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Smart Attendance Capturing System Using Blockchain

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Abstract— The increasing need for efficient and secure attendance management systems in various domains has led to the development of innovative solutions that leverage emerging technologies. This paper presents a Smart Attendance Capturing System that utilizes blockchain technology and QR code scanning to enhance the accuracy, transparency, and security of attendance tracking processes. Traditional attendance systems often suffer from manual errors, proxy attendance, and cumbersome record-keeping procedures. To address these challenges, the proposed system leverages the immutability and decentralized nature of blockchain technology to create a tamper-resistant and transparent attendance management system. The system incorporates QR code scanning, which enables quick and reliable identification of individuals. Each participant, whether it be students, employees, or event attendees, is assigned a unique metamask ID that contains relevant information associated with their identity. By scanning the QR code using a mobile device, the system retrieves the necessary information and records the attendance securely on the blockchain.

Keywords— Blockchain, ERC tokens, Metamask authentication, QR code.

I. INTRODUCTION

Nowadays, everyone has smartphones, every little chore of life is being managed by smartphones. The popularity of the smartphones is increasing day by day so, our system is trying to incorporate automated way of attendance capturing through smartphones. The current attendance capturing system is still going on in a traditional way through pen and paper where teachers call out the name of students and marking their attendance on sheets. This method is prone to human errors, it is easily modifiable and avoiding proxies is very difficult. Our system is trying to automate the process of attendance capturing through the scanning of QR code and storing it in blockchain. The blockchain serves as a distributed ledger, ensuring that attendance records are permanently stored and cannot be modified or manipulated. Every attendance transaction is cryptographically secured and timestamped, providing an immutable record that can be audited and verified by authorized parties. This feature enhances transparency and eliminates the possibility of fraudulent activities. The system introduces smart contracts on the blockchain, automating attendance-related processes. Smart contracts execute predefined rules and conditions, enabling automatic notifications, generating attendance reports, and triggering actions based on predefined criteria. These features streamline administrative tasks and reduce manual intervention, saving time and resources. The proposed Smart Attendance Capturing System offers several advantages over traditional attendance systems. It provides accurate and real-time attendance tracking, reduces administrative burden, eliminates human errors and proxy attendance, ensures transparency and accountability, and enhances data security through the decentralized nature of blockchain technology. The system can be implemented in various domains, including educational institutions, corporate organizations, conferences, and events. Its compatibility with mobile devices and QR code technology makes it easily.

II. RELATED WORK

The below-given category summarizes the references from various papers with similar goals and objectives.

A.W Wright et al [1] introduces a system where students are provided with RFID tags, while entering the classroom, students need to scan that tag, which monitors the attendance as well as the movements of students inside the classroom. The system utilizes the radio frequency identification technology to manage classroom activities of the students.

To enhance the attendance management system, R. K. Chauhan, V. Pandey et al [2] introduces the system which uses CNN model to analyse the image or video frames which helps in identify the students and makes tracking of attendance of students better by the usage of deep learning and computer vision techniques.

O. Sanli and B. Ilgen et al [3] proposes a “Face Detection and Recognition for Automatic Attendance System” presents a face detection and recognition approach for an automatic attendance system. The authors discuss the implementation of face detection algorithms to locate and extract faces from images or video streams. They also explore facial recognition techniques to identify individuals and record their attendance automatically. The paper highlights the importance of accurate face detection and recognition for attendance systems and presents their experimental results to demonstrate the effectiveness of their proposed approach. The utilization of face detection and recognition technologies in the automatic attendance system offers a promising solution for streamlining attendance tracking processes.

S. Rahman, M. Rahman, and M. M. Rahman et al [4] proposes an automated student attendance system based on fingerprint recognition. The authors propose a system that utilizes fingerprint scanning technology to identify and record student attendance automatically. They discuss the architecture and implementation of the system, highlighting the use of fingerprint recognition algorithms and their performance evaluation. The paper emphasizes the advantages of using fingerprint recognition for attendance systems, such as accuracy, reliability, and convenience. The automated student attendance system offers a practical solution for efficient and secure attendance tracking in educational institutions.

Almasalha, Fadi & Hirzallah, Nael et al [5] presents a students' attendance system based on QR codes. The authors propose a system that utilizes QR codes to track and record student attendance. Students are provided with unique QR codes that can be scanned using a mobile device or dedicated QR code scanner. The paper discusses the system's architecture, implementation, and performance evaluation, highlighting the benefits of using QR codes for attendance tracking, such as ease of use, speed, and accuracy. The students' attendance system using QR codes offers a practical and efficient solution for managing attendance in various educational settings.

III. PROPOSED METHODOLOGY

Proposed system Smart attendance capturing system using QR code is implemented using replica of ERC-1155 token and geolocation capture is aimed to build tamper proof, automated, decentralized system for attendance capturing. By implementing a replica of the ERC-1155 token, a standardized smart contract interface, the system ensures secure and efficient tracking of attendance records. Using QR codes, participants can easily check-in and verify their presence, while geolocation capture provides an additional layer of validation by capturing the user's geographical coordinates. This innovative combination of technologies offers a reliable and seamless approach to attendance management, enabling organizations to automate and optimize their processes while maintaining accuracy and accountability.

A. Token implementation:

ERC-1155 is a token standard on the Ethereum blockchain that allows the creation of fungible (identical) and non-fungible (unique) tokens. In this system, a replica of the ERC-1155 token can be created specifically for attendance management. Each student or participant can be assigned a unique token representing their attendance record. The token can have different states or attributes to indicate attendance, such as "present" or "absent". These tokens can have multiple owners, they all can share the same value of that property.

B. QR Code Generation:

A QR code can be generated for each event or class session. The QR code should contain relevant information, such as the event ID or session details. It is better than biometric scan as many users can mark their attendance at the same time.

C. Attendance Tracking Process:

Participants can use their smartphones or other devices with QR code scanning capabilities to scan the QR code. Scanning the QR code will trigger an action in the attendance system.

D. Geolocation Capture:

To prevent fraudulent check-ins, geolocation capture can be implemented alongside the QR code scanning process. The system requires participants to enable location services on their devices. When a participant scans the QR code, the system will also capture their geolocation data.

E. Backend System:

A backend system or server will receive the scanned QR code data and geolocation information. The system will verify the QR code and geolocation data to ensure the participant is within the designated location. If the verification is successful, the

attendance record for the participant will be updated in the ERC-1155 token contract.

F. Attendance Management:

The attendance management system can provide real-time attendance tracking and reporting. The system can generate reports on attendance statistics, individual records, and overall participation. This implementation combines the advantages of QR code scanning for ease of use and the ERC-1155 token for managing attendance records securely on the database. Geolocation capture adds an extra layer of security by validating the physical presence of participants.

G. Metamask authentication:

Metamask can be used to authenticate and verify the identity of participants accessing the attendance system. Users can sign in to their Metamask wallet, which acts as their digital identity, ensuring that only authorized individuals can interact with the attendance system. Metamask allows users to sign blockchain transactions securely. In the context of a smart attendance system, when recording attendance on the blockchain, Metamask can be used to sign attendance transactions, ensuring the integrity and authenticity of the attendance records.

H. User Interface:

In this system, user-friendly interface has been designed using React.js for an intuitive user interface for participants, administrators, and other authorized parties to interact with the system.

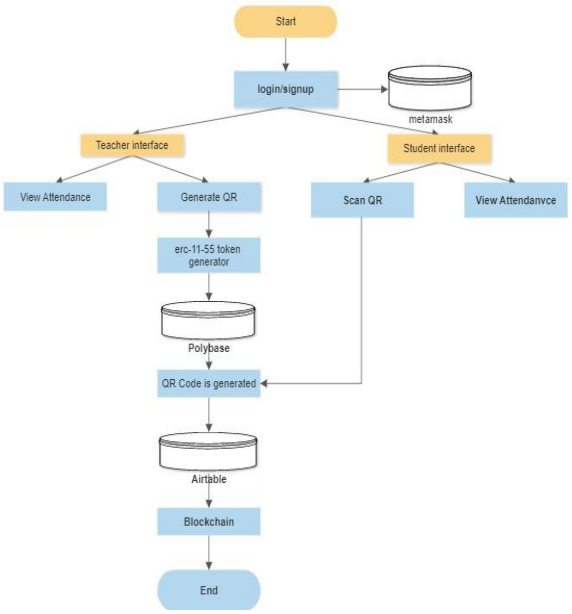


Figure3.1: Architecture of the Smart Attendance Capturing System.

The architecture is based on blockchain which is mainly concentrated on erc-11-55 tokens. First the login information will be stored on Microsoft Metamask.

After the login there will be two modes of users:

A: Teachers: teachers will be provided with viewing the attendance status with queries and generating QR for attendance.

Generating QR will result in generation of erc-11-55 coins and a meta data holding database that is polybase, which will hold the information related to token i.e., subject and time.

B: Student: students can view his attendance status and also scan QR generated by teachers which will result in getting ownership of the token and will result an entry in airtable.

Student's attendance will be marked in database once they scan the QR code and they can view their attendance status.

IV. RESULT

The implementation of a Smart attendance capturing system using a replica of ERC-1155 tokens and geolocation capture can have several potential results. Here are some outcomes:

1. Efficient attendance tracking: The system can provide a streamlined and efficient way to capture attendance using QR codes. Students or participants can scan their unique QR code using a mobile device, and the system can record their attendance accurately. This can eliminate the need for manual attendance taking, reducing human errors and saving time.

2. Increased accountability: By using replica ERC-1155 tokens, each participant can have a unique digital token associated with them. This enhances accountability as the tokens cannot be easily duplicated or manipulated. The system can track the tokens and verify the identity of participants, reducing the chances of proxy attendance.

3. Improved security: Using ERC-1155 tokens adds a layer of security to the attendance system. The tokens can be securely stored on the blockchain, ensuring their authenticity and preventing tampering.

4. Geolocation-based verification: By incorporating geolocation capture, the system can verify the physical presence of participants at the specified location. Geolocation data can be used to validate that participants are attending the intended event or class, further enhancing the accuracy and reliability of attendance records.

5. Data analysis and insights: The captured attendance data can be analyzed to gain insights into attendance patterns, trends, and student or participant behavior. This information can be used for various purposes, such as identifying attendance issues, optimizing scheduling, or generating reports for administrative purposes.

Parameters	Existing System	Proposed System
1. Cost	Comparatively costlier as it requires paper or biometric scanners.	Comparatively less costly.
2. Time	Requires lot of time to record attendance in paper-based attendance taking process.	Attendance capturing through QR scanning takes less time.
3. Security	Modifying the data is very easy hence, it is less secure.	It is very secure as it uses blockchain protocol.
4. Fraudulent attendance record	Avoiding proxies in this system is very difficult.	Geolocation capture ensures there is no proxies.

Figure 4.1: Result showing successful generation of QR code for particular subject's attendance.

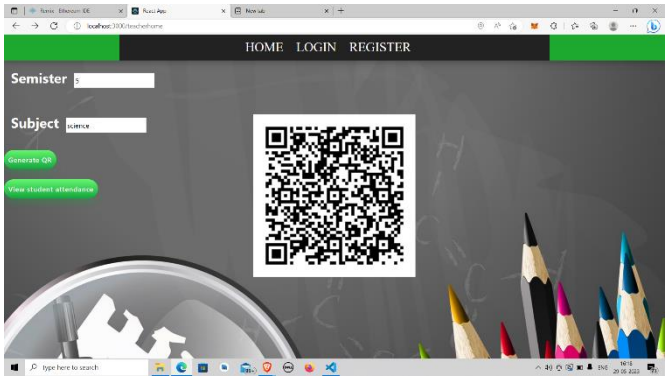


Figure 4.2: Result page showing successful scanning of QR code for marking the attendance

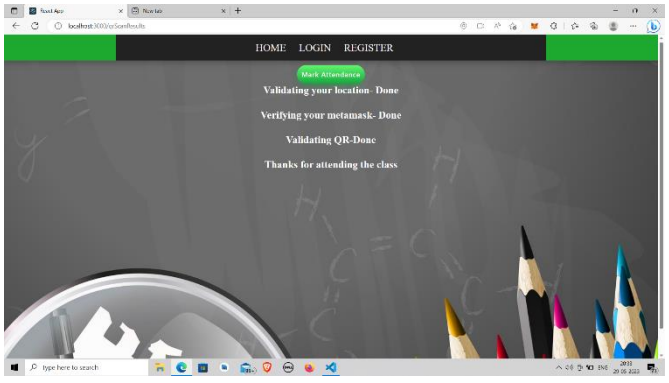


Figure 4.3: Result showing unsuccessful attendance marking since Geolocation-based verification failed

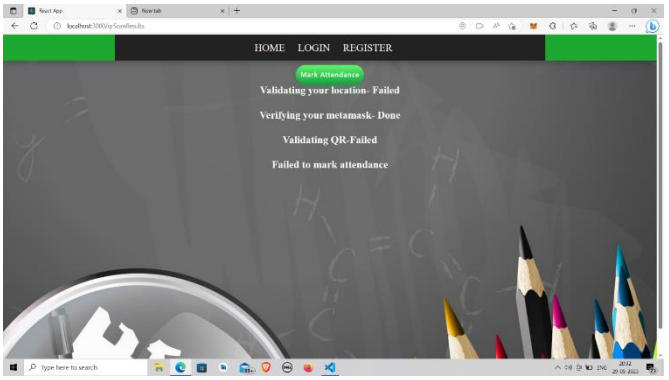
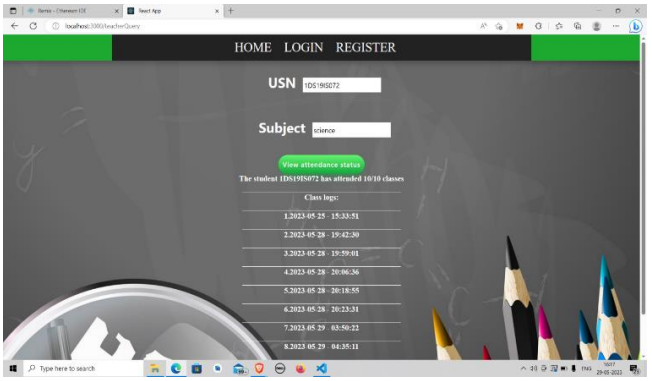


Figure 4.4: Result showing class logs and attendance record of the particular student.



V. DISCUSSION AND FUTURE SCOPE

1. Integration with Student Information Systems: The smart attendance system can be further enhanced by integrating it with existing student information systems. This integration would allow for seamless data exchange between attendance records and other student-related information, such as grades, schedules, and course enrolment.

2. Mobile Application Development: Developing a dedicated mobile application would provide students and faculty with a user-friendly interface to access attendance records, receive notifications, and interact with the system. The app could also incorporate additional features like course materials, announcements, and assignment submissions.

3. Analytics and Reporting: Implementing analytics capabilities would allow administrators to generate attendance reports, identify attendance patterns, and gain insights into student engagement. This data can be used to improve teaching methodologies, identify at-risk students, and provide personalized support.

4. Integration with Access Control Systems: Integrating the attendance system with access control systems, such as smart cards or biometric scanners, would further streamline the attendance process. Students' attendance could be automatically marked as they enter or exit a specific location, reducing the reliance on manual check-ins.

5. Scalability and Interoperability: As the system grows, ensuring scalability and interoperability becomes crucial. Consideration should be given to the system's ability to handle a large number of users, support different platform and integrate with other blockchain standards or smart contract protocols.

VI. CONCLUSION

The implementation of a smart attendance capturing system using a replica of ERC-1155 token and geolocation capture is an innovative approach that combines blockchain technology, QR codes, and geolocation to streamline the attendance process.

The smart attendance capturing system eliminates the need for manual attendance tracking, reducing administrative overhead and saving time for both students and faculty. leveraging blockchain technology, the system ensures that attendance records are secure, transparent, and tamper-proof, as each attendance transaction is recorded on the blockchain. Simplified QR codes provide a quick and convenient way for students to check-in, eliminating the need for traditional methods such as paper-based sign-in sheets or card swiping systems. Geolocation capture adds an extra layer of validation to the attendance system, ensuring that students are physically present at the specified location when marking their attendance.

V. REFERENCES

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