



International Journal of Advanced Research in Education and Technology (IJARETY)

Volume 13, Issue 3, May - June 2026

Impact Factor: 9.971



ARC Coin System : A Blockchain Based Student Reward System

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ABSTRACT: Attendance management is an important academic process in educational institutions, but traditional systems often suffer from proxy attendance, lack of transparency, and manual errors. This paper proposes **ARC Coin**, a blockchain-based student attendance reward system that ensures secure and tamper-proof attendance recording. The system uses blockchain and smart contracts to automate attendance tracking and reward distribution based on attendance percentage. Students are rewarded with digital tokens called ARC Coins, which can motivate consistent classroom participation. The proposed system improves transparency, reduces manual workload, and introduces an incentive-based approach to academic attendance management.

KEYWORDS: Blockchain, Attendance Management, Smart Contract, Student Reward System, Academic Transparency

I. INTRODUCTION

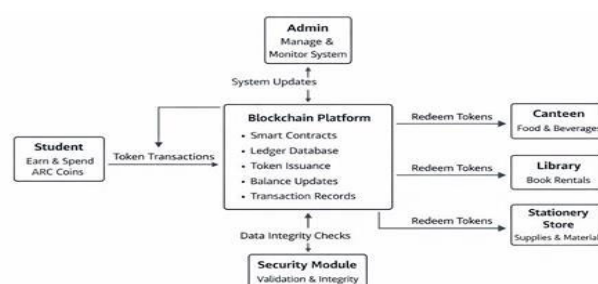
Attendance is one of the most essential academic parameters used in educational institutions to evaluate student discipline, participation, and eligibility for examinations. Most colleges and universities require students to maintain a minimum attendance percentage in order to satisfy academic regulations. Because of this, attendance monitoring plays an important role in academic administration and student performance tracking.

Despite its importance, many institutions still depend on traditional attendance methods such as manual registers, spreadsheets, or centralized digital systems. These approaches often lead to several problems, including human errors, proxy attendance, unauthorized record changes, and lack of transparency. Even when attendance is managed digitally, most systems are still controlled through centralized databases where records can be altered without proper traceability.

Another major limitation of existing attendance systems is that they do not provide any motivational mechanism for students. Attendance is generally treated only as a compulsory academic requirement rather than as an opportunity to encourage regular classroom participation. As a result, students often view attendance as an obligation rather than an important component of academic engagement.

With the growth of secure digital technologies, there is an increasing need for attendance solutions that are transparent, automated, and tamper-resistant. Blockchain technology offers a powerful solution in this context because it provides a decentralized and immutable ledger in which once data is recorded, it cannot be modified without verification [1], [2].

The proposed **ARC Coin** system addresses these limitations by combining blockchain-based attendance recording with a reward mechanism. Instead of merely recording student presence, the system motivates students by awarding digital tokens called **ARC Coins** based on their attendance performance. This creates a secure, transparent, and incentive-driven attendance ecosystem for academic institutions [3], [5].



II. LITERATURE SURVEY

A variety of attendance monitoring systems have been developed over the years to improve efficiency and reduce manual work in academic institutions. Traditional attendance methods primarily relied on physical registers and manual calculations, which were time-consuming and prone to errors. To overcome these limitations, several automated attendance systems have been introduced using technologies such as RFID, biometric authentication, QR codes, and web-based management systems [4].

RFID-based attendance systems are commonly used for quick student identification by scanning ID cards. Similarly, biometric systems such as fingerprint scanners and facial recognition mechanisms have been implemented to improve authentication and reduce proxy attendance. QR code-based attendance systems have also become popular due to their simplicity and low operational cost [4].

Although these systems improve attendance automation, they still have several drawbacks. Most of them are based on centralized architectures where the attendance records are stored and controlled in a single administrative database. This creates concerns related to record transparency, data security, and unauthorized modification. In many cases, even though the attendance is captured automatically, the final stored data remains vulnerable to manipulation [3].

Blockchain technology has recently emerged as an effective solution for secure record management. It has been widely explored in educational domains for certificate verification, transcript security, and digital academic credential storage [2], [5]. Blockchain ensures that once a record is stored, it becomes immutable and verifiable, making it highly suitable for academic systems that require trust and authenticity [1], [2].

Smart contracts further enhance automation by allowing predefined conditions to execute automatically without human intervention. In educational systems, smart contracts can be used to automate processes such as record validation, attendance percentage calculation, and reward allocation [5].

However, most of the existing attendance systems focus only on attendance capture and authentication. Very limited work has been done in combining **attendance management, blockchain-based immutability, and student reward mechanisms** into a single academic platform. This creates an opportunity for a system like ARC Coin, which not only secures attendance records but also introduces an incentive-based model to improve student participation.

Thus, the proposed ARC Coin system extends beyond simple attendance automation by integrating transparency, trust, and motivation into a unified academic framework.

III. METHODOLOGY / APPROACH

The proposed ARC Coin system is designed as a secure and automated attendance management platform that integrates blockchain technology with a reward-based incentive mechanism. The overall approach focuses on recording attendance, validating the records, calculating attendance percentage, and distributing rewards automatically through smart contract logic.

The system begins with **faculty authentication**, where the faculty member logs into the platform using valid credentials. After successful login, the faculty selects the appropriate class or subject and records student attendance digitally. This removes dependency on manual registers and allows attendance to be maintained in a structured digital format.

Once attendance is marked, the system performs **attendance validation** to ensure that the submitted records are accurate and free from duplication. This validation step helps maintain consistency and prevents incorrect or repeated attendance entries.

After validation, the system calculates each student's **attendance percentage** based on the total number of classes conducted and the total number of classes attended. This calculation forms the basis for the reward mechanism.

The attendance percentage is calculated using the following formula:

$$P = \frac{A}{T} \times 100$$

Where:

- **P** = Attendance Percentage
- **A** = Number of classes attended
- **T** = Total number of classes conducted

Based on the attendance percentage, the system applies a reward logic to determine whether the student is eligible for ARC Coins. The reward function is defined as follows:

- If $P \geq 90$, then **R = 10 ARC Coins**
- If $75 \leq P < 90$, then **R = 5 ARC Coins**
- If $P < 75$, then **R = 0 ARC Coins**

This reward model ensures fairness and consistency in incentive distribution.

The attendance records are then stored on the **blockchain layer**, where each attendance entry is treated as a transaction. These transactions contain academic attendance information such as student ID, subject ID, date, attendance status, and transaction reference. Since blockchain provides immutability and decentralized verification, the attendance records become tamper-proof and transparent [1], [2].

The **smart contract layer** automates the reward allocation process. Once the attendance percentage is evaluated, the smart contract automatically credits the appropriate number of ARC Coins to the student's wallet without requiring manual approval [5].

The system is developed using the following technologies:

- **Frontend:** React.js
- **Backend:** Node.js
- **Database:** MySQL
- **Blockchain Platform:** Ethereum Test Network
- **Smart Contracts:** Solidity [5]

Thus, the ARC Coin methodology ensures that attendance records remain secure, automated, transparent, and motivational for students.

IV. RESULTS & DISCUSSION

The ARC Coin system was developed as a prototype to evaluate its feasibility and effectiveness in an academic environment. The testing primarily focused on whether the system could automate attendance management while ensuring transparency, record integrity, and reward-based student engagement.

The prototype was tested using sample student attendance data to verify the working of different modules. Based on the testing process, the following outcomes were observed.

The system was able to **record attendance successfully** through the digital faculty interface without duplication or manual inconsistency. This reduced dependency on physical registers and simplified attendance entry.

The system also **calculated attendance percentages accurately** for each student based on the total number of conducted classes and attended sessions. This eliminated the need for manual attendance calculations and reduced the possibility of human error.

The **ARC Coin reward mechanism** worked effectively according to the predefined attendance thresholds. Students who satisfied the required attendance percentage received the corresponding number of ARC Coins automatically through smart contract execution [5].

Another major result observed was the improvement in **attendance record transparency and integrity**. Since attendance transactions were stored on blockchain, the records became tamper-proof and verifiable. This improved trust in the attendance system and reduced concerns related to unauthorized modification [1], [2].

From an administrative perspective, the system helped reduce manual monitoring and repeated attendance verification efforts. This indicates that the system can improve operational efficiency in academic institutions.

V. DISCUSSION

Compared to traditional attendance systems, ARC Coin introduces a stronger trust model because the attendance records are not stored only in a modifiable centralized environment. Instead, blockchain ensures immutability, transparency, and verification [2], [3].

Compared to RFID and biometric-based attendance systems, ARC Coin offers an additional **motivational component** by rewarding students for consistent attendance. This makes the system not only an attendance tracking tool but also a student engagement mechanism.

A comparative view is shown below:

Feature	Traditional Systems	ARC Coin System
Manual Error Reduction	Partial	High
Record Transparency	Low	High
Data Tamper Resistance	Low	High
Reward-Based Motivation	No	Yes
Automation Level	Medium	High

Although the current implementation is a prototype, the results indicate that the system can effectively support secure attendance management and reward-based academic participation. With further institutional deployment and real-time testing, the system can be extended for larger academic environments.

V. CONCLUSION

The ARC Coin system presents a secure, transparent, and incentive-driven solution for modern attendance management in educational institutions. Traditional attendance systems often face problems such as data manipulation, lack of transparency, manual workload, and absence of student motivation. These limitations reduce trust in attendance records and fail to encourage consistent classroom participation.

The proposed system overcomes these issues by integrating blockchain technology with smart contract-based reward automation. Attendance records are stored in an immutable format, ensuring that they cannot be altered once recorded [1], [2]. At the same time, students are rewarded with ARC Coins based on their attendance percentage, which introduces a positive motivational element into academic participation [5].

The prototype demonstrates that ARC Coin can effectively automate attendance recording, attendance calculation, reward generation, and secure record storage. By combining security, transparency, and student engagement into a single platform, the system provides a meaningful improvement over traditional attendance methods.

In conclusion, ARC Coin is not only an attendance management system but also a modern academic engagement framework that supports trust, fairness, and participation in educational institutions.

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International Journal of Advanced Research in Education and Technology

ISSN: 2394-2975

Impact Factor: 9.971