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WASTE MANAGEMENT USING BLOCKCHAIN TECHNOLOGY

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ABSTRACT:

Block chain is a share, immutable ledger that makes simpler to track assets and recording transactions in a network. Here, the primary objective of our project is to look into how block chain technology may enhance existing methods for handling waste. The project's main goal is to employ block chain technology to monitor and handle waste from its generation to final disposal. The collection, transportation, processing, and environmentally suitable disposal of waste products are all parts of waste management. Glass, paper, and plastics are examples of waste items that can be recycled and used again. The terms "collection,""segregation," and "recycling" each refer to a distinct block that is integrated using immutable block chain technology. The project's overall goal is to develop a more efficient, transparent, and sustainable waste management system that benefits both the environment and the economy.

KEYWORDS:

WASTE MANAGEMENT, BLOCK CHAIN TECHNOLOGY, REUSE AND RECYCLE.

INTRODUCTION

A solid waste management (SWM) unit has the primary job in big centres to support a healthy environment and safeguard natural resources by effectively handling solid trash. At present, the smart cities concept is empowering us to achieve the goal of sustainability. The United Nations (UN) formulated goal called sustainable development goals (SDGs), intended to build and preserve environments, under which people and the environment will be in sustainable equilibrium that meet current and future generation's social, economic, and other requirements.

In smart cities, SWM is one area where technology integration and enhancement are necessary for managing the waste generation that directly impacting the environment. Generally, the activities involved in the SWM are collection, transportation, recycling, reuse, disposal, and analysis of waste data. Tracking and Monitoring of every activity are necessary for the municipal administration to manage and enhance the mechanism effectively, as the large amount of waste generation is not effectively treated for acquiring maximum benefits from it in terms of reusing and recycling.

The proper management of waste in smart cities requires close coordination and collaboration among the involved stakeholders such as waste generators, collectors, shipper, and waste treatment facilities. Currently, Internet of things (IoT) and cloud server are the emerging technologies that are widely implemented in SWM for minimizing the effect of environment due to large amount of waste generation and for efficient data storage. But these technologies encourages only limited number of participants. Block chain technology enhances single platform that integrates the multiple participants of SWM for managing the waste efficiently. Additionally, a study has suggested implementing block chain technology for establishing an automatic payment system for collecting waste from any individuals. An individual will process the payment into the account of municipal administration through a mobile app.

The automatic reward system is generated based on the quantity of waste in the bins. Block chain technology is integrated to implement the secure reward system, as block chain technology is feasible for performing secure transactions by authenticating the data.

PROCESS INVOLVED IN WASTE MANAGEMENT:

1. GENERATION: Waste is generated from households, businesses, industries, and other sources.

FIG.1.GENERATION OF WASTE

2. COLLECTION: Waste is collected from the source of generation and transported to a processing or disposal facility. The collection process involves the use of trucks, garbage bins, and other specialized equipment.

3. SORTING AND SEPARATION: Waste is sorted and separated based on its composition and characteristics. This step is important for identifying materials that can be recycled or reused.

4. TREATMENT AND DISPOSAL: Waste that cannot be recycled or reused is treated and disposed of in a manner that minimizes its impact on the environment. Treatment methods include incineration, landfill and composting. Hazardous waste materials are subjected to specialized treatment and disposal methods.

5. RECYCLING AND REUSE: Recycling involves the collection of discarded materials and processing these materials into new and usable products. Reuse is the process of reprocessing and usage of the new form of the waste materials. Waste materials that can be recycled or reused are processed and returned to a production cycle. Recycling and reuse reduce the amount of waste that ends up in landfills, conserve natural resources, and reduced energy consumption.

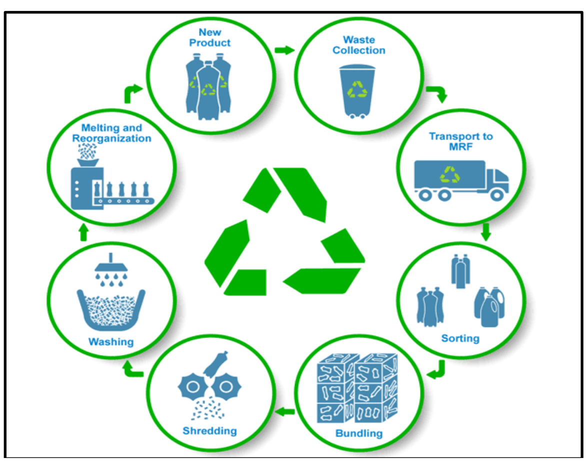

FIG.2.RECYCLING PROCESS OF WASTE MATERIALS

6. Monitoring and regulation: Waste management activities are monitored and regulated to ensure compliance with environmental regulations and standards. Monitoring involves the use of data collection and analysis tools to track waste generation, treatment and disposal.

Effective waste management requires the collaboration and cooperation of all stake holders, including government agencies, waste management companies, businesses and the public. The ultimate goal of waste management is to reduce the negative impact of waste on human health and the environment while promoting sustainable development.

SENSUS:

WASTE MANAGEMENT IN INDIA:

Waste management in India falls under the purview of the Union Ministry of Environment, Forests and Climate Change (Moe F& CC). In 2016, this ministry released the Solid Wastage Management (SWM) Rules, which replaced by the Municipal Solid Waste (Management and Handling) Rules, and 2000 of which had been in place for 16 years.

India generates 62 million tonnes of waste each year. About 43 million tonnes (70%) are collected, of which about 12 million tonnes are treated, and 31 million tonnes are dumped in landfill sites. Here is a bar graph that depicts the waste generation census in India with Delhi at the first position and Jaipur at the last position.

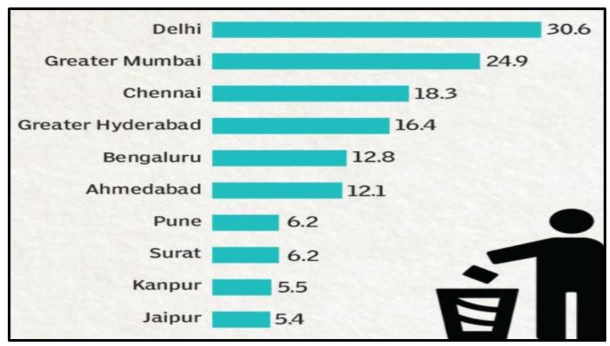

FIG.3.WASTE GENERATION SENSUS IN INDIA

WASTE MANAGEMENT IN GLOBE:

Waste generation has increased massively around the world in recent decades, and there are no signs of it slowing down. By 2050, worldwide municipal solid waste generation is expected to have increased by roughly 70 percent to 3.4 billion metric tons. This is due to a number of factors, such as population growth, urbanization, and economic growth, as well as consumer shopping habits.

However, less than 20 percent of waste is recycled each year, with huge quantities still sent to landfill sites.

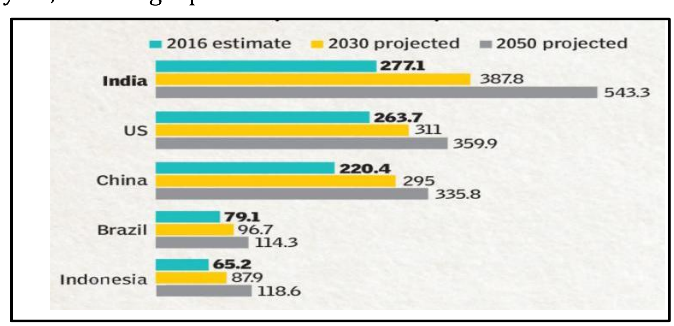

FIG.4.ESTIMATED WASTE GENERATION IN GLOBE

BIGGEST WASTE PRODUCERS WORLDWIDE:

As the world's most populous nation, China is responsible for the largest share of global municipal solid waste – at more than 15 percent. However, in terms of population the United States is the biggest producer of waste. The U.S. accounts for less than five percent of the global population, but produces roughly 12 percent of global MSW and is the biggest generator of MSW percapita. On average, Americans produce slightly more than 800 kilograms of waste every year. This is more than double the per ca pita waste generation of Japan, where citizens produce on average, 350 kilograms of MSW each year.

BLOCKCHAIN:

WHAT IS BLOCKCHAIN?

A block chain is a growing collection of records, or blocks, that are linked together via encryption. Each block includes trade information, a time stamp, and a cryptographic hash of the previous block. By using block chains, we may securely store information on a shared system that anybody can access but cannot modify. Block chain employs a distributed method to authenticate each transaction while keeping track of all information trades in a ledger. While Seyfang and Longhurst (2013) contend that the use of social money may enhance aspects of community sustainability, Satoshi-Nakamoto (2008) argues that block networks' technological architecture may promote sustainability due to its integrity.

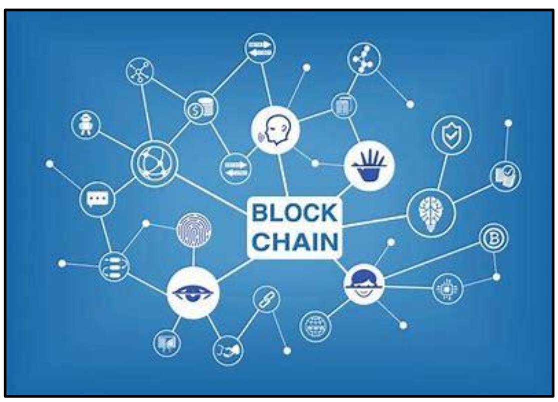

FIG.5.BLOCK CHAIN

Block chain, sometimes referred to as distributed ledger technology (DLT), makes the history of any digital asset unalterable and transparent through the use of a decentralized network and cryptographic hashing.

" A PEER-TO-PEER ELECTRONIC CASH SYSTEM"

Every chain consists of multiple blocks and each block has three basic elements:

1. The **data** in the block.
2. The **nonce** — "number used only once." A nonce in block chain is a whole number that's randomly generated when a block is created, which then generates a block header hash.
3. The **hash** — a hash in block chain is a number permanently attached to the nonce. For Bitcoin hashes, these values must start with a huge number of zeroes (i.e., be extremely small).

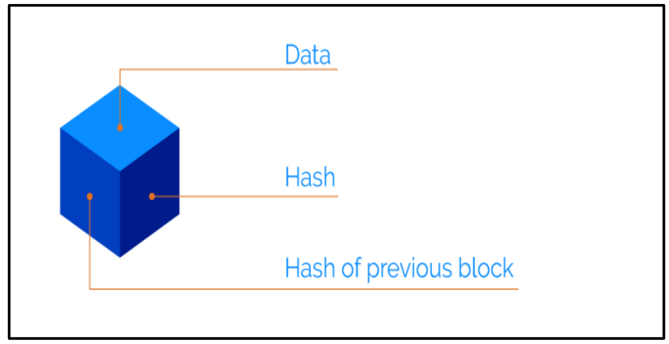

FIG.6.ELEMENTS OF BLOCK CHAIN

FEATURES OF BLOCKCHAIN TECHNOLOGY:

1. IMMUTABLE:

It means that the block chain is permanent and unalterable. This technology functions through a collection of nodes. Any transaction recorded on the block chain cannot be modified or deleted. This makes the block chain immutable and it provides a high degree of security and trust.

1. No one can add any transaction blocks to the ledger without the approval of majority of nodes.

2. Validated records are irreversible and cannot be edited.

2. DECENTRALIZATION:

It is a decentralized system which has no central authority to the entire network.

1) It is independent of human calculations.

2) This network is very less prone to failures.

3) Hackers cannot hack the network and doing so, is very much expensive.

4) These networks don't depend on any third parties to access the system.

3. TRANSPARENCY:

It is one of the best features of the block chain that is entirely traceable and very much easy for maintenance.

All transactions that take place in the block chain are visible to all participants in the network. Each block in the chain contains a record of all transactions that have taken place and when a new block is added to the chain, it cannot be altered. This ensures transparency and trust.

4. DISTRIBUTED LEDGER:

A public ledger will provide complete information about the participants and transactions that are done. All the participants can have a copy of the ledger.

1. A distributed ledger can track the changes in the ledger.

2. Changes are updates in few seconds because of non - involvement of any intermediaries.

3. To make any further changes like adding a new block, it must be accepted by almost all the nodes.

5. SECURITY:

This technology uses advanced cryptographic algorithms for secure transactions and data. All the records are encrypted individually. Each piece of data in the network has a unique identity. The blocks are cryptographically linked to one another. Any modification in the data is impossible due to the change of all hash IDs.

PROPOSED ARCHITECTURE:

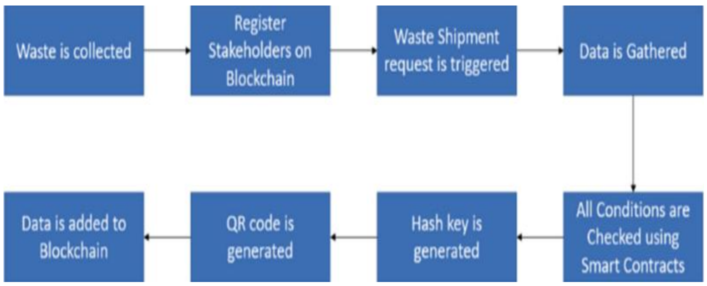

FIG.7.BLOCK DIAGRAM OF ARCHITECTURE OF WASTE MANAGEMENT

This is the proposed architecture of the waste management using the block chain technology. This is a decentralized network that has no central authority to control the entire network and every individual blocks. The data in the block chain is only given to the consecutive blocks. The data here is very secure and cannot be altered.

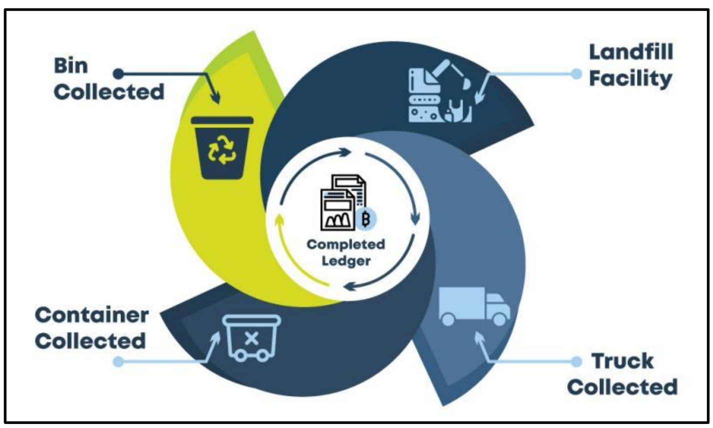

FIG.8.PROPOSED ARCHITECTURE

ASSOCIATION OF BLOCKCHAIN WITH WASTE MANAGEMENT:

This technology can be used to improve waste management systems in various methods. These include:

1. SUPPLY CHAIN TRANSPARENCY: Block chain can be used to track the movement of waste through the supply chain, ensuring transparency and traceability. By recording every transaction in a tamper-proof, decentralized ledger, block chain can help reduce fraud and increase accountability.

2. WASTE TRACKING: Block chain can also be used to track the disposal of waste. For example, waste management companies can use block chain to record the weight, type, and location of waste at every stage of the disposal process, ensuring that waste is properly managed and disposed of in compliance with regulations.

3. SMART CONTRACTS: Block chain can be used to automate waste management processes using smart contracts. Smart contracts are self-executing contracts with the terms of the agreement between buyer and seller being directly written into lines of code. This can streamline the process of waste collection, transportation, and disposal by automating payments, reducing administrative costs, and increasing efficiency.

4. RECYCLING REWARDS: Block chain can also be used to actuate waste reduction and recycling. For example, a waste management company could offer blockchain-based rewards to households or businesses that reduce their waste or increase their recycling efforts. These rewards could be in the form of digital tokens or cryptocurrencies that can be redeemed for goods and services.

RESULT:

The result of waste management using block chain technology project has been promising, with the technology showing the potential to significantly improve waste management processes. Here are some of the main results of block chain-based waste management projects:

1. INCREASED TRANSPARENCY: Block chain technology provides a tamper-proof, decentralized ledger that allows waste management stakeholders to track the movement of waste through the supply chain. This increased transparency can help reduce fraud, increase accountability, and improve trust between stakeholders.

2. IMPROVED EFFICIENCY: Block chain technology can automate many waste management processes, such as waste tracking, transportation, and disposal. Smart contracts can streamline the process by automating payments, reducing administrative costs, and increasing efficiency.

3. INCENTIVIZED RECYCLING: Block chain-based rewards can encourage households and businesses to reduce waste and increase recycling efforts. These rewards can be in the form of digital tokens or crypto currencies that can be redeemed for goods and services, creating economic incentives for waste reduction and recycling.

4. REDUCED WASTE SENT TO LANDFILLS: Block chain-based waste management projects have shown to reduce the amount of waste sent to landfills, by promoting recycling and stimulating waste reduction.

5. NEW ECONOMIC OPPORTUNITIES: Block chain-based waste management projects have also created new economic opportunities, particularly in developing countries where waste management is a significant challenge. These projects have the potential to create new sources of income for individuals and communities by motivating the collection and recycling of waste.

Overall, the result of waste management using block chain technology project has been positive, with the technology showing the potential to significantly improve the efficiency, transparency, and accountability of the waste management industry while also prompting waste reduction and creating economic opportunities.

CONCLUSION:

Block chain technology is playing a significant role in the modern world with its security and transparency capability. We have implemented block chain in the SWM for realizing the automatic reward system to the individuals for disposing of waste in the bins. The automatic reward system is executed based on real-time monitoring of data from the Io T devices of the bins. Io T devices are the integration of sensor nodes, which are customized and embedded in the bins. This sensor node communicates the real-time data to the cloud server via a gateway. A mechanism is implemented for integrating the cloud server with a block chain network through Flask server-based API. In the real-time implementation, it is observed that the weight of the bins is creating new transactions in the block chain network. Moreover, we have proposed a method for verifying miners in private block chain with a trust point concept addressed in the study.

Waste management system by combining ideas of block chain technology. We leveraged the features and benefits of technologies to reach a more practical and suitable solution to cope with some challenges of waste management systems.

The proposed system provides a trustworthy environment for the cooperation of companies, which are included in the chain of waste management.

The system also plans to make enough encouragement for citizens and other waste generators, such as businesses, industries, and hospitals, to play a more effective and constructive role for the separation of recyclable wastes in the source.

Finally, municipalities could impose their policies system more easily and properly.

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