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WASTE MANAGEMENT IN SMART CITIES USING BLOCKCHAIN

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Abstract: By increasing human health, safeguarding aquatic habitats, and lowering air pollution, smart cities do have the ability to tackle the environmental issues provided by appropriate waste management. In this article, we look at how blockchain technology might help smart cities manage waste by allowing for traceability, immutability, transparency, and audits in a decentralised manner, dependable, and secure way. We discuss the advantages of blockchain technology in a variety of waste management situations, such as real-time garbage cans monitoring and tracking, reliable waste channelling and compliance with waste management rules, efficient waste resource management, waste management data preservation, and material handling are all examples of waste management services. To focus to the usefulness of blockchain technology in smart city waste management, we report on many projects and case studies based on blockchain technology.

We identify and address a number of open research challenges that are impeding the successful deployment of blockchain in management of waste in smart cities.

Keywords: Waste Management, Blockchain, Decentralized, Transparent.

I.INTRODUCTION

Cities have been consistently producing large amounts of waste for the past decade, posing vulnerability to human health and the nature.

Garbage management in smart cities requires careful coordination and collaboration among all stakeholders, including waste sources, collectors, shippers, and waste treatment facilities, and a blockchain framework is employed to fulfil these objectives.

We also discuss the benefits of blockchain technology in a variety of waste management use cases and application scenarios, including real-time waste tracing and tracking, reliable channelization and compliance with waste treatment laws, efficient waste resource management, documentation protection, and fleet management.

II.LITERATURE SURVEY

Blockchain for smart cities: A review of architectures, integration trends and future research directions [1]

In recent years, as a new paradigm for offering high-quality service, the smart city has gained traction to citizens by consistently managing the resources of the city. Smart cities may provide the best services to improve residents' daily lives in the areas of health, transportation, energy use, and education and are all factors to consider. However, the smart city concept is still maturing, and security concerns are becoming more widespread, despite its potential. The use of blockchain technology has the potential to accelerate the development of smart cities because of its features like verifiability, transparency, immutability, and decentralisation.

As a result, this paper provides the most up-to-date blockchain technology for addressing smart city security concerns. The article looks at how blockchain is being used in a number of smart communities, including as healthcare, transportation, smart grid, supply chain management, financial systems, and data centre networks. Finally, an in-depth literature assessment of blockchain-based smart city systems identifies several future research areas.

Convergence of blockchain and artificial intelligence in IoT network for the sustainable smart city [2]

Smart cities may evolve into smart societies in the digital era through building new technology. The broad use of blockchain technology, in particular, has marked the rise of a new digital smart city environment. A wide range of blockchain applications promise to resolve issues, cryptocurrency, the Internet of Things (IoT), government, and social services, to name a few. In addition, the fusion of artificial intelligence (AI) and blockchain technology will alter network architecture for smart cities in order to create a long-term ecosystem. However, in order to achieve the aim of a sustainable smart city, these technological advancements bring both possibilities and obstacles. This paper examines the literature on

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the security difficulties and issues that affect blockchain adoption in smart cities. This white paper examines some of the key features of the intersection of blockchain and artificial intelligence technologies that will help in the building of a focussed, sustainable society. We look at solutions for blockchain security and discuss fundamental concepts that may be used to build a variety of intelligent transportation systems using blockchain AI. Unresolved difficulties and future research directions, such as new security recommendations and future concepts for a sustainable smart city ecosystem, will also be discussed.

Evaluating the factors that influence blockchain adoption in the freight logistics industry [3]
Using the Analytical Network Process, this study presents a theoretical foundation for the Technical Organizational Environment (TOE) of the important elements that impact and prioritise the effective implication of blockchain technology in the waste transportation business (ANP). According to the report, "availability of genuine blockchain technologies," "infrastructure facilities," and "government policy and support" are the three key variables impacting blockchain adoption in the waste transportation business. These findings will aid government agencies, transportation logistics firms, and blockchain service providers in developing strategies for successful blockchain promotion and deployment, as well as increasing their organisations' worldwide competitiveness.

A blockchain based truthful incentive mechanism for distributed P2P applications [4]
In distributed peer-to-peer (P2P) applications, colleagues organize and work for themselves to efficiently perform a specific task, such as file forwarding, message forwarding, or data downloading. Users, on the other hand, might be selfish and refuse to collaborate because they are concerned about power usage and bandwidth. Therefore, each user should receive a satisfactory reward as a reward for the consumption of resources for cooperation. However, in a dynamic and decentralized P2P environment, there is still a lack of adequate incentives to meet the diverse needs of users. On the other hand, Blcokchain is responsible not only for financial transactions, but also for the responsibilities of decentralized and secure digital economy transactions, which can be programmed to increase the market value of blockchain-based cryptocurrencies. As a result, this paper offers a true blockchain-based incentive mechanism for decentralised peer-to-peer apps that leverage cryptocurrencies like Bitcoin to motivate users to collaborate. This mechanism rewards users who help them deliver successfully. Because P2P blockchain users and miners may behave selfishly or cooperate with each other, we offer a secure verification method and pricing strategy and incorporate this into the incentive mechanism. We illustrate the efficiency and safety of the suggested stimulation mechanism by analysing the analysis and assessment of game theory.

Municipal solid waste recycle management information platform based on Internet of Things technology [5]
Unprecedented population growth and increasing waste production due to urbanization have become major problems for developing countries. Many of the issues directly related to the increase in literature waste production and the difficulties associated with managing it in smart cities have been taken into account. These problems are the result of the inadequate use of waste collection and treatment mechanisms, the increasing movement of people to huge cities and the absence of smart technologies used to support waste management systems. As a result, large amounts of waste are scattered everywhere, making it difficult to manage waste. In addition, there are many issues related to unscientific procedures related to solid waste management, as well as the inadequacy and inefficiency of existing systems. This document provides an IoT-based system for monitoring smart bins and solid waste management for municipal waste. As discussed above, this system will help address IoT-based waste management and waste collection issues for smart cities. The proposed system can efficiently collect waste, detect fire in waste and anticipate future waste production. IoT-based devices control and monitor electrical boxes. These devices connect wirelessly to a central hub and send folder population information to the original location. The main benefit of the system is that it helps to protect the environment by collecting waste in a timely manner to prevent overfilling of bins.

III.METHODOLOGY

A swarm is a collection of diverse robots that collaborate to complete tasks or activities. When sorting garbage, a swarm of robots may communicate with one another and exchange opinions on the type of waste being evaluated, allowing them to automatically detect reusables in the garbage.

Each robot can employ artificial intelligence to communicate with other robots in accordance with a set of rules. Robots can interact safely and reliably with one another thanks to blockchain technology. Working with accessories is now self-contained, adaptable, and time-saving thanks to this technology.

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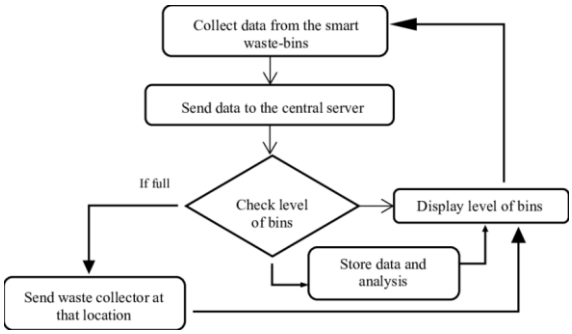

Fig. 1. Design Methodology [6]

A consortium or federated blockchain platform may be set up to register endorsers, validators, and committers from several organisations to accomplish this use case. A consortium platform, unlike private blockchain platforms, is managed by a group of organisations.

Because the bulk of existing solutions consider the Ethereum platform for implementation, it has been determined that the importance of data privacy has been disregarded. Furthermore, sensors that detect, gather, and exchange trash-related data on the blockchain are heavily used in the developed apps for waste management in smart cities.

IV.IMPLEMENTATION

The data structure and algorithmic basis architecture for our suggested system for implementing an autonomous incentive system for solid waste management were designed utilising the Python programming language and a python-based server framework called flask.

The flask server will act as a single node in the blockchain network, and it has the following components.

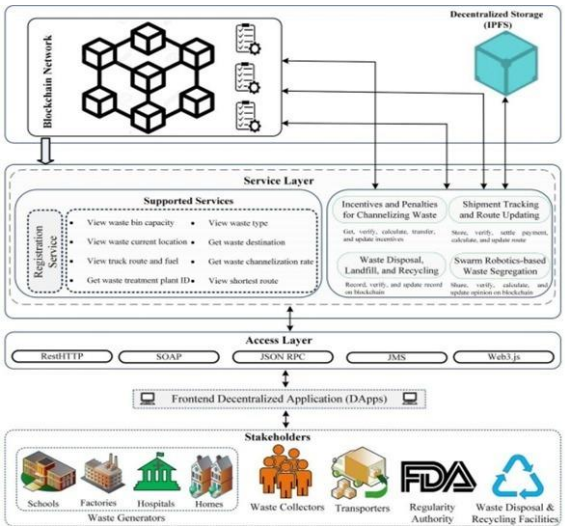

Fig. 2. Blockchain-based framework for waste management services in smart cities [7]

The Flask server is set up and is available to utilise the blockchain to perform SWM transactions. The quantity of the waste of the bins is displayed in the flask server.

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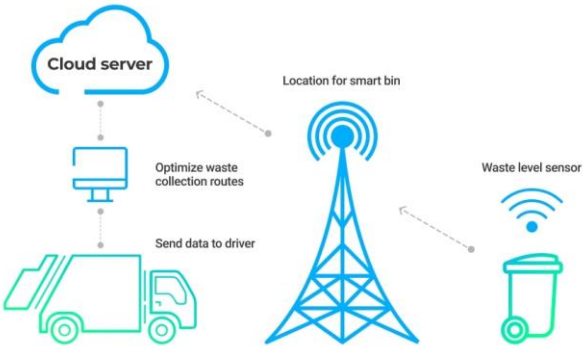

Fig. 3. Data flow in smart cities for waste management [8]

Basically, the blockchain technology is a decentralized network, where the participants or clients are linked in a decentralized way.

V.CONCLUSION

We've discussed how decentralised, tamper-proof, transparent, traceable and trackable, auditable, safe and dependable blockchain technology may be utilised to manage garbage in smart cities.
We looked at how smart cities may employ blockchain technology to handle a variety of connected activities and acts related to garbage compilation, transportation, segregation, dumping, and reusing. To emphasise system components, participants and their responsibilities, and data flow between system components, we presented a blockchain-based waste management architecture.
We delivered in-depth discussions and case studies on recent blockchain-based research papers and case studies to demonstrate blockchain's utility in smart city waste control. The automatic reward system works based on real-time monitoring of IoT data container devices. Sensor nodes transmit real-time data to cloud Integration of cloud server into a blockchain network.

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