GreenChain: A Blockchain and React Native-Based Reward Platform for Eco-Friendly Activities

Dimitrie-Dragoș SANDU and Dana-Mihaela VÎLCU

***Abstract*—As global awareness of environmental sustainability grows, innovative solutions are necessary to encourage individual action towards reducing carbon footprints. This paper introduces "GreenChain," a mobile application that leverages blockchain technology to motivate and reward users for engaging in eco-friendly activities. The novelty of this work lies in the practical integration of a custom cryptocurrency, GreenCoin (GRC), with real-world verifiable actions such as using public transport, reducing energy consumption, and recycling. The application is built with React Native for cross-platform compatibility (Android and iOS), uses the Ethereum blockchain for transaction transparency, and integrates Google OAuth2.0 for secure user authentication. The system tracks and validates sustainable behaviors, rewarding users with GRC, thus gamifying and incentivizing environmental responsibility. Preliminary feedback indicates the app is effective in promoting environmental consciousness through its intuitive design and tangible rewards system.**

***Index Terms*—blockchain, cryptocurrency, environmental sustainability, gamification, react native.**

I. Introduction

In the current context of global climate change and growing concern for environmental sustainability, it is essential to find innovative solutions that stimulate responsible ecological behaviors at both individual and collective levels. The impact of human activities on the environment has become a major issue, generating increased pressure to develop technologies that can help monitor and reduce each person's carbon footprint.

Blockchain, an emerging technology primarily known for its role in the development of cryptocurrencies, also offers significant opportunities in the ecological field. Its decentralized and transparent nature can provide a verifiable and efficient method to stimulate and reward sustainable actions. The use of this technology to verify and incentivize individual ecological actions introduces a new level of accountability and personal involvement in the fight against climate change.

The main contributions of this paper are summarized as follows.

1. We propose the GreenChain application, a comprehensive platform designed to integrate blockchain technology into users' daily lives, encouraging them to adopt environmentally friendly practices. Through GreenChain, actions such as using public transport, recycling, and reducing energy consumption are not only encouraged but also rewarded with a custom cryptocurrency, GreenCoin.
2. We create a complete architecture that includes a cross-platform mobile application built with React Native[2], a backend server using Node.js[3], and an ERC-20 token[4] on the Ethereum blockchain[5]. This system validates user actions, such as scanning public transport tickets, utility bills, and recyclable PET products, and distributes rewards in a transparent and secure manner. The platform incorporates gamification elements to increase user engagement.

All transactions and accumulations of GreenCoin are recorded on the Ethereum blockchain, which uses the Proof of Stake (POS) mechanism, ensuring superior energy efficiency compared to traditional Proof of Work systems and thus reducing the ecological impact of the blockchain activities themselves [1].

II. Related Work

The foundational technology enabling GreenChain is the blockchain, a concept that has evolved significantly since its inception. The idea of cryptographically securing digital documents in a chain of blocks to prevent tampering was first introduced by Stuart Haber and W. Scott Stornetta in 1991 [2]. However, the term "blockchain" gained prominence with the 2008 publication of Satoshi Nakamoto's paper, "Bitcoin: A Peer-to-Peer Electronic Cash System" [3]. This introduced a decentralized public ledger that eliminated the need for a central authority, a response to the vulnerabilities exposed by the 2008 financial crisis.

While Bitcoin demonstrated the potential of blockchain for financial transactions, the technology's capabilities were significantly expanded with the proposal of Ethereum by Vitalik Buterin in 2013 [4]. Unlike Bitcoin, which is optimized as a digital currency, Ethereum was designed as a platform for developing decentralized applications (dApps) and smart contracts. Smart contracts are self-executing scripts that run on the blockchain, automatically enforcing the terms of an agreement when predefined conditions are met. This innovation opened the door for a wide range of applications beyond finance, including ecological solutions like GreenChain.

A key component of the Ethereum ecosystem is the ERC-20 Tokenization Standard [5], which defines a common set of rules for creating fungible tokens. This standardization ensures interoperability between different dApps, wallets,

D.-D. SANDU is with the Information Technology Agency, Bucharest, Romania (e-mail: dragossandu38@gmail.com).

D.-M. VÎLCU is with the Military Technical Academy "Ferdinand I", Bucharest, Romania (e-mail: dana.vilcu@mta.ro).

[2] https://reactnative.dev/
[3] https://nodejs.org/
[4] https://eips.ethereum.org/EIPS/eip-20
[5] https://ethereum.org/

and exchanges, and provides a robust foundation for creating custom cryptocurrencies like GreenCoin.

The evolution of consensus mechanisms is also critical. While Bitcoin uses the energy-intensive Proof of Work (PoW) algorithm, Ethereum has transitioned to a Proof of Stake (PoS) mechanism. In PoS, transaction validation is determined by the amount of currency a participant holds and is willing to "stake" as collateral. This approach significantly reduces the computational power and energy consumption required to secure the network, aligning perfectly with the environmental goals of the GreenChain project.

Beyond the foundational technologies, the digital landscape includes a variety of applications designed to promote a sustainable lifestyle. Applications such as Commons: Smart Money for Good [6] (available on AppStore), focus on calculating the carbon footprint by analyzing users' financial transactions, offering personalized recommendations to reduce environmental impact. Other platforms, like the Ecosia search engine [7], integrate ecological actions (tree planting) into daily digital activities. Similarly, reward systems like Recyclebank [8] have demonstrated success in stimulating recycling through convertible points to get great deals at local business and exclusive discounts on sustainable goods. In contrast to these approaches, GreenChain differentiates itself by using blockchain technology (Ethereum) to provide transparency and security in the reward process. Furthermore, the platform does not rely on estimates derived from financial data but on the validation of concrete, verifiable actions (scanning transport tickets, utility bills, and recyclable packaging), which it rewards directly with its own cryptocurrency, GreenCoin.

III. METHODS

The architecture of the GreenChain solution (Fig. 1) is composed of several key components that interact to provide a robust and scalable platform. The system is structured into three main parts: the client application (frontend), the server application (backend), and the GreenCoin cryptocurrency operating on the blockchain.

A. Application Architecture

The overall architecture facilitates secure and rapid interactions between the user and the blockchain. The user interacts with the React Native mobile application. For authentication, the app uses Google Sign-In[9] and Firebase. All business logic, data processing, and requests are handled by a REST API connecting the client to the backend server. The backend, built on Node.js, communicates with a MongoDB [10] database for data storage and with the Ethereum blockchain for transactions. Wallet interactions are managed through WalletConnec[11], which links to mobile wallets like MetaMask [12]. The GRC cryptocurrency is an ERC-20 token deployed on the Ethereum blockchain, with its logic defined in a Solidity[13] smart contract.

B. Client Application (Frontend)

The GreenChain client application is developed using React Native, a framework that allows for the creation of mobile apps for both iOS and Android from a single JavaScript and React codebase. This approach ensures a native user experience on both platforms. The application is structured in three layers:

1. The Native Layer: Interacts directly with the device's operating system and hardware, such as the camera for scanning barcodes and QR codes from PET products, tickets, and bills.
2. The JavaScript Layer: Contains the core application logic, including state management (using Redux[14]), user session handling, and communication with the backend server.
3. The React Layer: Defines the user interface (UI) using reusable and declarative components. Every screen, from the login form to the rewards history, is built with React components.

C. Server Application (Backend)

The backend is built with Node.js and the Express.js[15] framework, chosen for their performance and ability to handle concurrent requests efficiently through a non-blocking I/O model. This is crucial for an application that requires real-time updates. The backend is responsible for:

- API Endpoints: Exposing a REST API for the client application to register users, submit data from scans, and retrieve user history and statistics.
- Business Logic: Validating the data submitted by users (e.g., checking if a ticket has already been scanned) and calculating the appropriate GRC rewards based on predefined rules.
- Database Interaction: Using MongoDB as its NoSQL database to flexibly store user data, activity logs, and other application-related information.
- Blockchain Communication: Utilizing the Web3.js[16] library to interact with the Ethereum blockchain. This includes invoking functions on the GreenCoin smart contract to mint and transfer GRC tokens to users as rewards.

The backend is deployed on Heroku[17], a cloud platform as a Service (PaaS) that simplifies deployment, management, and scaling of the application.

D. GreenCoin Cryptocurrency

GreenCoin is the native cryptocurrency of the GreenChain ecosystem, designed to reward users for their ecological actions. It is implemented as an ERC-20 token on the Ethereum blockchain.

[6] https://apps.apple.com/us/app/commons-smart-money-for-good/id1438446236
[7] https://www.ecosia.org/
[8] https://recyclebank.com/
[9] https://developers.google.com/identity/sign-in/web/sign-in
[10] https://www.mongodb.com/
[11] https://walletconnect.com/
[12] https://metamask.io/
[13] https://github.com/argotorg/solidity
[14] https://redux.js.org/
[15] https://expressjs.com/
[16] https://web3js.readthedocs.io/en/v1.10.0/
[17] https://www.heroku.com/

 Digital Object Identifier 10.32754/JMT.2026.1.11

The development and deployment process involved several key steps:

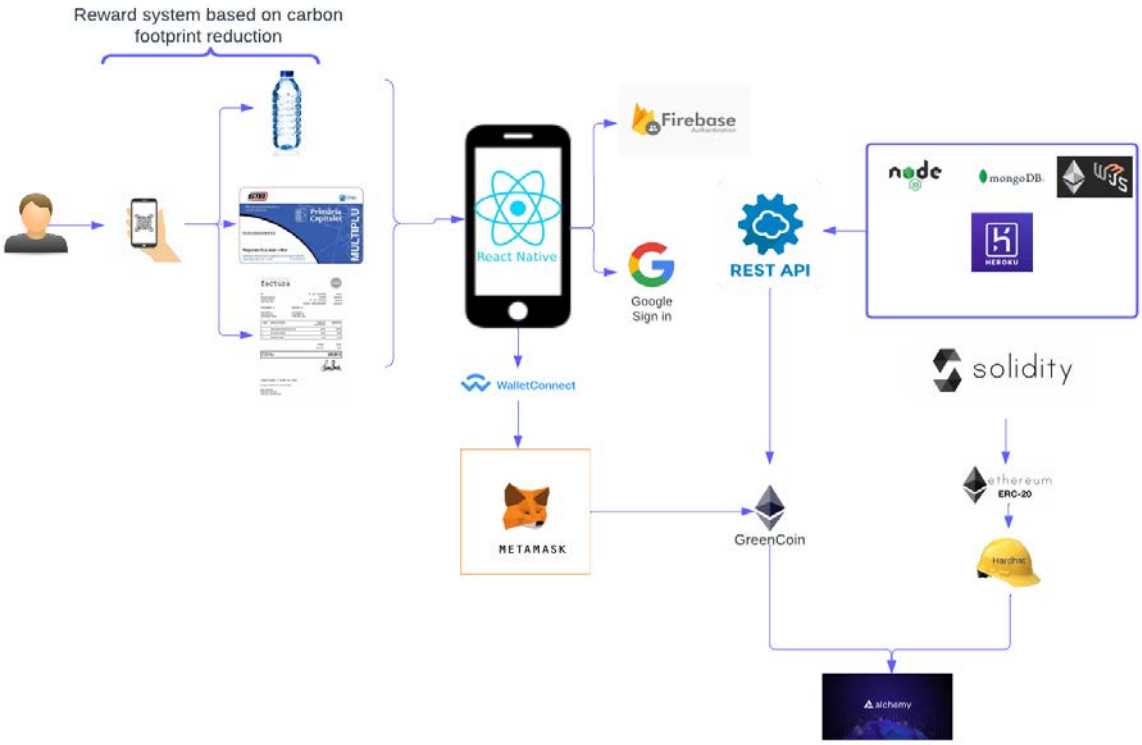


Figure 1. The architecture of the GreenChain application

1. Smart Contract Writing: The smart contract was written in Solidity, inheriting the secure and audited ERC-20 standard implementation from OpenZeppelin [18] to ensure robustness and interoperability.
2. Compilation and Testing: The Hardhat [19] development environment was used to compile the Solidity code into Ethereum Virtual Machine (EVM) bytecode and to run a comprehensive suite of unit tests using the Mocha [20] framework. These tests verified transaction correctness, balance management, and compliance with the ERC-20 standard.
3. Deployment: After successful testing, the smart contract was deployed to the Sepolia[21] test network. The Sepolia network allows for real-world testing conditions without incurring actual gas fees, making it ideal for development and validation. The deployed contract and its transactions are publicly verifiable on block explorers like Sepolia Etherscan.

IV. Results

The result of this work is a fully functional mobile application, GreenChain, available for both Android and iOS, which successfully implements the proposed reward system for ecological activities. The user's journey through the application was tested and validated, demonstrating the successful integration of all technical components. Also, the final usability test proved a very good user experience.

A. User Onboarding and Wallet Integration

Upon first opening the application, the user is presented with an authentication screen. Users can either register a new account using their name, email, and a password via Firebase Authentication or use the streamlined Google Sign-In (OAuth2.0)[22] for faster access (Fig. 2).

After successful authentication, the application prompts the user to connect their digital wallet using WalletConnect. This interface allows users to select from various mobile wallets, such as MetaMask, and authorize the connection securely without exposing their private keys to the application (Fig. 3).

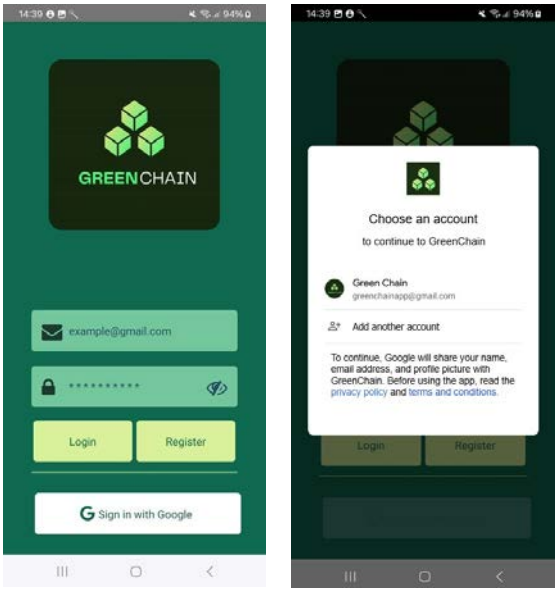
B. Core Application Features

Once logged in, the user lands on the main dashboard, which provides an overview of their weekly activity, a motivational message, and quick access to the core functionalities: Tickets, Bills, History, and Wallet. The side menu offers navigation to their Profile, Settings, and other options (Fig. 4).

User Profile: The profile page provides gamified feedback on the user's performance. It displays key statistics such as the total kilograms of CO2 saved, the user's rank compared to others (e.g., "Top 10% of all users"), and a breakdown of their progress in different categories: PETs recycled, kWh reduced, and public transport tickets used (Fig. 5).

Wallet and History: The Wallet page displays the user's wallet address, their current GRC balance, and a history of recent transactions recorded on the blockchain. The general History page shows a detailed log of all rewarded activities, such as bill submissions, including the GRC amount awarded and the corresponding kWh reduction (Fig. 5).

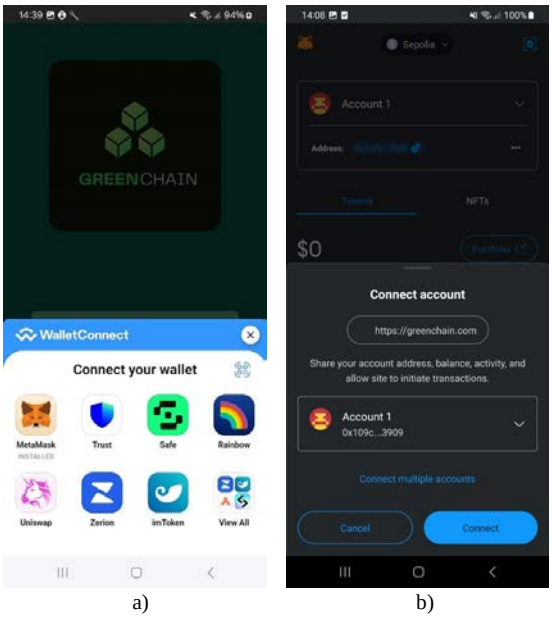
[18] https://www.openzeppelin.com/
[19] https://hardhat.org/
[20] https://mochajs.org/
[21] https://sepolia.etherscan.io/
[22] https://www.rfc-editor.org/info/rfc6749



a) b)

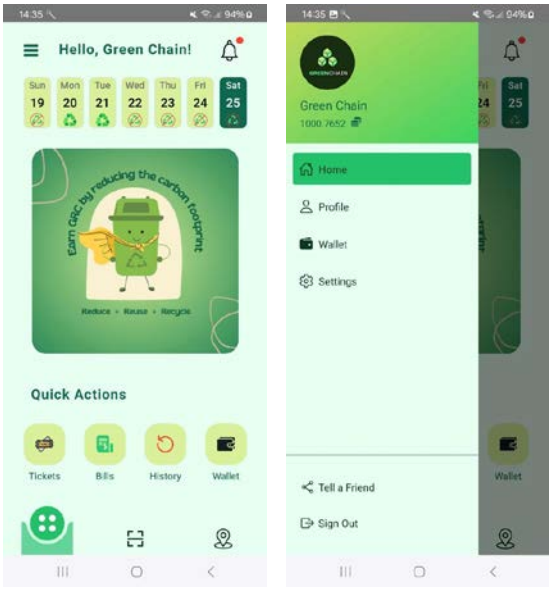
c)

Figure 2. a) Authentication screen. b) Google Authentication. c) Firebase Authentication



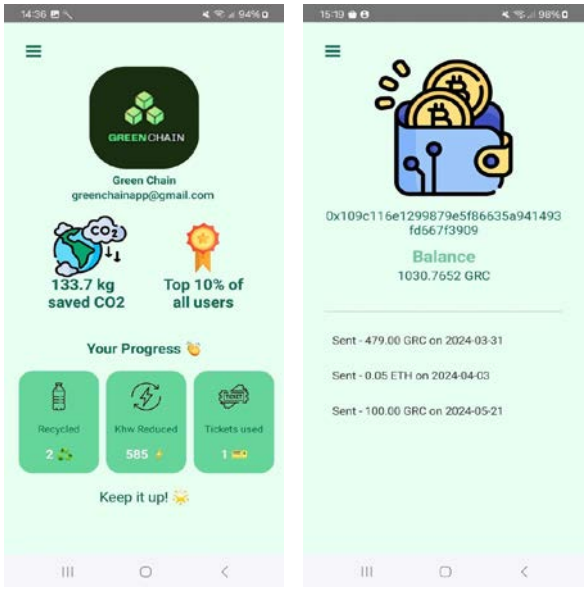
a) b)

Figure 3. a) Selecting an available wallet. b) Authorization for connection to the wallet



a) b)

Figure 4. a) Main screen of the app. b) The side menu



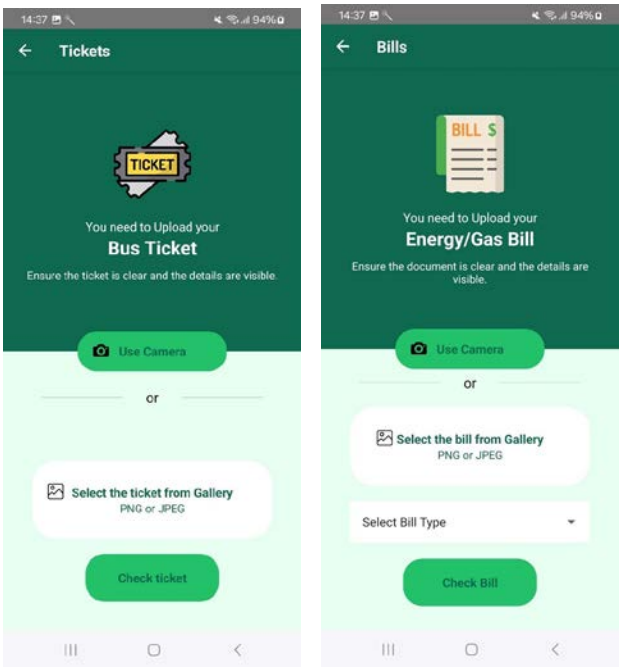
a) b)

Figure 5. a) User profile screen. b) Wallet and history screen

C. Performing and Validating Eco-Actions

The application provides distinct modules for submitting different types of ecological activities.

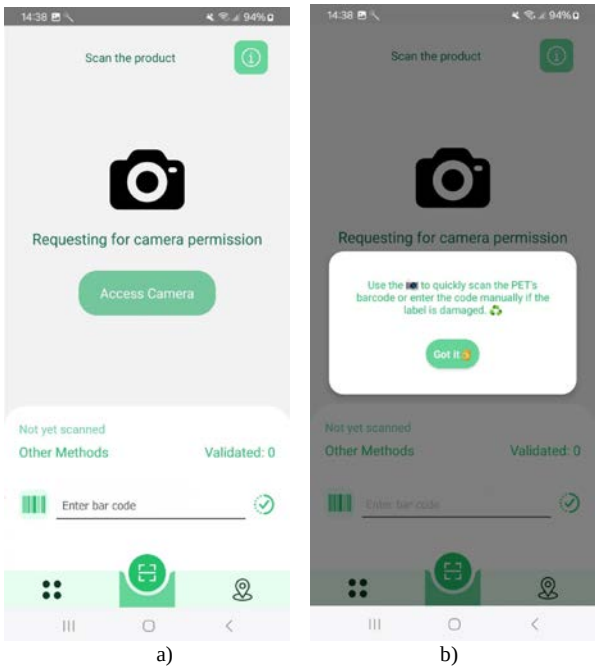
Scanning Tickets and Bills (Fig. 6): To ensure the accuracy of the validation process, the current version of the application supports a specific range of documents. For public transport, tickets from the public transport network in Bucharest (buses, trams, and trolleybuses) are accepted. For utility bills, the system is configured to process invoices from major Romanian energy suppliers, namely E.ON (electricity and gas), Hidroelectrica (electricity), and Enel (electricity and gas). For these accepted documents, the user can either use the device's camera to take a picture or upload an existing image from their gallery. The backend processes the image to extract relevant data and validate its authenticity. If the submission is valid, a success notification appears, confirming the GRC reward received (e.g., "Success: Ticket is ok! You just received 0.25 GRC!"). If the ticket has already been used or the bill data cannot be extracted, an error message is shown.



a) b)

Figure 6. a) Bus Ticket. b) Energy/Gas Bill selecting/screening screens

Recycling PETs: The application helps users find nearby recycling collection points using an integrated Google Maps interface, for which it requests location permissions (Fig. 7). At the collection point, the user can scan the barcodes of PET products. The app requests camera permission and then uses the camera to capture the barcode. A successful scan is confirmed, and the item is marked as validated. If an invalid barcode is scanned, an appropriate error message is displayed (Fig. 8).

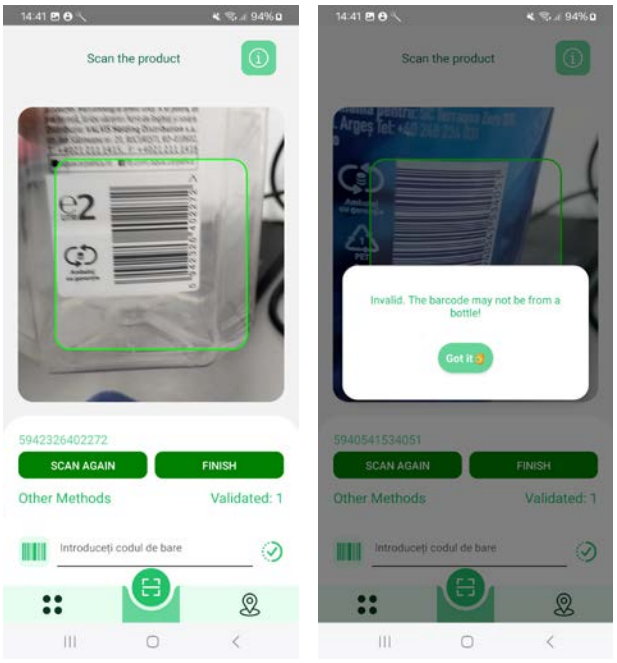


a) b)

Figure 7. a) PET scanning screen. b) Info Modal for scanning

D. Preliminary User Feedback

Initial user feedback collected during development highlighted the app's effectiveness in promoting environmental consciousness and active participation in carbon reduction activities. Also, in the last usability test performed on the final version of the app, the users appreciated the intuitive design and the tangible rewards system, which significantly enhanced their engagement and motivation to perform eco-friendly actions.



a) b)

Figure 8. a) PET barcode scanning. b) Invalid barcode

V. CONCLUSION

This paper presented GreenChain, a platform that demonstrates the feasibility and potential of using modern technologies like blockchain and cross-platform mobile development to promote environmentally friendly behaviors. The project successfully integrates a React Native application, a Node.js backend, and an Ethereum-based cryptocurrency to create an innovative and scalable solution.

The choice of the Ethereum blockchain, with its robust support for ERC-20 smart contracts and its energy-efficient Proof of Stake mechanism, provided the necessary security, transparency, and environmental alignment for the project's goals. The implementation on the Sepolia testnet allowed for thorough and safe testing of the entire reward distribution lifecycle. Functionalities such as secure authentication via Google OAuth2.0 and Firebase, and seamless wallet management through WalletConnect contribute to a complete and user-friendly experience.

In conclusion, GreenChain represents an important step towards a more sustainable future by showing how technological innovation can be applied to foster ecologically responsible behaviors. It serves not only as a practical tool for users to track and be rewarded for their environmental efforts but also as a model for how technology can play a crucial role in addressing global sustainability challenges. The platform successfully creates a community of users who are more conscious of their environmental impact and motivated to contribute to a greener planet.

The entire app is available on github: https://github.com/SanduD/GreenChain.

REFERENCES

[1] R. Zhang and W. K. (Victor) Chan, "Evaluation of energy consumption in block-chains with proof of work and proof of stake," *J. Phys. Conf. Ser.*, vol. 1584, no. 1, p. 012023, Jul. 2020. doi:10.1088/1742-6596/1584/1/012023

[2] S. Haber and W. S. Stornetta, "How to time-stamp a digital document," *J. Cryptology*, vol. 3, no. 2, pp. 99–111, Jan. 1991. doi:10.1007/BF00196791

[3] S. Nakamoto, "Bitcoin: A peer-to-peer electronic cash system," *Satoshi Nakamoto Institute*, Oct. 2008. [Online]. Available: https://nakamotoinstitute.org/library/bitcoin/.

[4] V. Buterin, "Ethereum: A next-generation smart contract and decentralized application platform," *Ethereum*, 2014. [Online]. Available: https://ethereum.org/content/whitepaper/whitepaper-pdf/Ethereum_Whitepaper_-_Buterin_2014.pdf.

[5] "The ERC-20 token standard," *Base Documentation*. [Online]. Available: https://docs.base.org/learn/token-development/erc-20-token/erc-20-standard.