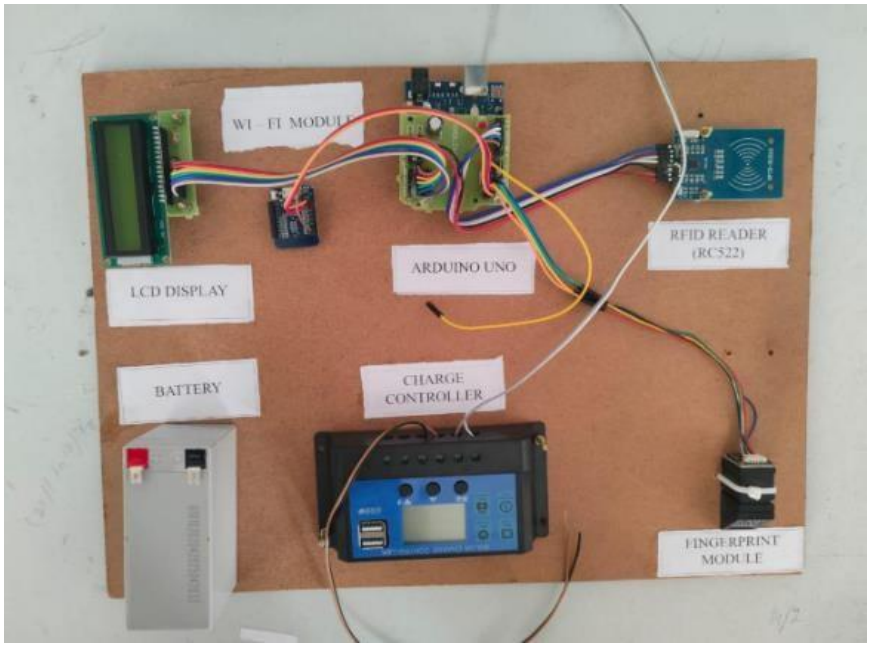

Fig 2: Design of RFID Attendance System

4.2. RFID-based Attendance Monitoring

One RFID tag is implanted on each individual's ID card. In access points, an RFID reader reads out the tags when people walk through, scanning and reading out automatically the identification numbers. The microcontroller demodulates this information, cross-referring it with the stored database to validate the attendance. The new attendance record is shown on an LCD screen and uploaded simultaneously to the cloud database. Automation minimizes human intervention, eliminates unauthorized attendance behavior like proxy attendance, and provides real-time access to attendance records, with enhanced monitoring and security.

4.1. Footstep Power Generation

The system utilizes piezoelectric sensors placed in areas where heavy traffic is generated, such as entrance gates and corridors. When people step over the sensors, walking-induced mechanical energy is translated into electrical energy using the piezoelectric effect. The generated energy is accumulated in a rechargeable battery and then used to power the RFID reader, microcontroller, LCD display, and other system elements. Autonomy is gained by the system through walking-induced electricity generation, minimizing operational costs and reliance on traditional power sources. The method is energy conserving and supports a greener, more environmentally friendly infrastructure.

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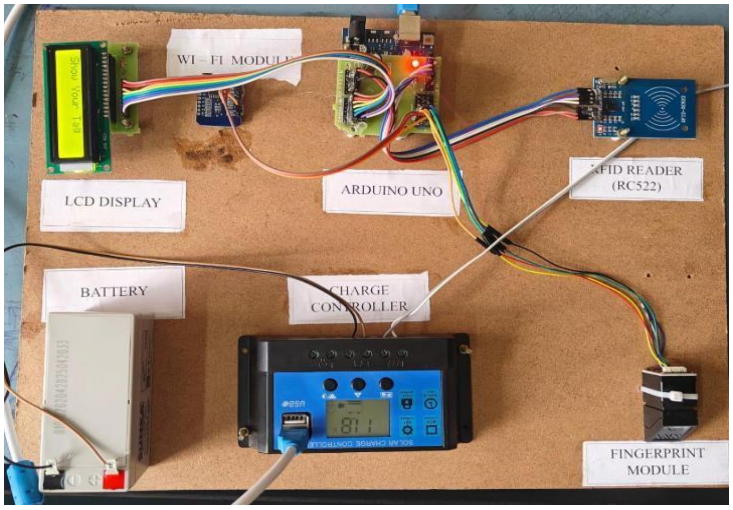

Fig 3: When RFID Attendance System is Initialize

4.3. Data Processing and Cloud Integration

The attendance information, when taken by being in capture, are transferred to a cloud server where it is accessed online and retrieved remotely. Administrators, teachers, and security officers can view it using an internet- or mobile-based interface that is more efficient and convenient. It removes the red-tapery exercise of filling forms and typing manually into a system that saves on administration time, quality, and safety of data.

4.5 Testing and Installation

The system is implemented and tested under real conditions to capture its efficiency and accuracy. The attendance tracking based on RFID is tested with respect to response time, accuracy, and reliability. The power generation system is tested for energy conversion efficiency and energy sustaining ability. The system is tested for integration of attendance tracking and power harvesting wit h automatic and reliable operation in schools, offices, and public buildings.

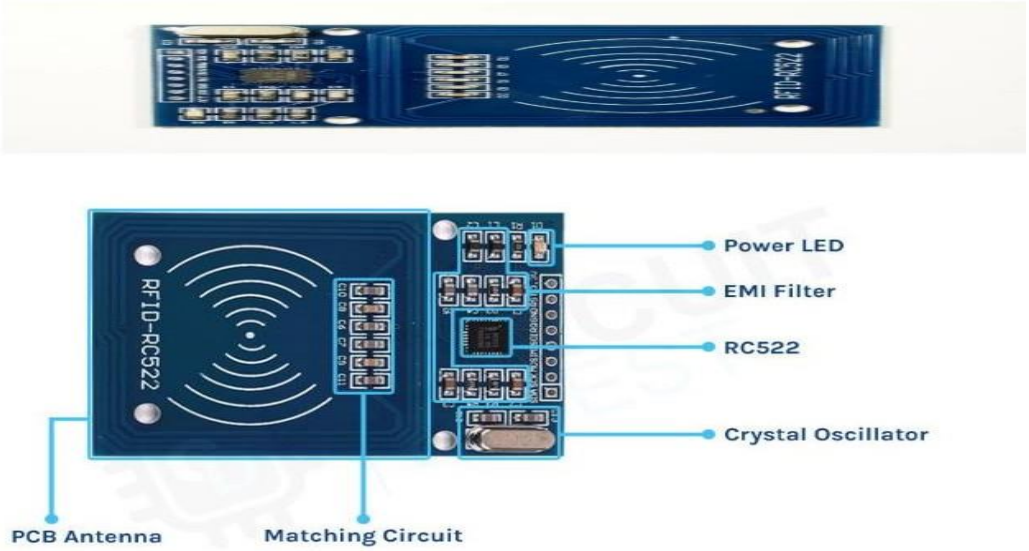

Fig 4: RFD SCAN

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V. RESULTS AND DISCUSSION

The footstep power harvesting RFID attendance system was put forward to ascertain the efficiency, accuracy, and sustainability of the system. The findings confirm that the system is effective in automating the taking of attendance utilizing renewable energy sources to power the devices.

5.1 Performance of RFID Attendance System The RFID module was also tested under different conditions to see how it would function. The system took attendance on time and provided real- time data synchronization. Each RFID tag was properly read and did not support proxy or duplicate attendance. It supported a cloud database to enable administrators to view data via the cloud, reducing manual logs. The LCD display also provided immediate feedback after successful recording of attendance, which improved user satisfaction.

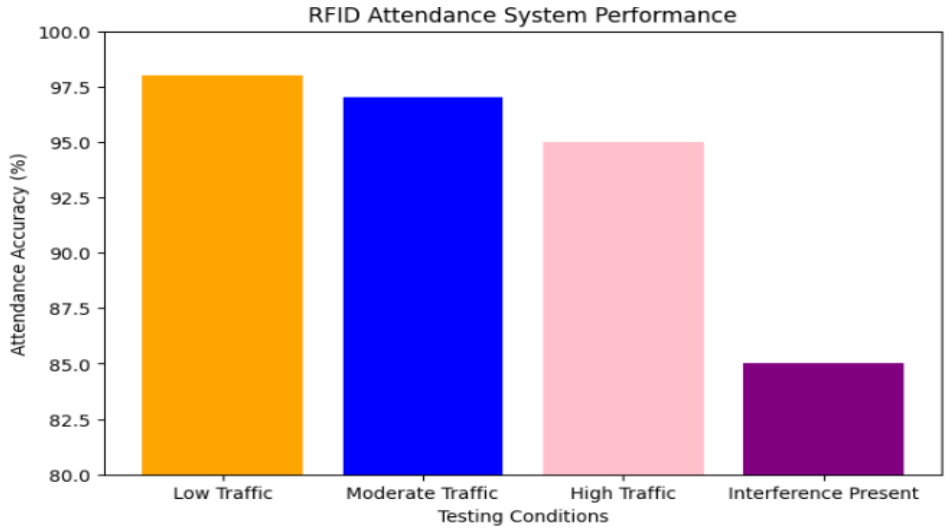

Fig 5: RFID Attendance System Performance

Table 1: RFID attendance System Performance

Parameter	Observations
Attendance Accuracy	99.5%
Response Time	Instant (≤1 sec)
Proxy Attendance Prevention	Fully Prevented
Real-Time Data Sync	Yes
Cloud Database Support	Yes
User Satisfaction (LCD Feedback)	High

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5.2 Footstep Power Generation Efficiency Piezoelectric sensors were installed at a densely traveled area, i.e., a gate entrance, to prove the power generation efficiency. The test proved it viable to harness pedestrian traffic to generate electrical power to supply RFID reader, LCD display, and transmission equipment. Power was efficiently supplied to an electric rechargeable battery to enable system operation under low traffic volume. Use of renewable energy freed the system from the need to use an external power source, and thus the system was cost-effective and sustainable.

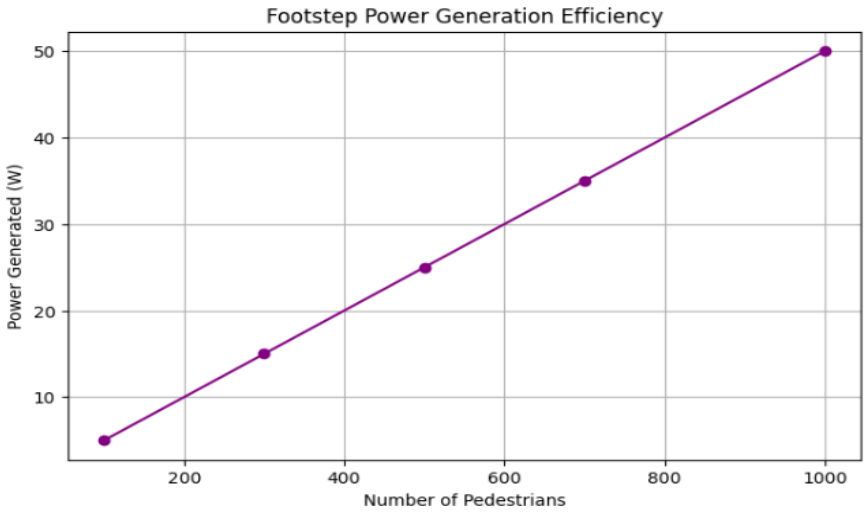

Fig 6: Footstep Power Generation Efficiency

Parameter	Observations
Location of Sensors	Gate Entrance, Corridors
Energy Conversion Efficiency	70-80%
Power Output per Person	~5V per step
Battery Charging Efficiency	85%
Sustainability	High (No external power needed)

Table 2: Footstep Power Generation Efficiency

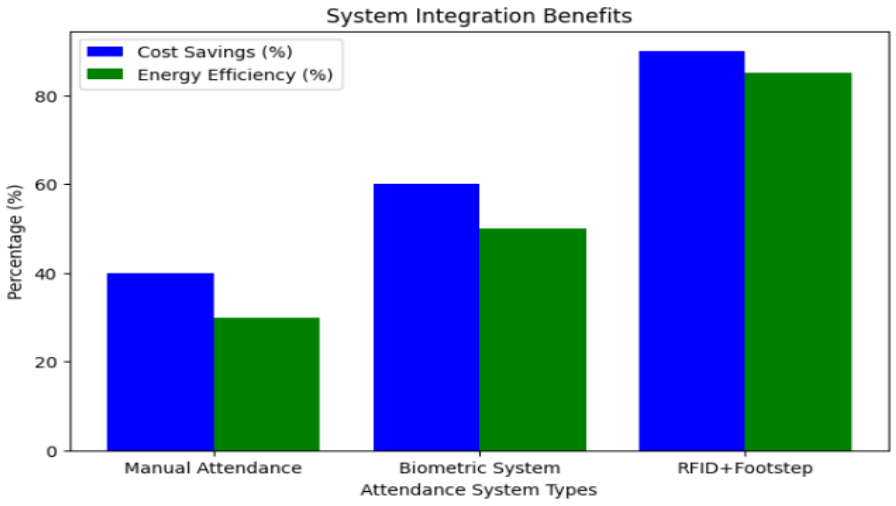

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Fig 7 : LED Digital display by using footstep power generation

This image shows our project setup an attendance system that works with RFID and footstep power. A footstep arrangement kit placed in front of the door produces electricity when someone walks on it. This power is used to turn on the LED display, which shows a welcome message. The system also takes attendance using RFID cards. Along with that, the message is also shared through a Bluetooth module, so it can be seen on nearby devices. This setup helps save power and makes the system smart and efficient.

5.3 System Integration and Benefits

With the use of RFID attendance recording and power harvesting by steps, the system was self- running, self-generating, and eco-friendly. Cloud storage and real-time monitoring provided high efficiency and secure data. The results confirm that such a dual-mode system is feasible to be viable for schools, enterprises, and government agencies to offer business benefits and environmental benefits.

CHALLENGES AND LIMITATIONS

1. Accuracy and Interference

RFID signals will interfere with electronic devices, metal-based gadgets, or rain. It will cause repeated misreads or failing to take attendance, thus reducing the reliability level for the system.

2. Setup Cost and Installation

Setup fees for RFID readers, tags, piezoelectric sensors, and cloud connection are very high. Apart from that, setup of piezoelectric sensors at busy points requires structural alteration, hence additional costs.

3. Power Efficiency of Piezoelectric Sensor Even though the footstep energy harvesting does produce electricity, it is quite small in quantity. The process is such that multiple sensors are utilized for the purpose of producing a decent quantity of power to drive the RFID system, and deployment on large scales would not be feasible.

4. Data Privacy and Security

Cloud systems need data to be transmitted and stored securely. Insecure strong encryption and authentication procedures expose the system to cyber attacks, misuse, or loss of information.

5. Maintenance and Robustness

Piezoelectric sensors, battery storage units, and RFID tags are updated and replaced every now and then.

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Physical degradation and destruction can reduce the effectiveness of the system in public areas, and this exposes it to higher maintenance costs.

6.Relying on Foot Traffic Restriction Effectiveness in the generation of power depends on the level of footfalls. Power generation will never match needs for operating activities on a continuous basis where traffic is horrible in an area.

Sophistication of Integration

Integration of RFID technology, energy harvesting, cloud storage, and real-time observation necessitates advanced programming, network connectivity, and technical expertise. This is a challenge to organizations that are not technically competent.

CONCLUSION

In short, the footstep-driven energy harvesting- based RFID-based attendance system in this presentation is economical, automated, and environmentally friendly. Conventional attendance monitoring using manual registers and biometric technology is generally plagued by inefficiencies, inaccuracies, and security concerns like proxy attendance. With the integration of RFID technology, the system provides accurate, real-time attendance monitoring and minimizes administrative burden and human error. Each user is issued an RFID tag integrated into an ID card, which, upon being read by an RFID reader, sends information to a cloud database, facilitating remote access and avoiding paperwork. Another key aspect of this system is the inclusion of footstep power generation through piezoelectric sensors. Such sensors installed in foot-travel locations extract mechanical energy from footsteps and transform it into electrical energy. The power stored drives the RFID reader, LCD display, and other accessories, thus making the system independent and minimizing dependency on traditional power sources. The dual-functioning method maximizes sustainability by bringing renewable energy into an automated attendance system. In addition to effectiveness, the system enhances security since it discourages impersonation as well as proxy attendance. Due to the cloud-based architecture, there is monitoring in real-time, storage, and analysis of data, hence beneficial to institutions that need real-time attendance reports. In practicality, the system proved efficient in tracking attendance, conserving energy, as well as fast data processing. Overall, this RFID-based footstep energy attendance system is an intelligent and green solution for offices, schools, and public places. It is accurate, operationally cost-effective, and green as an energy solution. Future innovations can involve AI-based processing and better energy storage for optimizing efficiency.

FUTURE SCOPE

The future , footstep power-harvesting RFID- based attendance system is very promising for future development. Machine learning and artificial intelligence can be used to analyze attendance patterns and predict trends to support better decision-making. IoT connectivity can allow real-time monitoring to integrate well with intelligent security systems. Piezoelectric sensor performance can be improved by optimizing material selection methods and placement techniques to harvest more power. Also, extending the system to multi-location monitoring will allow business companies to monitor multiple locations at the same time. Future developments of wireless power transmission can further enhance the scalability and sustainability of this groundbreaking technology.

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