TrashTreasury

1st Sanket Makh
Computer Engineering
Pune Institute Of Computer Technology **Pune, India**

2nd Manasi Kamath
Computer Engineering
Pune Institute Of Computer Technology **Pune, India**

3rd Kedar Koshti
Computer Engineering
Pune Institute Of Computer Technology
Pune, India

4th Shivani Yadav
Computer Engineering
Pune Institute Of Computer Technology
Pune, India

5th Nikita Kapadnis
Computer Engineering
Pune Institute Of Computer Technology
Pune, India

***Abstract*—TrashTreasury offers an innovative way to use a reward-based system to encourage safe garbage disposal in response to the growing worldwide waste management challenge. With the use of waste bins with sensors, our suggested system would utilise blockchain technology to create a reward system that can automatically identify and classify the type of garbage disposed of while also weighing it. Subsequently, the gathered data is smoothly transferred to a cloud-based platform, where a specialised programme analyses it to ascertain the right compensation for the user, taking into account the kind and volume of waste. This cutting-edge waste management system offers a comprehensive response to numerous urgent problems. It facilitates efficient recycling procedures and responsible disposal practices by precisely identifying classified garbage. The procedure is made user-friendly and efficient by the incorporation of sensor technology, which does away with the need for manual sorting and weighing. Moreover, real-time data analysis made possible by the cloud-based architecture enables prompt incentive distribution and feedback. By incentivizing people and communities to actively participate in sustainable waste management methods, the incentive system helps to mitigate the environmental damage caused by inappropriate disposal. In conclusion, our proposed model presents a thorough strategy for trash management that combines innovative technology with user incentives to promote ethical and environmentally friendly behaviour. This cutting-edge technology has the power to transform how garbage is disposed of, slow down environmental deterioration, and build a more sustainable and clean future.**

***Index Terms*—Blockchain, Smart Contracts, Reward System, Traceability, Transparency, Waste Management, Machine Learning, sustainable waste management, Cloud, Token-based incentive systems,Tokenomics, Blockchain governance models, Decentralised systems, Sustainability aspects of BCT, Social impact of BCT**

I. Introduction

One of the most important aspects of keeping the environment clean and sustainable is managing solid waste. Reward-based programmes have drawn notice recently as creative ways to promote ethical recycling and garbage disposal. These programmes provide incentives or rewards for managing garbage responsibly in an effort to encourage people and communities to get involved in waste management activities.

The notion of smart cities has surfaced, providing a route towards sustainability; yet, solid waste management (SWM) has come to light as a domain that necessitates substantial technical advancement in order to tackle the problems associated with trash generation and its ecological aftermath. The various tasks that make up SWM, such as data analysis, recycling, disposal, and waste collection and transportation, are essential. To fully utilise waste through reuse and recycling, careful recording and monitoring of these processes are necessary for effective management. Unfortunately, the absence of accurate data on garbage types and volumes makes it more difficult for local administration to handle waste efficiently, which hinders environmental conservation.

Researchers have looked into a number of hardware and software solutions in an effort to address these urgent issues. These days, cloud servers and the Internet of Things (IoT) have become major players in SWM, with the goal of reducing the environmental impact of large-scale waste production. However, these technologies have drawbacks that restrict involvement in the monitoring of SWM activities, particularly with regard to data security and authentication. Furthermore, there's a growing consensus about the necessity of an all-encompassing platform capable of bringing together all the different SWM stakeholders in order to effectively simplify waste management.

The technology behind digital currencies like Bitcoin, known as blockchain, is a distributed, peer-to-peer, immutable record that is decentralised and allows for safe and transparent transactions where each transaction is verified by the majority of participants. By developing new business models for regenerative finance and streamlining and improving waste management processes, the application of blockchain technology to create a token-based reward system has the potential to transform the industry. The purpose of this review paper is to examine all studies, publications, and expeditions that use blockchain technology to create a real-time incentive

programme for people who properly dispose of their waste in approved bins.

This Blockchain-based business and governance model for philanthropy uses blockchain technology to enable secure and authenticated reward system transactions, thereby revolutionising the waste management industry. It takes into account a number of factors, including the amount of waste deposited, the current price set by the administrator for a particular type of waste, and whether or not the waste is properly segregated.

II. Problem Statement

Develop a model that utilizes innovative technology to incentivize and reward individuals for proper waste disposal practices. The modal aims to encourage active participation in waste management initiatives by offering incentives, such as discounts, vouchers, or loyalty points, to individuals who consistently adhere to proper waste disposal guidelines. By integrating rewards into the waste management process, the modal seeks to promote environmental sustainability, improve community cleanliness, and enhance the efficiency of waste collection and disposal systems.

III. Proposed Methodology

The model aims to develop a system that provides the user with following functionalities

Data Collection: Gather data on waste disposal, including the type and quantity of waste collected, through various means such as municipal waste management systems, waste collection agencies, and community clean-up initiatives.

Segregation and Input: Segregate the collected data based on waste type (e.g., recyclable, organic, non-recyclable) and input it into the proposed module, ensuring accuracy and completeness of the data.

Database Integration: Establish a database system to store the collected data related to garbage disposal. Utilize relational database management systems (RDBMS) or NoSQL databases to efficiently manage and organize the data.

Reward Calculation: Develop algorithms within the module to calculate rewards earned by individuals based on their contribution to proper waste disposal. Consider factors such as the type and quantity of waste disposed of properly, frequency of disposal, and adherence to waste management guidelines.

Blockchain Integration: Implement blockchain technology to securely store the calculated rewards. Utilize smart contracts to automate reward distribution and ensure transparency and immutability of reward transactions.

Redemption Option: Provide users with the option to redeem their accumulated rewards at the time of tax payment. Integrate a user-friendly interface within the module or a dedicated platform where users can view their rewards, choose to redeem them, and track their redemption history.

A. The Following are the modules:

1. Data Collection Module:

Description: This module is responsible for gathering data from IoT sensors installed in waste collection bins and other relevant sources. The collected data includes information about the type and quantity of waste collected. This data is sent to the backend for reward calculation. Sensor equipped bins are installed with a camera which also captures real-time images of waste disposal. This data is fed to the machine learning model for classification

Functionality: It collects real-time data on waste disposal activities, such as the weight of waste collected, the type of waste (recyclable, organic, non-recyclable), and location-based information.

Output: The collected data is processed and formatted for input into the Machine Learning module for further analysis and insights.

2. Machine Learning Module:

Description: This module utilizes machine learning algorithms to analyze the collected data and generate insights. It provides detailed information about the types and quantities of waste collected, trends over time, and patterns in waste disposal behavior.

In our system, CNN is used to create an image classifier that recognizes items and classifies trash material. A sequential CNN model is created using Keras. Convolutional layers with ReLU activation and MaxPooling are added. Dropout layers are used for regularization to prevent overfitting. Dense layers with ReLU activation are added for classification. Sigmoid activation is used in the final layer for binary classification. The model is compiled with binary cross-entropy loss and Adam optimizer. Training is done for a specified number of epochs (8 in this case).Test images are loaded and passed through the prediction function to classify them.

Functionality: By applying machine learning techniques, such as clustering and classification, it identifies patterns in waste disposal activities and provides valuable insights to stakeholders.

Output: The module presents insights through visualizations, statistical summaries, and reports, facilitating informed decision-making regarding waste management strategies.

3. Reward Calculation Module:

Description: This module is responsible for calculating rewards earned by individuals based on their contribution to proper waste disposal practices. A mathematical formula has been created which takes into account the type and amount of waste along with user behavior.

Functionality: It applies a predefined formula, determined by backend logic, to calculate rewards considering factors such as the type and amount of waste disposed of properly and adherence to waste management guidelines.

Output: It generates reward amounts for each user, which are stored securely for redemption at a later stage.

4. Reward Redemption Module:

Description: This module facilitates the redemption of rewards earned through proper waste disposal practices during

tax payment.

Functionality: Users are provided with an option to redeem their accumulated rewards as a discount while paying taxes. The module integrates with tax payment systems to allow users to apply their earned rewards towards tax payments.

Output: Users can choose to utilize their rewards at the time of tax payment, reducing the amount they owe based on the redeemed reward value.

IV. Workflow

1) User registers on the website and creates an account.
2) Waste disposal bins are equipped with IoT devices such as sensors and cameras.
3) Sensors calculate the weight and level of the garbage.
4) The camera takes a picture of the garbage collected and sends it to an ML-based classifier.
5) The ML model classifies the garbage collected into categories like organic/inorganic.
6) Parameters such as the amount of waste, type of waste, and user behavior are used to calculate reward points.
7) Reward points are added to the user's account.
8) Users can access these points and redeem them to avail certain tax benefits, thereby reducing the amount coinciding with the value of points earned.

V. Screenshots

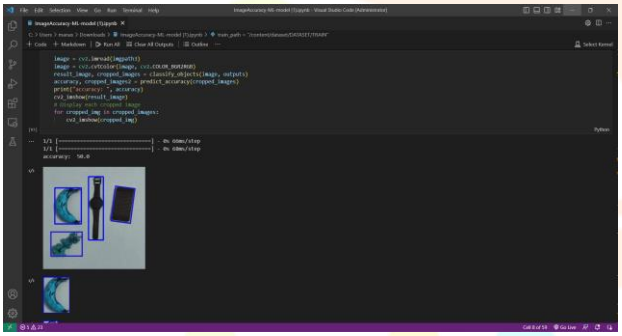

Fig. 1. Output given by ML model

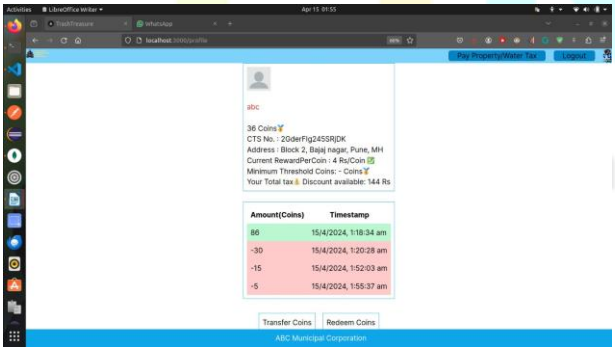

Fig. 2. User Profile

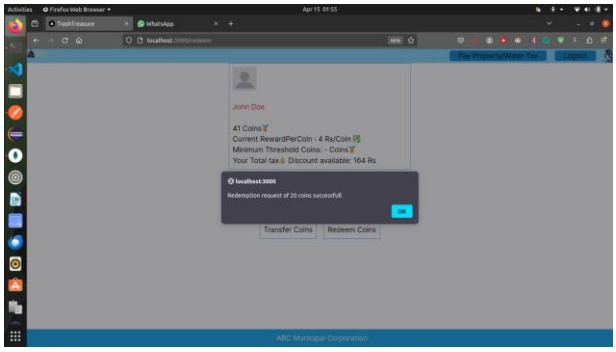

Fig. 3. Redemption

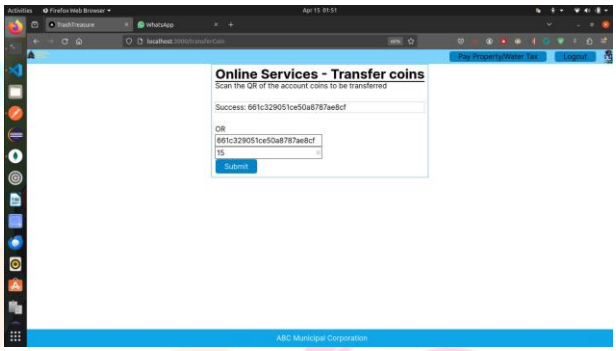

Fig. 4. Transfer of coins

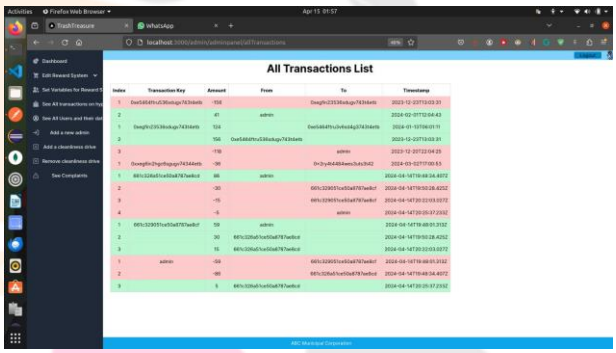

Fig. 5. See all transactions

VI. Results

1) Waste classification: Our CNN model is trained for 8 epochs. Test images are loaded and passed through the prediction function to classify them. 90
2) Transparency and Accountability: Storing waste disposal data on the blockchain ensures transparency and immutability of records. This promotes accountability among users, waste management authorities, and other stakeholders, fostering trust and confidence in the waste management system.
3) Tax Revenue Generation: The ability for users to redeem points for tax payment provides a novel mechanism for generating tax revenue. Tax authorities can benefit

from increased compliance and revenue collection while incentivizing positive behavior in waste management.

4) Community Engagement and Participation: By gamifying waste management and offering tangible rewards for participation, our platform encourages community engagement and active participation in environmental conservation efforts. This can lead to a greater sense of ownership and responsibility among community members for maintaining clean and sustainable environments.

VII. Limitations

1) The accuracy and reliability of data collected from IoT sensors and other sources may be affected by technical issues such as sensor malfunctions, data transmission errors, or environmental factors like extreme weather conditions.
2) The current developed prototype deals with public blockchain, which consumes a lot more gas fee for each transaction, proving to be an unnecessary overhead.
3) As the user base grows, scaling the system to accommodate increased data volume, processing requirements, and reward distribution may pose challenges in terms of infrastructure, resources, and management.
4) If the rewards offered incentivize consumption or activities with environmental consequences (e.g., redeeming rewards for goods with high carbon footprints), it could potentially negate the positive impact of proper waste disposal efforts.

VIII. Future Scope:

1) Scaling the Solution:
   a) Maximize the impact by expanding the reach to cover larger geographical areas.
   b) Deploy additional sensor-equipped bins.
   c) Enhance cloud infrastructure to handle increased data volumes.
2) Integration with Municipal Waste Management:
   a) Collaborate with municipal waste management authorities.
   b) Streamline waste collection and disposal process.
   c) Develop interfaces and protocols for integration with existing waste management infrastructure.
3) Building a Mobile Application:
   a) Implement the project on a website level initially.
   b) Plan to develop a mobile application for ease of use and feasibility in the future.
4) Regulatory Compliance:
   a) Stay updated with environmental regulations and policies.
   b) Ensure compliance with local and national waste management standards.

The TrashTreasury project is an exciting endeavor with the potential to continue making a substantial impact on the environment. By focusing on these areas of future work, we can further advance our mission to create a more eco-friendly and responsible future.

IX. Conclusion

This paper introduced an innovative Incentives and Reward System for efficient and sustainable solid waste management through the integration of Blockchain and Machine Learning technologies. Our model has successfully tackled the problem of mismanaged waste by introducing sensor-equipped bins that not only collect garbage but also analyze the type and weight of waste. By securely transferring this data to the cloud, we have created a robust foundation for our Reward-based system. The implementation of Machine Learning algorithms has enabled the system to accurately assess the type and amount of waste deposited, allowing us to calculate appropriate rewards for users. This incentivizes responsible waste disposal practices and promotes a culture of environmental consciousness and sustainability. In conclusion, the TrashTreasury project has the potential to revolutionize the way society addresses waste management challenges. By harnessing the power of technology and incentives, we are moving closer to a cleaner, greener, and more sustainable environment for all.

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