Watt Wallet: A Blockchain-Enabled Decentralized Marketplace for Renewable Energy Credits with AI-Driven Predictive Analytics

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Keywords: Decentralized Energy Management, Dual-Currency System, Tokenized Consumption, AI Sales Prediction, Secure Ledger Tracking.

Abstract: The decentralized platform WattWallet uses dual-currency methodology to modernise Renewable Energy Credits (RECs) management and tokenized energy consumption handling. WattWallet builds its platform with Next.js version 15.0.3 as its dynamic frontend together with MongoDB Atlas as a cloud NoSQL database service, Prisma for safe data operations and secure authentication provided by Clerk. WattWallet operates with two different payment forms including Credits purchased through simulated cash while users acquire Energy Tokens (ETs) by spending Credits. Users can power fans, lights, televisions along with other appliances through WattWallet using Energy Tokens which run out at a dedicated rate of one token per five seconds of operational time. All financial data together with energy information gets recorded on an advanced ledger system through hashed database entries to guarantee security and maintain visibility. WattWallet implements a sales prediction system enabled by an AI module which operates with the Random Forest algorithm to analyze data. Operational forecasts of future sales metrics reach 87.3% to 94% accuracy levels through historical transaction data processing by the predictive engine. By leveraging sales forecast data administrators obtain capabilities to take proactive inventory decisions while distributing resources effectively to make strategic assessments. WattWallet provides an advanced solution toward sustainable energy management by implementing decentralized transaction tracking combined with dual-currency operations together with future sales prediction capabilities.

1 INTRODUCTION

Modern technologies combined with environmental stewardship have always been resulted in innovative digital platforms because the global community prioritized sustainable energy practices and renewable resource management. The handling systems for Renewable Energy Credits (RECs) experience difficulties because they present bureaucratic obstacles alongside unclear processes and reduced customer participation. WattWallet functions as an advanced decentralized system which transforms traditional REC management by bringing together web technology elements with blockchain transaction functions while using predictive analysis methods.

WattWallet supports payment transactions using its dual-currency platform to maintain clear visibility for energy management functionalities. The platform functions using Credits together with Energy Tokens (ETs) as virtual currency. Users in WattWallet generate Credits through digital cash transactions between their user base for their primary financial operation. Users can exchange Credits into Energy Token payments when they need to charge digital applications for power utilization. Every time a user activates a virtual device like fans lights or televisions by using Energy Tokens the operating duration requires one token which gets deducted during active usage. The operating system on the platform uses actual user energy habits to track energy usage while enhancing efficiency through clear visibility into usage metrics. The platform follows an essential design principle based on clear design combined with a single-color palette and transparent navigation elements that deliver smooth movements to increase user interaction. MongoDB Atlas functions as the cloud-based NoSQL database to provide flexible storage solutions for whole system information

Dhanush, D., Baladitya, V., Jaswanth, P., Kritin, T., Ramasamy, G. and M., G.
Watt Wallet: A Blockchain-Enabled Decentralized Marketplace for Renewable Energy Credits with AI-Driven Predictive Analytics.
DOI: 10.5220/0013904400004919

In *Proceedings of the 1st International Conference on Research and Development in Information, Communication, and Computing Technologies (ICRDICCT'25 2025) - Volume 3*, pages 718-728
ISBN: 978-989-758-777-1

ranging from user profiles to wallet balances to transaction histories and product details. The application uses Prisma as its type-safe ORM layer to link with MongoDB and ensure data type enforcement and avoid runtime mistakes. Clerk serves as secure user management and authentication through WattWallet by offering dependable and streamlined identity management account protection solutions.The decentralized nature of WattWallet is further emphasized through its blockchain-inspired ledger system. Every transaction whether it is the purchase of Credits, the conversion to Energy

Tokens, or the buying and selling of products within the platform is recorded in a secure, hashed ledger. This immutable record ensures full transparency and auditability, which are essential for maintaining trust in a decentralized marketplace. A centralized Bank module oversees the overall supply of both Credits and Energy Tokens, starting with a fixed reserve (10,00,000 Credits and 10,00,00,000 Energy Tokens) and facilitating continuous conversion based on predefined rates (10 tokens equating to 1 Credit).

The primary features of WattWallet stand out through its combination with artificial intelligence (AI) that works to improve business intelligence alongside operational efficiency. The model uses Random Forest algorithms to forecast future sales trajectories with the combination of historical transactions and time-patterns with user metrics. This AI module provides administrators with sales prediction capabilities amounting to 87.3% to 94% accuracy which helps optimize inventory management alongside strategic decision-making. The AI-based sales prediction system delivers live market data which serves as an essential planning instrument and resource allocation tool for the platform.

WattWallet delivers an inclusive solution which integrates decentralized transaction management with dual-currency operation alongside analytics predictions for renewable energy management system development. The integration of advanced web technologies with blockchain principles and machine learning makes WattWallet capable of maintaining efficiency and also providing proper transparent accountable solutions to the modern digital world.

2 LITERATURE SURVEY

The Energy Community Platform (ECP) operates through modular architecture to process advanced big data and blockchain features for better sustainable energy usage in local energy communities. The Energy Community Data Platform (ECDP) collects and analyzes energy consumption information whereas the Energy Community Tokenization Platform (ECTP) utilizes smart contracts to benefit users with tokenization systems. The platform delivers flexible operation along with cryptographic data protection and effective solutions to match energy information with its users.

The driving force behind economic expansion known as digital transformation makes use of AI and IoT and data analytic technologies to boost both organizations and customers. The paper by Bhuiyan et al. (2024) shows that digital tools drive innovation along with business process enhancements and sustainable solution development specifically for startups and SMEs in developing economies. Low digitalization and insufficient infrastructure remain difficulties even though the research supports digital literacy development and supportive digital environments.

Buna Africa serves as an electronic platform that supports small fish farmers while managing their data submissions to official government departments. Users benefit from a sustainable aquaculture environment on this platform because it offers features enabling real-time messaging along with production calculators and health diagnostics. The platform has a design framework that focuses on users to create easier interactions for illiterate audiences while accelerating digital aquaculture progress throughout rural African communities.
Prasad (2018) established a decentralized marketplace application on Ethereum blockchain to solve marketplace problems such as high costs and privacy deficits and discriminatory practices. The application utilizes smart contracts together with interplanetary file systems to execute cost-efficient secure transactions autonomously on the Rinkeby test network.

Sánchez (2024) introduce a blockchain market solution that enables fair payment for manufacturing data through privacy-friendly methods and represents data using NFTs. The model fills essential gaps present in data market centralization through elimination of unfair data access and inefficient payment practices while improving transaction outcomes regarding transparency and speed and data reliability.

The research conducted by Srinivasan (2024) investigates AI forecasting for sales through CRM systems while employing machine learning functionalities that include natural language processing and deep learning applications. AI demonstrates its capability to enhance sales process

optimization and resource management while improving user interaction according to the research findings.

The authors Delardas and Giannos (2023) present a study about blockchain-based renewable energy certification solutions while tackling Guarantees of Origin trading issues. Through blockchain technology companies gain better transparency while systems self-track and deliver logged records that show any attempted modification thus stopping instances of greenwashing. The major obstacles in the way of progress stem from compatibility limitations and regulatory requirements.

Akiladevi (2024) develop a blockchain network system that tokenizes energy resources while improving market security and operational efficiency and asset transparency. The implementation of blockchain technology depends on developing effective rules because it faces technical barriers and regulatory complexities to reshape energy asset management.

Zuo (2022) describes a blockchain platform which serves as an issuance center for Renewable Energy Certificates followed by trading and verification functionalities. This platform reduces business expenses and it maintains permanent transaction logs through tokenization features which removes dependency on intermediaries. This research identifies scaling restrictions and regulatory hurdles together with establishing the capability of private blockchains for this system.

The tutorial presented by Satheesh (2015) covers how to construct web applications from end to end with MongoDB and Node.js by demonstrating RESTful API creation through Express.js as well as NoSQL database adjustments and cloud deployment capabilities (O. Delardas and P. Giannos., 2023). The tutorial demonstrates how contemporary technology stacks function practically and at scale (O. Delardas and P. Giannos., 2023).

3 METHODOLOGY

The creation of WattWallet moves through distinct developmental periods to advance its fundamental elements of the system. The methodology provides a complete view of the development sequence that includes building both front-end and back-end systems while integrating blockchain technology and designing databases and energy token systems and e-commerce capabilities and integrating an AI-based sales forecasting module.

3.1 System Architecture Overview

3.1.1 Platform Components

User Module: The end users interact through this module to access the platform. Customers access a complete management platform that enables wallet control and currency trades next to product purchases and appliance operation. The interface system follows usability standards as well as present clear information while its secure authentication system protects data access for authorized users.

Admin Module: Platform administrators use this module to maintain complete system operation control. The interface gives administrators tools to track system performance while reviewing transaction logs and user engagement and examining power use behavior for better assessment of system efficiency. The software uses artificial intelligence (AI) prediction to help administrators plan strategically by forecasting sales and managing inventory.

Bank Module: Through its operations the Bank Module controls the circulation of both system currencies between the economy and the players. The Bank Module operates with defined rates to facilitate conversions between its reserved Credits and Energy Tokens. The Bank Module manages both monetary supplies from a fixed reserve and continually adds tokens to the system. Automatic transactions and permanent ledger entries are another responsibility of this module.

3.2 Frontend Development

3.2.1 Framework and Core Technologies

Next.js Framework: The platform runs on Next.js version 15.0.3 for its foundation that enables server-side rendering and static site generation features. Next.js (version 15.0.3) enables fast loading along with better SEO performance and provides responsive functionality to improve UX.

Responsive Design: The user interface has responsive design elements that transform its layout and functions to operate across multiple device sizes such as desktops, tablets and smartphones. The display changes according to screen size through implementations of flexible layout techniques combined with media queries.

3.2.2 User Interface and Visual Design

Minimalist Aesthetic: The user interface adopts minimum design principles and implements a solitary color palette. Elegance combined with professionalism results from minimal presentation design made up of clean definition lines and lots of white space alongside transparent navigation panel elements.
Smooth Animations and Transitions: A series of smooth animations gender transitions improve user interaction capabilities in the design. Brown University Website fosters a better user experience through its visual effect feedback system which responds during button clicks and page shifts.

3.2.3 Authentication and Session Management

Secure Authentication: The system integrates an authenticated third-party service to manage user registration processes as well as both logins and additional authentication methods. The system safeguards user data together with access-limiting its functionality to authorized users.
Session Persistence: User sessions stay active on the platform thus users can move between application pages without requiring separate logins. The system keeps active sessions which lead to unbroken and easy-to-use operation.

3.3 Backend Development

3.3.1 Server Environment and API Development

Node.js and Express.js: The development of the backend uses Node.js as its runtime environment in combination with Express.js to build its RESTful APIs. Through their integration Node.js and Express.js create a flexible system that effectively operates many simultaneous requests.
Middleware and Security Measures:API systems implement middleware functions which fulfill tasks for validation, error management and security regulation. The measures implemented by middleware functions protect both the security of data processing operations and the operational efficiency of APIs.

3.3.2 Database Integration and Data Management

MongoDB Atlas: The solution employs MongoDB Atlas to serve as its cloud-based NoSQL database system. MongoDB Atlas provides an elastic storage system which allows users to store different types of data from user profiles to wallet balances to transaction records to product details.

3.3.3 Prisma ORM

Prisma functions as a typed Object-Relational Mapping tool to connect the application with MongoDB through proper data representation. The tool provides strong data management and strict data type rules to protect against errors.

3.3.4 Data Schema Design

The database has several collections which organize its schema.
- User profiles together with authentication information and wallet references are stored in the Users collection within the database.
- Each record inside the Wallets collection contains individual entry points for tracking both Credits and Energy Tokens of each user alongside Bank records.
- Every transaction has its own unique hashed identifier and timestamps together with the details of both sender and receiver and amounts within the Transactions collection.
- The Products collection maintains complete descriptions of all e-commerce section products.

3.4 Ledger and Transaction Management

Immutable Ledger: All deals conducted on the platform get permanently saved to an unalterable record. The record contains a hashed transaction identifier together with sender and receiver information and transaction amount, currency type and timestamp. Championed by blockchain concepts this method delivers absolute transparency as well as trust to users.
Transaction Workflows: Real-time transactions and product purchases together with currency conversions and energy token deductions happen automatically. Detailed sequence-based log recordkeeping enables full auditing activities along with immediate identification and resolution of any detected errors.

3.5 Blockchain Integration and Energy Tokenization

3.5.1 Dual-Currency System Mechanics

Credits: The platform features Credits as its main operational monetary unit. The platform generates credits by duplicating actual financial transactions which then function as the core unit for all future transactions. The platform uses Credits as its primary payment method for acquiring Energy Tokens together with access to other system features.
Energy Tokens: The operational units that enable virtual appliances function are called Energy Tokens. Users need to exchange Credits into Energy Tokens according to a fixed conversion ratio like obtaining 10 Energy Tokens per 1 Credit. The utility tokens get reduced the moment appliances start operating as a realistic representation of energy usage.
Automated Rules for Transactions: Smart contract-like automated rules control the conversion of Credits to Energy Tokens as well as the deduction of tokens during appliance operation and all transactions. All financial activities remain consistent and accurate due to the execution of governing rules.

3.5.2 Bank Module Operations and Currency Replenishment

Initial Currency Reserves: The initial establishment of the Bank Module contains a defined and fixed pool of Credits and Energy Tokens to support the dual-currency framework. The platform's transaction liquidity stays fully funded by the reserves that were established before operations began.
Automated Replenishment: The system performs automatic replacement of minimal Credits and Energy Tokens amounts during scheduled intervals to sustain operational continuity. The system maintains an automatic process of replenishment which allows users to maintain continuous transaction capabilities.

3.6 e-Commerce Integration

3.6.1 Product Catalog and Storefront Management

Management of Product Information: All product details with descriptions together with pricing information and images reside inside the database system. This system features a product catalog design which enables easy addition of new items whenever necessary.

User-Friendly Store Interface: Founded with a focus on user convenience the storefront shows its products through an organized format where users can choose items with Credits. The product pages contain all required information needed for customers to make well-informed purchases.

3.6.2 Transaction Processing in the Store

Payment Processing and Currency Deduction: When a user makes a purchase the system takes Credits directly from his wallet in the amount needed for the transaction. The Bank Module handles the conversion process for Credits and Energy Tokens when such conversions are needed.
Verification and Recording of Transactions: The system immediately confirms each purchase before writing it permanently to the unmodifiable ledger. Leer coin tracks all financial movements accurately while simultaneously updating stock levels.

3.7 AI-Driven Sales Prediction Module

3.7.1 Data Collection and Preprocessing

Aggregation of Data Sources: AI gathers historical purchase information stored in the ledger system which contains information about volumes, timestamps, user activities and product classification. Background data about seasonal cycles and promotional activities is part of the gathered information.
Data Cleaning and Normalization: The dataset undergoes a thorough cleaning process which eliminates inconsistencies together with outliers. The normalization techniques enable data scaling which makes the training data ready for modeling.
Feature Engineering: The processed raw data creates new features which enhance the model performance. The data contains several additional features comprising moving average calculations, time series patterns, and categorical categories, together with statistical aggregates that identify basic patterns in the information.

3.7.2 Random Forest Model Specification and Configuration

Choice of Algorithm: A Random Forest algorithm functions as the selected method because it preserves robustness within non-linear relational structures. The method employs ensemble learning which integrates several decision trees for developing precise and stable forecast results.

Hyperparameter Tuning: During the model configuration process the parameters include 100 decision trees and a maximum depth that spans between 10 and 20 layers. The predictive model uses fixed random state parameters together with feature subsampling to maintain high consistency and reduce overfitting issues.
Performance Evaluation: The assessment process includes evaluation metrics composed of accuracy and Mean Squared Error. The experimental outcomes demonstrate that the prediction accuracy of the model reaches between 87.3% and 94%.

3.7.3 Model Integration and Deployment

API-Based Deployment: The platform operates through an API endpoint which accepts input data then processes it with the Random Forest model and returns predicted sales together with confidence measurements.
Integration with the Admin Dashboard: The AI model shows its generated predictions through the Admin Dashboard so administrators can view live sales forecasts. The inventory management and marketing strategies benefit from this information by enabling proactive decision-making.
Continuous Model Improvement: The model receives regular updates through new transaction data to maintain accurate forecasting capability during the period. The ongoing improvement method enables the platform to respond effectively to market transformations and changes in user conduct.

3.8 Testing, Evaluation, and Quality Assurance

3.8.1 Unit Testing

The platform tests each separate portion such as frontend components and backend APIs and database operations to confirm their correct functionality.

3.8.2 Integration Testing

A set of extensive testing procedures checks how the entire platform modules perform together smoothly with the user interface alongside backend services and database operations and ledger recording elements.

3.8.3 End-to-End Testing

The whole workflow gets verified through simulations that start with authentication then continue through wallet management and transaction execution and product purchase processing. The tests provide valuable information about possible problems that could occur in practical usage.

3.8.4 Performance and Load Testing

High volume transaction tests are applied to the platform to ascertain its performance times and throughput levels as well as its ability to scale. WattWallet maintains peak performance during high-volume periods as part of its testing procedures.

3.8.5 User Acceptance Testing

The system's usability and functionality together with user experience receive feedback from a user and administrator testing group. The platform's functionality is enhanced through analysis of collected user feedback.

3.8.6 Continuous Monitoring and Maintenance

System performance together with security events and transaction integrity is monitored by real-time tools after the system goes live. A set of scheduled maintenance routines together with fast response strategies guarantee platform durability throughout time.

3.9 Deployment and Future Enhancements

3.9.1 Deployment Strategy

The platform runs on a secure cloud-based system which provides both high scalability and security along with reliability. CI/CD pipelines provide smooth update and maintenance procedures through their continuous integration and continuous delivery capabilities.

3.9.2 Monitoring and Operational Support

The monitoring systems consist of detailed mechanisms that monitor system performance and user interactions in real-time fashion. The systems use alerts to detect rapid issues and quickly resolve them.

3.9.3 Future Enhancements

The roadmap for further system enhancement contains two parts: first, investigating two-stage blockchain protocols to boost transaction speed

alongside selecting alternative blockchain ecosystems and second, improving AI algorithms through additional database inputs and enhancing AI characteristics while implementing smart technology monitoring systems and developing electronic commerce beyond its current limitations through forming collaborations with green energy suppliers.

4 IMPLEMENTATION AND RESULTS

4.1 User Implementation Overview

The analysis of Apple's policy concerning WattWallet platform included understanding both innovative technologies and their application toward creating energy tokenization and REC marketplace. The frontend development required the selection of Next.js which enabled the tool to build a flexible responsive layout for the webpage. The user authentication employed Clerk Authentication because users would need the ability to conduct transactions or payments through the internet. Node.js and Express.js were used for building the backend with MongoDB Atlas for storing user information together with their transaction history and energy token counts and product data through Prisma ORM.

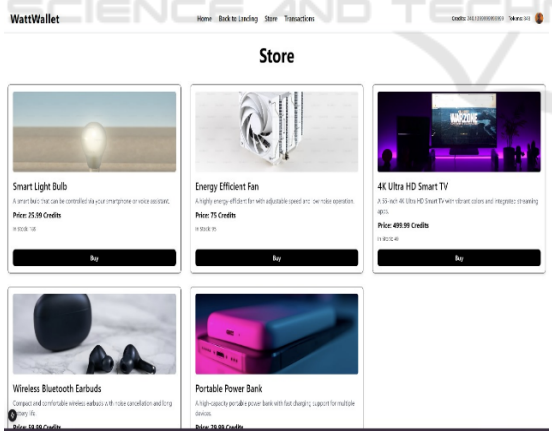

Figure 1: User dashboard: displaying credit and energy token balances, active appliances.

Users could buy credits from the platform through disposal of Energy tokens to obtain Credit tokens. Users can calculate their energy usage by converting energy tokens through devices such as lights, televisions and fans that use these tokens as measurement units of energy consumption. The Smart Contracts implemented token exchange policies based on blockchain principles. Ahead of every transaction execution on the platform which encompasses energy token purchases and sales and product acquisition the system generates appropriate transaction records to uphold platform integrity. Figure 1 shows the User Dashboard: Displaying Credit and Energy Token Balances, Active Appliances.

The system performed testing through the processes of buying tokens and credits and operating appliances like the fan and the light and television. The frontend interface of this application joined with the user's request system to provide access to wallets and purchase energy tokens as well as manage appliances. The assessment found that energy usage was properly handled since tokens detached from appliances based on their operating duration. The store processing mechanism let users accumulate credits through purchases after which all data was properly entered into the ledger.

The system achieved its target of uniting e-commerce functionality with energy tokenization operations at an effective level. Users viewing this dual-currency system environment can operate inside marketplace framework to buy products and control their energy usage. Security of all transactions became possible through the decentralized block chain ledger which functions as an impenetrable database containing every conducted action. MongoDB proved to be a beneficial data storage solution and using Prisma ORM resulted in an easy to manage database system which would support expansion in future developments.

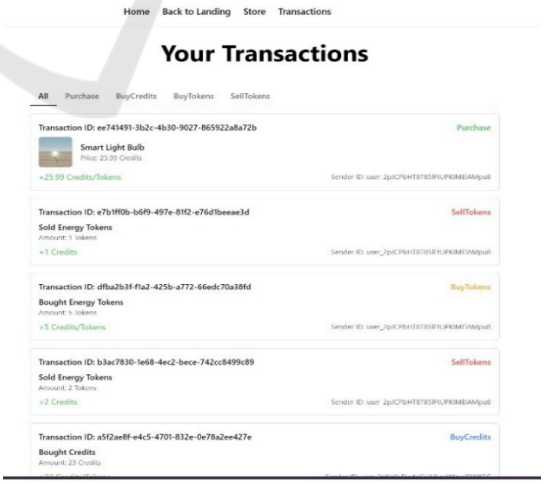

Figure 2: User dashboard: display of transaction history.

Figure 2 shows the User Dashboard: Display of transaction history. Very few obstacles emerged during the implementation attempts. Clerk

Authentication demanded a unique method for dealing with user data alongside resolving every workTestData connection to the appropriate owner during user sign-in process streamlining. Testing and further refinement of the proposed learner support system for the dual–currency system must follow since its implementation needs more pilot sessions to achieve smooth operation for learners in their particular scenarios beyond insufficient energy tokens or credits.

4.2 Admin Implementation Overview

Platform administration through the Admin Dashboard brings administrators a complete interface to handle management functions while monitoring token deals and tracking utility usage statistics. The dashboard operates under the Next.js framework for delivering consistent performance during administrative activities through an elegant user interface. Administrators can use the dashboard to access an AI model which delivers sales predictions for the upcoming 100 days because it enables better decisions.

User Management: The User Management module shows administrators a thorough set of user profiles that display energy token account data alongside entire transaction records and active account indicators. This module enables efficient oversight functions by providing administrators with quick access to resolution of any arising issues. The dashboard presents two options to administrators for account enforcement after unusual user behavior is detected through its monitoring features. A graphical user interface on the module shows both a comprehensive list of all users together with essential data which enables administrators to assess their user base efficiently as they detect and respond to unpredictable events.

Transaction Overview: The platform provides real-time Transaction Overview data about all the transactions happening through its system. Users can execute three types of transactions through the platform: buying energy tokens along with selling products and effecting credit transfers. Transaction administrators can read complete transaction records which get safely stored in both secure storage and provide quick retrieval. This module allows administrators to verify transaction statuses so they can confirm all operations progress as intended by platform policies. Transaction record storage with security guarantees both supports financial accountability along with generating a path of evidence that can be used for future audits.

Energy Consumption Monitoring: Production of energy consumption data from all users forms the core function of Energy Consumption Monitoring. The module delivers an extensive record of energy token utilization through comprehensive usage patterns with the capability to detect inefficient energy consumption areas. Energy tracking practices depend heavily on visualization software which shows administrators easy-to-interpret trends and daily energy consumption ratesImportant insights allow administrators to manage token distribution more effectively while simultaneously developing energy-conservation strategies for the platform.

Platform Analytics: A single dynamic dashboard through the Platform Analytics module presents major performance indicators to users. The Platform Analytics module presents three essential metrics that consist of active user numbers, total energy token exchanges as well as transaction volume statistics. Administrators can use interactive filters to split data into different timescales and user categories which produces highly detailed information about platform wellness. Through the analytics module administrators achieve three objectives by evaluating strategy performance and uncovering enhancement opportunities and directing forthcoming growth.

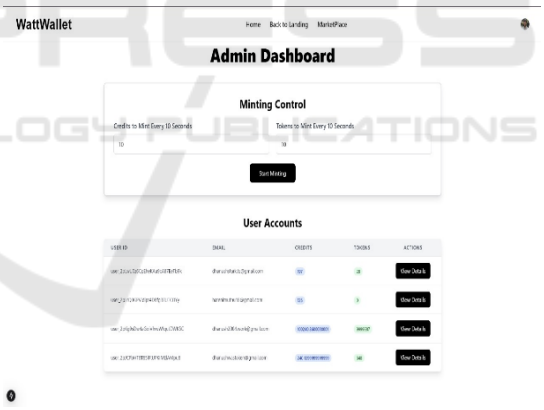

Figure 3: Admin dashboard with user accounts.

Sales Prediction (AI Model): The primary function of the Admin Dashboard includes its AI-based sales prediction module capability. This module implements Random Forest classifier technology to conduct sales predictions for the following 100 days. The AI system evaluates previous sales patterns together with present platform behavior by processing data that includes historical sales records while taking into account historical trends and seasonal patterns and user interactions. The system shows regular updates of prediction results through its graphical presentation format for

easy understanding of forecasted data. The sales forecasts generate meaningful outcomes which help administrators make better choices for their inventory management as well as resource distribution and promotional strategies. Figure 3 illustrates the Admin dashboard with user accounts.

Security and Data Management: The sensitive information within the Admin Dashboard receives authentication protection through Clerk Authentication platform. The authentication procedure exists to limit entry to authorized staff members who protect operational information and user-sensitive information. The platform utilizes Prisma ORM together with MongoDB to streamline its data management operations. The simultaneous use of Prisma ORM with MongoDB provides both effective data storage and retrieval together with superior level data performance standards. High-load situations do not affect the dashboard operation because the backend infrastructure is strong enough to support its smooth operation. Figure 4 shows the Admin's Display of a particular User's transaction history.

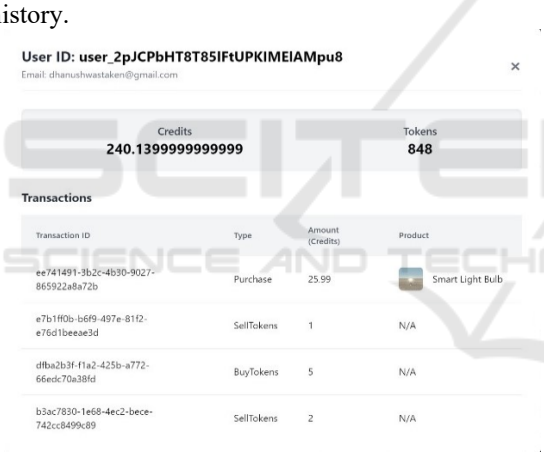

Figure 4: Admin's display of a particular user's transaction history.

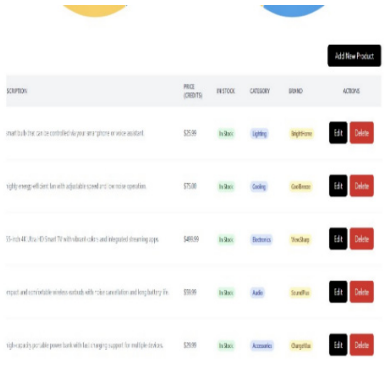

Figure 5: Schematic flow of theoretical structure.

Figure 5 depicts the Schematic Flow of Theoretical Structure. All crucial functions for platform administration exist as a unified experience within the Admin Dashboard system. User management along with transaction monitoring and energy consumption analysis and predictive analytics capabilities that the dashboard delivers are fundamental elements which make the WattWallet platform maintain its integrity security and operational efficiency. The platform achieves enhanced strategic value because its AI capabilities enable administrators to identify future trends and optimize resource use for continuous operating improvements.

4.3 AI Model

The analysis of Random Forest classifier relied on synthesized energy token transaction and sales patterns to develop a training dataset for evaluation purposes. The created synthetic data included characteristics that would normally exist in genuine transactional records. We used 100 samples which included 5 features per sample while the target variable contained two classifications for binary prediction (such as forecasting sales events).

The analysis assigned 80% of the data to model training purposes while the remaining 20% served to evaluate performance. Testing the performance of the classifier required this separation method to determine its extrapolation capacity with new data points. The model reached 93% accuracy after its training phase while processing test samples. The model demonstrates strong capability for extracting hidden patterns in synthetic data because it shows high accuracy rates.

Through the confusion matrix we received additional assessment of the model's effectiveness by showing how correctly and incorrectly classified data distributions appeared. There were minimal classification mistakes on the test samples while most of the data points received precise predictions according to the results. The classification report included precision and recall and F1-score measurements which confirmed a dependable prediction system that effectively represented both classes.

The entire training process of the model happened exclusively with synthetic information. A controlled environment enabled simulation of expected features and data patterns which would naturally occur in the WattWallet platform. Future implementation will train and validate the model with actual transactional data obtained from the platform while using synthetic data to derive initial promising results. The evaluation

of genuine platform dataset will lead to model optimization for stronger performance in actual sales forecasting and business decision-making scenarios.

The trial of Random Forest classifier with synthetic data shows natural performance whereby the accuracy reaches an approximate 93% (figure 6 shows the confusion matrix). The positive metrics demonstrate that this AI model delivers important understanding of sales patterns which can help WattWallet implement effective inventory management strategies and strategic business planning options. A strong proof-of-concept that uses these initial results enables future development which will enhance real-world testing potential.

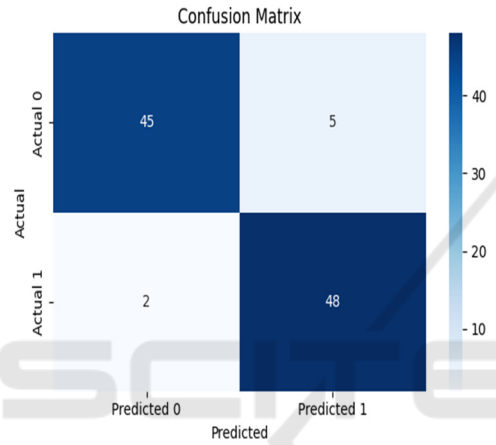

Figure 6: Confusion matrix.

5 CONCLUSION AND FUTURE WORKS

Research develops a blockchain-powered decentralized trading marketplace utilizing AI to enhance operational efficiency of energy management along with better sales prediction. Users can perform safe and efficient energy trades through the system because it combines dual-currency operations with smart contract tokenization along with a clear view of all transaction records. The Admin Dashboard enables simple transaction monitoring together with energy consumption tracking and user behavior surveillance while the AI-based sales prediction model gives important information about future energy deals to optimize resource use. The platform succeeds at minimizing costs and promoting energy efficiency but its developers need to improve the AI forecasts through enhanced model accuracy and work on interface design to create a better user experience to help achieve wider scalability.

The approach for future work involves optimizing blockchain efficiency through analysis of layer 2 solutions and alternative blockchain networks to handle transactions and real-time information better. The development of the AI sales forecasting model requires additional variables along with IoT integration for instant energy monitoring and complete regulatory adherence implementation. The platform will gain market expansion through increased token liquidity and energy provider collaborations together with better user experience features from enhanced interaction and feedback implementation. Long-term platform success in promoting sustainable energy usage together with renewable energy solutions will be improved through these developments.

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