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E-Coins for College

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***Abstract*—In the rapidly digitising era of academics, there's a growing need for effective, transparent, and motivation-driven systems that can effectively cater to student achievements and participatory behaviours. This project has aimed to establish a blockchain-based platform dedicated to recognizing and rewarding students based on their academic and extracurricular involvements within the college.**

By leveraging blockchain technology's inherent security and transparency, this system will grant virtual coins to students for outstanding performances and active event participation. These coins are designed to be redeemed for academic and extracurricular benefits offered by the college, such as special recognition, academic concessions, or even participation opportunities in exclusive college events. The motive behind this project lies in the fundamental principle of incentivized education being a proven method to boost learning, progress as well as innovation among students. The aim is to invigorate a cohesive, inspired student community. Future enhancements could involve integration with other institutional systems, offering a broader spectrum of rewards and scaling it for larger student bodies.

***Index Terms*—Blockchain-based platform, cryptocurrency, tokens, secure and transparent system, virtual coins, student achievements, participatory behaviours, recognition and reward system, academic performance, extracurricular involvement, incentivized education, reward redemption, academic benefits.**

I. INTRODUCTION

Recognition fulfils a student's intrinsic need for validation. Rewards, by inducing dopamine release, link hard work with pleasure, fostering consistent excellence. The concept isn't new: B.F. Skinner's Operant Conditioning theory suggested that behaviours followed by rewards are often repeated. Re- search, such as those in the Journal of Applied Behavior Analysis, indicates that positive reinforcement can amplify academic performance. [1]

Beyond immediate benefits, sustained recognition cultivates resilience, adaptability, and a growth mindset in students. They emerge more accountable, understanding commitment and achievement, eventually shaping well-rounded individuals who can make positive societal contributions.

The primary goals of this project include:

Develop a Secure Blockchain-based Platform: Implement a decentralised blockchain solution ensuring data integrity, transparency, and immutability to securely record and verify student achievements.

Design Smart Contracts for Reward Distribution: Create smart contracts to automate the allocation and distribution of virtual coins based on predefined criteria such as academic performance metrics and participation in extracurricular activ- ities.

Establish Reward Redemption Mechanisms: Develop secure mechanisms for students to redeem earned virtual coins for tangible benefits such as academic concessions, exclusive event invitations, or merchandisewithin the college ecosystem.

There are various potential benefits of implementing such a system in educational institutes. It can enhance motivation and engagement, fostering a culture of continuous learning and personal development in students. It promotes holistic development by encouraging students to explore diverse interests and engage in extracurricular pursuits that enrich their overall educational experience. The project would also allow for equity and empowerment for all students by being inclusive and impartial.

II. PROBLEM STATEMENT

Traditional methods of recognizing and rewarding student achievements on campus can often seem disconnected and in- consistent. With a unified, blockchain-backed rewards system, we can streamline recognition, encourage consistent student engagement, and offer tangible incentives like certificates, recognitions, or academic concessions. This approach will foster a motivated and connected student community.

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III. METHODOLOGY

The methodology employed for this project involved design- ing a system architecture that integrates a frontend developed using React, hosted on the Polygon Matic Mumbai Blockchain network [2], and connected with MetaMask wallet functional- ity for secure user interactions. Frontend development focused on implementing features such as user registration and coin

redemption, while smart contracts [9] were developed using Solidity to define the logic governing virtual coin transac- tions. Integration efforts included deploying smart contracts onto the Polygon Matic Mumbai Blockchain and connecting the frontend to the blockchain network using Web3.js and MetaMask.Testing procedures will encompass comprehensive functional and user experience testing, including unit tests, integration tests, and user acceptance testing. Upon successful testing, the application will be deployed to a production en- vironment, followed by ongoing monitoring and maintenance to ensure reliability and security. Updates and enhancements will be implemented as necessary to meet user requirements and improve system performance.

IV. OBJECTIVES

A. Establishment of Blockchain-Based Student Recognition System

Develop a secure and transparent blockchain-based platform for recognizing and rewarding student achievements within the college.

Implement a system to incentivize academic and extracurric- ular involvements among students through virtual coins.

Utilize blockchain technology to ensure the integrity and immutability of student reward transactions.

V. Enhancement of Student Engagement and Participation

Encourage active participation in academic and extracur- ricular activities by offering virtual coins as rewards for outstanding performances and event participation.

Foster a culture of motivation and engagement among students by providing tangible incentives for their efforts.

VI. Development of an Efficient Rewards System

Design a user-friendly frontend interface for students to register, track their virtual coin balances, and redeem rewards. Implement smart contracts using Solidity to define the logic governing virtual coin transactions, ensuring transparency and security.

VII. Integration with Existing Institutional Systems

Explore integration opportunities with other institutional systems to expand the range of rewards and benefits available to students.

Ensure seamless interoperability with existing college infras- tructure to maximize the impact and reach of the rewards system.

E. Promotion of Learning, Progress, and Innovation

Reinforce the principles of incentivized education to stim- ulate continuous learning, progress, and innovation among students.

Empower students to leverage their virtual coins for academic concessions, special recognitions, or exclusive participation opportunities in college events.

F. Testing, Deployment, and Maintenance

Conduct thorough testing, including functional, integration, and user acceptance testing, to validate the reliability and usability of the rewards system.

Deploy the application to a production environment, monitor- ing for performance, security, and reliability.

Provide ongoing maintenance and support to address any issues, implement updates, and enhance the system based on user feedback and requirements.

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V. SCOPE

A. Enhanced Student Motivation and Engagement

The rewards system will incentivize students to actively participate in both academic and extracurricular activities, leading to increased motivation and engagement.

By earning virtual coins for their achievements, students will be encouraged to strive for excellence in their studies and take part in various college events and initiatives.

B. Promotion of Academic Excellence

The system will recognize and reward academic achieve- ments, encouraging students to excel in their studies.

Students who demonstrate outstanding academic performance will be incentivized to maintain high standards and pursue further academic excellence.

C. Recognition of Extracurricular Involvements

The rewards system will also acknowledge students' partic- ipation in extracurricular activities such as sports, clubs, and community service.

This recognition will foster a well-rounded educational expe- rience, emphasizing the importance of holistic development beyond academics. [6]

D. Opportunities for Growth and Development

By redeeming virtual coins for various benefits such as academic concessions, special recognitions, and participation opportunities, students will have access to resources that facilitate their growth and development.

These benefits may include access to specialized workshops, mentorship programs, or exclusive events aimed at enhancing students' skills and knowledge

E. Regular Utilization by Students and the College

The rewards system is designed to be regularly utilized by both students and the college administration.

Students will frequently interact with the system to track their virtual coin balances, redeem rewards, and participate in activities to earn more coins.

The college administration will actively manage and adminis- ter the rewards system, monitoring student achievements and distributing rewards accordingly.

F. Long-Term Impact on Student Success

Over time, the rewards system will contribute to the overall success and growth of students by fostering a culture of excellence, motivation, and continuous improvement.

Students who actively engage with the system and avail themselves of its benefits are likely to experience enhanced academic performance, personal development, and future ca- reer prospects.

G. Scalability and Sustainability

The rewards system is scalable and can accommodate the growing student population and evolving needs of the college community.

As students continue to engage with the system and earn rewards, the college will witness sustained benefits in terms of student retention, satisfaction, and overall academic success.

VI. PROBLEM REPRESENTATION

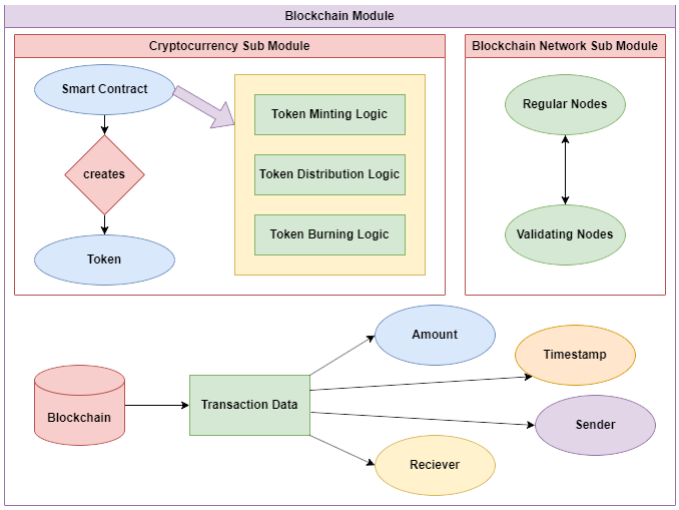

Fig.1. Blockchain Module

The Blockchain Module (Fig.1) has two main sub-modules:

- **Cryptocurrency Sub Module**.

This sub-module is responsible for the creation and manage- ment of tokens used within the system.

It includes three functionalities:

Smart Contract:This creates the token according to pre-defined rules.

Token Minting Logic: This determines how many tokens are created based on student performance or participation.

Token Distribution Logic: This distributes the minted tokens to students based on the smart contract rules.

- **Blockchain Network Sub Module (P2P)**.

This sub-module refers to the peer-to-peer network that underpins the blockchain system.

It consists of two types of nodes:

Regular Nodes: These nodes can participate in the network by the blockchain.

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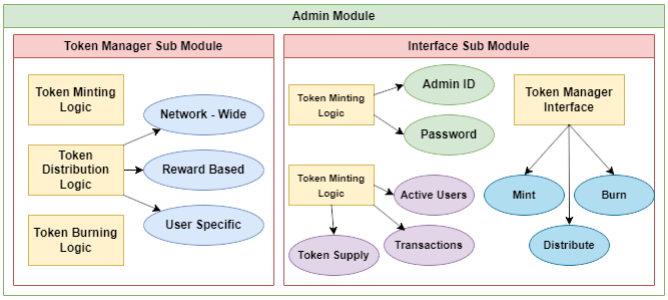

Fig.2. Admin Module

validating transactions.
Validating Nodes: These nodes have the additional responsibility of verifying and adding new blocks to

The Admin Module (Fig.2) has several functionalities re- lated to user management and token management. Here's a breakdown of the functionalities:

- User Management

  Admin Authenticator: This block verifies the identity of the admin trying to access the system. It involves username and password verification.
  Admin ID: This represents the unique identifier for the admin user.

- Token Management

  Token Minter: This functionality allows the admin to mint new tokens, possibly for system initialization or other purposes. Token Burner: This functionality allows the admin to burn tokens, potentially to regulate the overall token supply within the system. User Specific Token Supply: This section likely refers to the ability for the admin to set or manage the token allocation for individual users. Mint and Burn transactions are likely sub- mitted to the blockchain network through a separate process.

- Token Distribution

  The flowchart shows three distribution methods:
  Reward based: Tokens are distributed to students based on achieving certain performance or participation milestones.
  Network-wide: Tokens are distributed to all users on the net- work, possibly at predefined intervals or according to specific events.
  Transactions: This refers to peer-to-peer transactions between users within the system, where tokens are exchanged for goods or services.

- Monitoring System

  This block refers to the admin's ability to monitor the overall system health, including activities related to token minting, burning, distribution, and potentially user activity.
  The admin can also monitor Active Users and Transaction counts.

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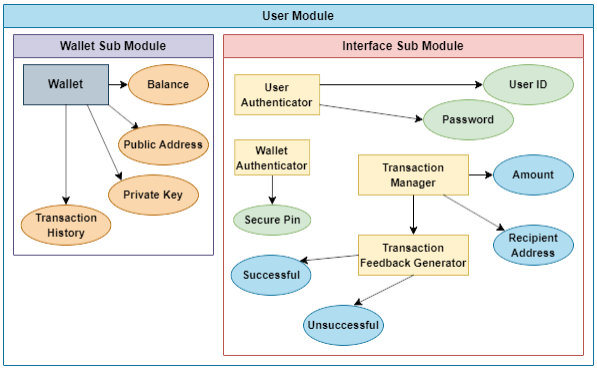

Fig.3. User Module

The User Module (Fig.3) has several functionalities related to accessing the user's wallet and transaction history. Here's a breakdown of the functionalities:

- User Wallet

Wallet Sub Module: This sub-module manages the user's wallet where their tokens are stored.
Public Address: This refers to the unique identifier of the user's wallet on the blockchain network.
Wallet Authenticator: This block verifies the user's identity when they try to access their wallet. It involves username and password verification.
Balance: This shows the total number of tokens currently held by the user in their wallet.

- Transactions

Transaction History: This section allows the user to view their past transactions, which include details such as:
Amount of tokens received or spent. Transaction recipient or sender.
Timestamp of the transaction.

- Token Redemption

Transaction Manager: This functionality allows users to initi- ate transactions for spending their tokens.
Amount: This refers to the number of tokens the user wants to spend.
Recipient Address: This refers to the wallet address of the recipient where the tokens will be sent.

- Feedback Mechanism

Feedback Generator: This block allows users to provide feedback about the system or their experience using tokens.
Overall flow after integrating all the three modules:

A. System Initialization

Admin goes through an authentication process. Initial token supply and minting rules are predefined through Smart Con- tract in the Cryptocurrency Sub Module. This establishes the foundation for the token economy within the system.

User Enrollment and Authentication

Students register and create user accounts within the system. Upon login, users go through an authentication process to access their wallet.

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B. Student Performance and Participation Data

The system can access student performance (e.g., grades, exams) and participation (e.g., events, clubs) data through input from students.

C. Token Minting and Distribution

Based on predefined rules in the Smart Contract, the system triggers the creation of new tokens (Cryptocurrency Sub Module). The Token Minting Logic determines the number of tokens awarded based on student performance or partici- pation data. Minted tokens are distributed to students' wallets according to the Token Distribution Logic.

D. User Wallet and Transaction Management

Users can view their wallet balance (Balance) and trans- action history (Transaction History). Users can initiate trans- actions to spend tokens (Transaction Manager) by specifying the amount and recipient's wallet address. Transactions are broadcasted to the P2P network.

E. Network Validation and Record Keeping

Regular Nodes and Validating Nodes work together to validate transactions on the blockchain network. Validated transactions are added to new blocks, which are then appended to the blockchain, creating a secure and tamper-proof record.

F. Token Redemption and Reward System

Students can redeem tokens for pre-defined rewards offered by the college (e.g., academic concessions, exclusive events). The system might involve interaction with external platforms or college administration for reward fulfillment.

G. Admin Monitoring and System Management

The admin can monitor overall system activity including token minting, burning, distribution, and user transactions. The admin can manage user-specific token allocation (User Specific Token Supply). The admin can also initiate additional token distributions (network-wide) or burn tokens to regulate token supply.

VII. PROPOSED SYSTEM

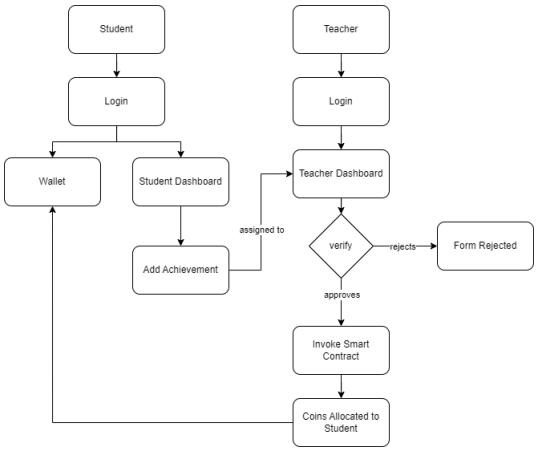

Fig.4. System Flow

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A. User Interface (UI)

Develop a user-friendly frontend interface accessible via web browsers or mobile applications. The UI facilitates user registration, login, and account management functionalities. Design intuitive dashboards for students to view their virtual coin balances, track their achievements, and redeem rewards.

B. Blockchain Integration

Integrate the Polygon Matic Mumbai Blockchain network to ensure secure and transparent transactions. Develop smart contracts using Solidity to govern virtual coin transactions and reward distributions. Implement blockchain wallets for users to securely store and manage their virtual coins.

C. Reward Mechanism

Define a comprehensive reward mechanism that incentivizes both academic achievements and extracurricular involvements. Establish criteria for earning virtual coins based on various activities such as academic performance, event participation, leadership roles, and community service, etc.

D. Admin Panel

Create an administrative dashboard for college staff to manage the rewards system. Admins should have the ability to create and manage reward categories, set coin distribution rules, and monitor student activities and achievements.

E. Coin Redemption System

Implement a coin redemption system where students can exchange their virtual coins for rewards. Offer a variety of rewards including academic concessions (e.g., course waivers, library privileges), special recognitions (e.g., certifi- cates, badges), and participation opportunities in exclusive college events.

F. Security and Authentication

Implement robust security measures to safeguard user data and transactions. Utilize encryption techniques to secure user credentials and sensitive information. Implement authentica- tion mechanisms such as multi-factor authentication (MFA) to prevent unauthorized access.

G. Testing and Quality Assurance

Conduct thorough testing of the system to ensure functional- ity, performance, and security. Perform unit testing, integration testing, and user acceptance testing to identify and rectify any issues or bugs.

H. Deployment and Maintenance

Deploy the system to a production environment following successful testing. Provide ongoing maintenance and sup- port to address any issues, implement updates, and enhance system performance. Regularly monitor system usage and performance metrics to ensure optimal functionality and user satisfaction.

I. Training and Documentation

Provide comprehensive documentation and training mate- rials for users and administrators. Offer training sessions to familiarize users with the system's features and functionalities.

J. Feedback and Continuous Improvement

Establish mechanisms for collecting user feedback and suggestions for system improvements. Regularly review and update the system based on user feedback and emerging technologies to enhance usability and effectiveness.

VIII. RESULTS

Fig.5.1. Home Page

Home Page contains links to all necessary functions, such as student and teacher registration as well as log in pages.

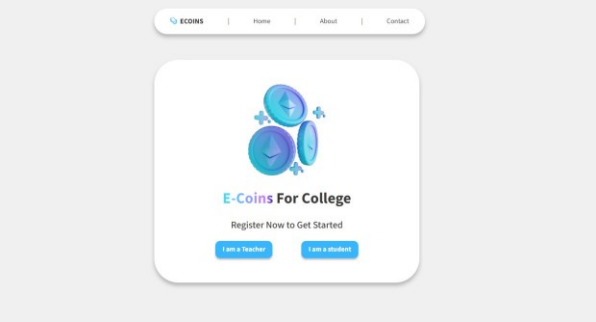

Fig.5.2. Registration Page

Users can register to the system by using valid email address and password. Teachers must go through a gateway using a security key to ensure that only they can register as teachers.

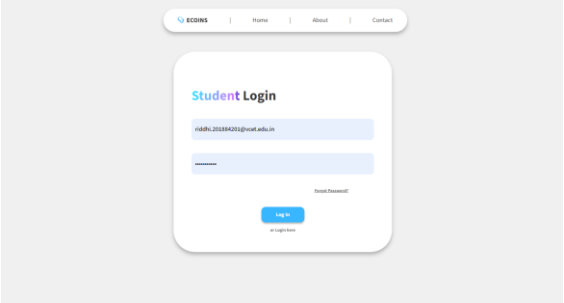

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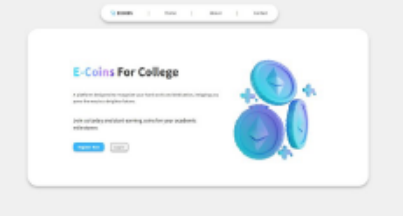
Fig.6.1. Student Login Page

Students can login using login credentials created while registering to the system. Login credentials required are email and password.



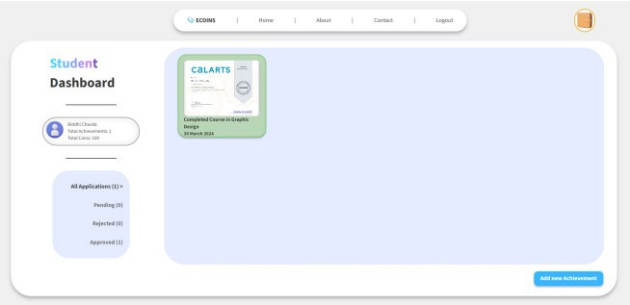


Fig.6.2. Student Dashboard

After logging into the system, students can access the 'Student Dashboard'. This dashboard allows them to view their applications including pending, rejected and approved applications. They can also click on the wallet icon at the top right of the page to check their wallet. The dashboard is where students can find the option to submit an application for getting an achievement approved.

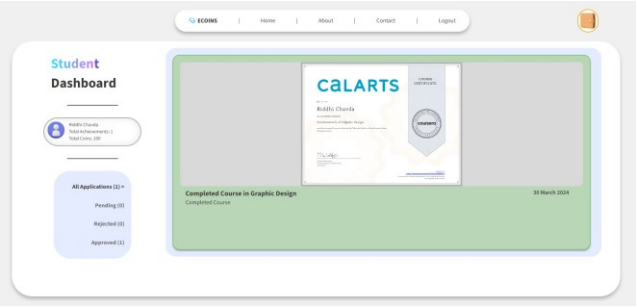


Fig.6.3. Approved Achievement

The student can view each approved achievement through the dashboard. This also serves as a record of the student's positive performance.

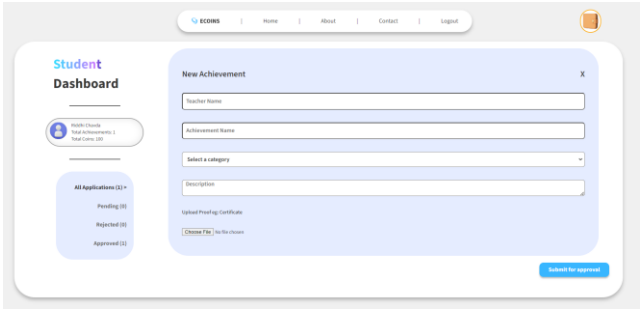


Fig.6.4. Adding Achievements

Students can fill up this form to submit details of their achievement to any teacher who can verify these details. They must attach a proof of achievement, this may be a certificate or letter by a recognisable authority. On submission, these details are sent to the teacher's dashboard for verification.

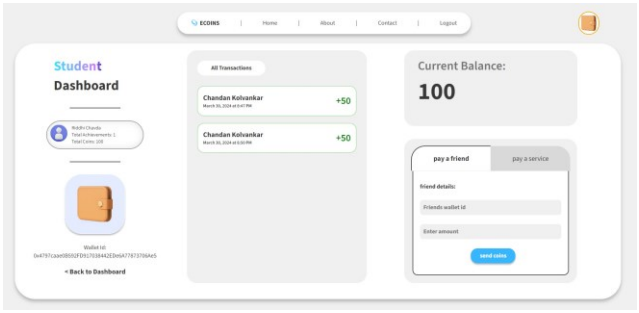


Fig.6.5. Student Wallet

This displays the amount of coins the student currently possesses. It also shows all the transactions that have taken place, including all coins sent and received. The student can navigate to this page if they wish to transfer coins to another student, or use coins at a service within college campus. They can do that by simply using their friend's wallet address, or selecting the service from the drop-down menu, that they wish to send coins to.

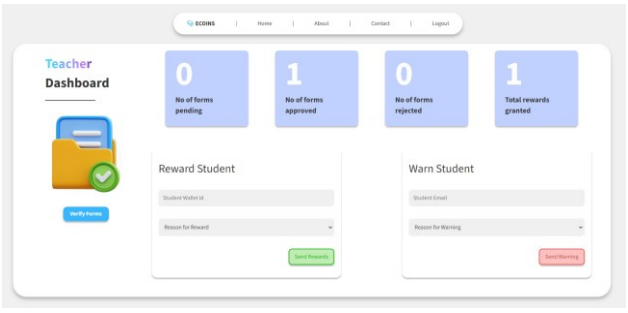


Fig.7.1. Teacher Dashboard

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On logging, a teacher can view the forms they need to verify. They have the option of rejecting or approving any given form. They can also individually send a reward to a specific student if they deem it necessary. This can be done by specifying a reason for rewarding, after which the system allots an appropriate amount of coins to the given student. They may also send a warning to a student for certain misconducts or behaviours.

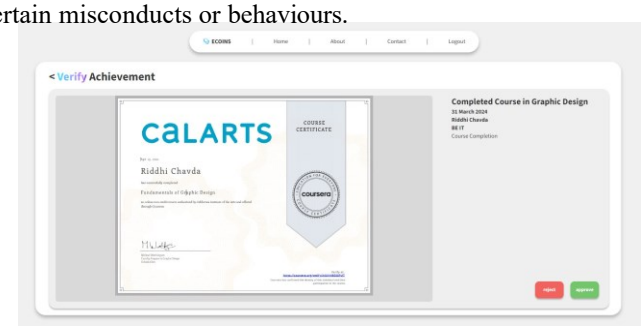

Fig.7.2. Verifying an Achievement

The teacher can view each achievement sent for verification, and determine whether it is genuine. On approval of an achievement, the system allots the appropriate amount of coins to that particular student for their achievement.

IX. CONCLUSION

Based on the proposed system for the blockchain-based student recognition and rewards system, it can be concluded that:

The implementation of a blockchain-based rewards system holds significant promise for enhancing student engagement, motivation, and academic success within the college. By leveraging blockchain technology, the project aims to create a transparent, secure, and efficient platform for recognizing and rewarding students' academic achievements and extracurricu- lar involvements.

Through the proposed system, students will have the opportunity to earn virtual coins for their accomplishments, ranging from academic excellence to active participation in college events and community service. These virtual coins can be redeemed for a variety of rewards, including academic con- cessions, special recognitions, and exclusive participation op- portunities, thereby incentivizing continuous learning, growth, and development among students.

The system's user-friendly interface and robust security measures ensure seamless interaction and protection of user data and transactions. Additionally, the administrative dashboard empowers college staff to manage the rewards system effectively, monitor student activities, and make informed decisions regarding reward distributions.

By deploying the system and providing ongoing maintenance, training, and support, the college can foster a culture of excellence, motivation, and innovation among its student body. Furthermore, the project's scalability and adaptability allow for continuous improvement and expansion to meet the evolving needs of the college community.

In conclusion, the implementation of a blockchain-based student recognition and rewards system represents a valuable investment in the growth and success of students, fostering a vibrant and engaged learning community within the college.

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We would like to extend our heartfelt appreciation to the individuals and institutions who have been instrumental in the successful completion of our project. Our foremost gratitude goes to our esteemed Mentor, Prof. Chandan Kolvankar, as well as our Head of Department "Dr. Thaksen Parvat" whose expertise, guidance, and unwavering support have been invalu- able throughout this research journey. Their encouragement and belief in our abilities were a constant source of motivation. In summary, this project's successful completion was made possible through the collaborative efforts and support of our mentors, institution and peers. Our friends and family deserve special recognition for their unwavering support, patience, and understanding during this demanding undertaking. Their en- couragement and belief in our abilities were a constant source of motivation. We must also acknowledge the contributions of all the academicians who served as supervisors and assessors. Their feedback, insights, and evaluation played a significant role in shaping our project. We are deeply grateful to each one of them.

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