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CARBON-SYNC: A CARBON TRADING SYSTEM FOR A LOW CARBON ECONOMY

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ABSTRACT

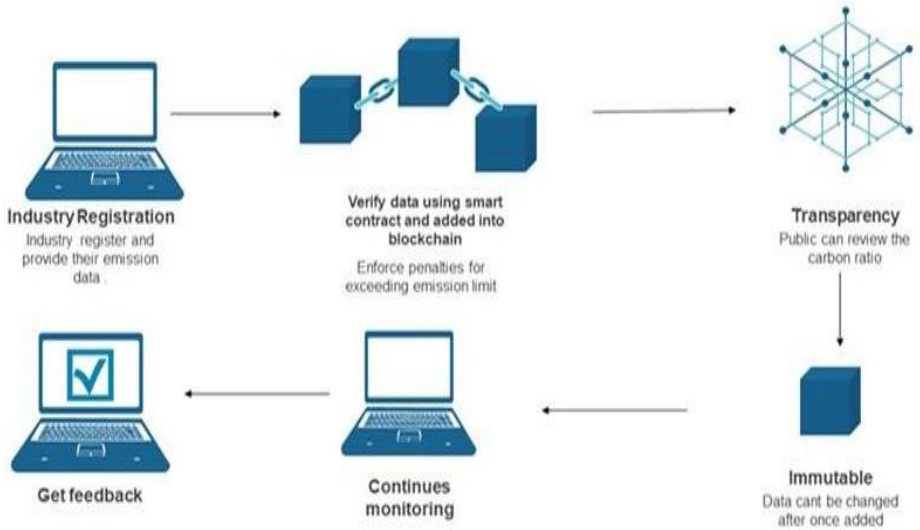
This paper addresses carbon emission management through integrated Web 3.0 and blockchain technologies. The exact statement of the research problem is to find a platform that offers transparency, security, and decentralization in monitoring and controlling carbon production while providing incentives to companies for environmental sustainability. The objectives are to present a decentralized solution whereby the DAO controls allowances for companies, enforces their use with the aid of blockchain, and offers token-based rewards for participation in green activities. The major conclusion derived is how the blockchain increases levels of transparency and security, enabling all forms of transactions or carbon trading activities to be traced in real time. It also initiated a point-based reward system for companies, affiliated with planting trees and cleaning rivers, which in turn encourages these companies to reduce their carbon emissions further. The internal carbon auction mechanism encourages responsible use of carbon without the meddling of the DAO directly. This decentralized platform hence offers an effective solution for carbon management by unifying emerging technologies to goals related to the environment, building a green corporate environment

Keywords: Web 3.0, Blockchain, Decentralized, DAO (Decentralized Autonomous Organization), Carbon Footprint.

I. INTRODUCTION

The global fight against climate change has stipulated the rising demand for ingenious solutions to carbon emissions management. Traditional approaches lack both transcriptional and accountability levels, thereby failing in the development of appropriate carbon management systems. This is where modern decentralized technologies like blockchain and Web 3.0 provide a new opportunity to serve pressing environmental challenges. Technologies such as these can give way to a more transparent, secure, and decentralized platform for managing carbon allowances while further incentivizing companies to greener behavior. The problem statement the paper addresses is exactly the non-existence of a transparent and decentralized mechanism that efficiently manages carbon allowances in a way that presses companies towards environmental activities. It discusses how blockchain and Web 3.0 technologies integrated with a decentralized autonomous organization can build an efficient carbon management platform necessary for environmental sustainability.

II. GENERAL ARCHITECTURE



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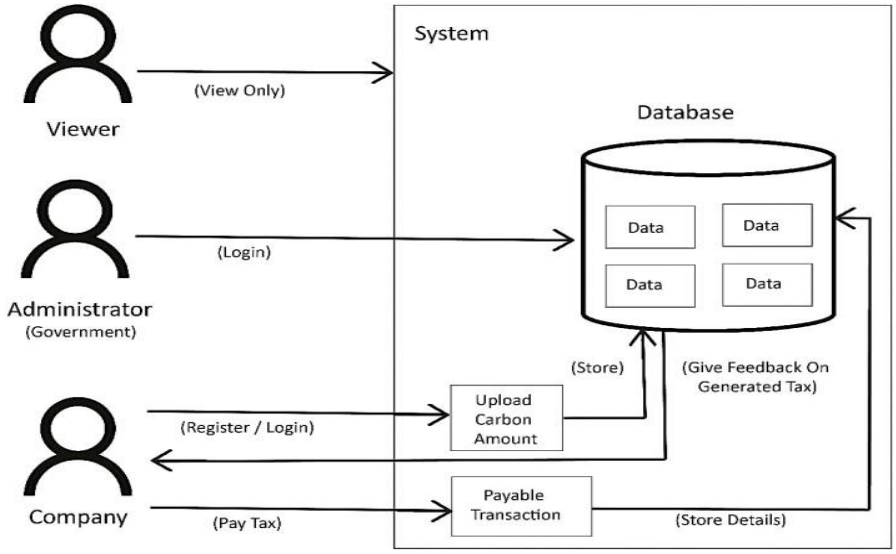

Implementation Model

III. LITERATURE REVIEW

1. Carbon Credits on Blockchain. Et.al. Dhiren Patel, Benita Britto, Sanidhya Sharma, Kaustubh Gaikwad, Yash Dusing.

This paper further explores how blockchain could be implemented in carbon trading systems to decentralize, make traceable, and have greater transparency. It has been indicated that blockchain can enhance carbon credit transactions through a decentralized ledger; however, it further points out, with a study on blockchain, challenges regarding the cost incurred during the implementation process and the complexity carried out by such systems. Those systems will offer a more secured way of dealing with carbon credits, but a rather huge technological infrastructure needs to be established to limit access.

2. Study on applying blockchain in carbon trading. Lucas Francisco, et.al., Rodrigo Bonacin.

In this study, the applications of the blockchain in carbon trading especially with sophisticated set-ups will be focused. It illustrates the potential transparency and traceability it can provide for carbon credits through a decentralized structure when the blockchain is used for its carbon credits management. The research will focus the technical expertise the blockchain application requires due to the high cost and complexity of its implementation. Despite these limitations, the study confirms the outlook of blockchain for changing the carbon credits trading management scenario and governance in the advanced technological setting.

3. A Blockchain-Based User-Centric Emission Monitoring and Trading System for Multi-Modal Mobility. Et.al. Johannes Eckert, David López.

This deals with designing an emission trading system based on blockchain technology, more so in the transport sector. The aim is to utilize this system in offering a user- centric approach that features low latency and high throughput when trading emissions credits. It looks quite efficient and quick in processing data, but the researcher is aware of many complications while utilizing such systems within the already prevalent carbon trading frameworks. The user-centric system can be of help in streamlining an emission tracking and trading service environment, especially within multi-modal transportation settings, which falls under the broader scope of carbon credit management.

4. Smart Contract Service Optimization in Blockchain- Cloud Collaborative Computing. By Yongjian Li, Ting Chen, Et.al.

Optimization in blockchain-cloud systems of smart contracts is crucial for the implementation of carbon trading systems that are scalable and efficient. Authors propose methods to optimize the services provided by smart contracts and reduce the computational costs that enhance the performance of decentralized applications. The CarbonSync project has relevance in that it points out the technical matters involved in the implementation of the blockchain for carbon credit management, improving transactions with smooth faster and cost-effective transactions within the carbon market.

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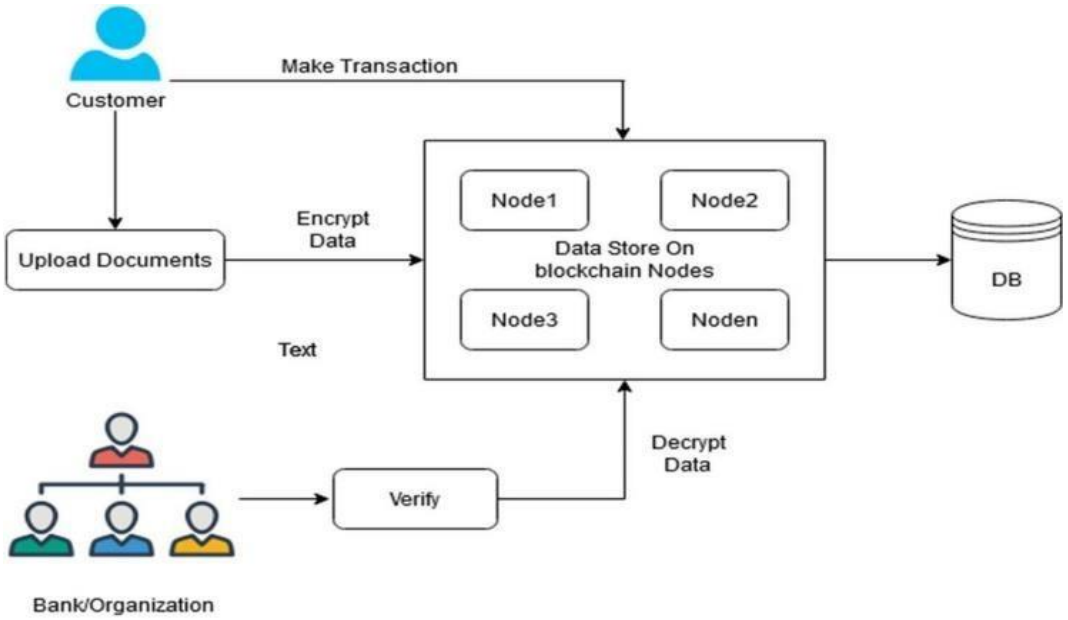
IV. METHODOLOGY

CarbonSync adopts a structured methodology by incorporating the appropriation of blockchain as well as IoT into the management of carbon credits. This is achieved through the exploitation of smart contracts on top of the Ethereum blockchain to automate transactions in carbon credits and gathering of real- time emissions data through IoT sensors that have to be verified and stored on the blockchain, thus ensuring accuracy and transparency. The carbon credits are tokenized to retrieve the emissions data using predefined models. Thus, efficient trade can be carried out through a decentralized marketplace. The user interface is created using React.js in order to monitor emissions and to participate in carbon trading. All non-essential data are stored off-chain for better performance. It thus facilitates smooth interactions between the blockchain and the database through APIs. Such a system will have to undergo rigorous testing before being implemented to ensure reliability and continuously monitored and updated to ensure continued long-term success.

V. SYSTEM ARCHITECTURE



The architecture of this framework, as shown in the figure, is that of a secure data transaction system that employs blockchain technology. It begins with the customer who uploads documents or commences a transaction. Data from the client will be encrypted before being sent because sensitive information requires protection and privacy. This encrypted data will consequently be stored across different nodes of the blockchain (Node1, Node2, Node3, etc.). This proposition is anchored to the concept of the blockchain ledger regarding decentralization as a form of security as well as not allowing tampering to occur. The nodes should be maintaining a local copy of data, which will then provide integrity and immutability. Some of the non-sensitive information or metadata can be optimized by being stored in a central DB and thus can be kept off the blockchain.

Apart from this, the architecture allows the authorized organizations or banks to access and verify the documents. After gaining the access to the stored data, they can further decrypt it by using the respective security credentials. Further, this association of cryptography with blockchain emphasizes secure access of the sensitive data to only the authorized parties. Ensuring no violation in the data integrity in the process, this ensures complete protection during the transmission and storage of data.

VI. DISCUSSION

Through its blockchain technology, the CarbonSync project enhances the transparency and accountability in carbon credit management systems. This system uses blockchain's decentralized ledger to track, trade, and report carbon emissions. It helps ensure the precise registration and recording of all carbon credit transactions, thus not exposing the vulnerability of reproducing and forging data or fraudulent activities. With the integration of IoT devices, it is possible to carry out real-time emission monitoring, which enables one to trace and verify, in real time, the exact data emanating from the monitoring sites on the blockchain immediately.

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The system backend, developed in such a way that automatically accepts data from various sources, including IoT sensors, into the blockchain. By using smart contracts, it allows for the automation of carbon credit trading, where in terms of transactions, they may be executed on either end without having to involve any middlemen, thereby ensuring efficiency, cutting down on operational costs, and guaranteeing compliance with conditions already determined beforehand. With the use of Ethereum and Solidity, a trade will surely be executed in a honest and transparent way.

It will also democratize access to the carbon credit market by making opportunities for even small-sized organizations and individuals to participate, opening possibilities for all kinds of market players and making it possible to expand the scope of participants in the market while trying to increase engagement to reduce carbon emissions. With some considerable advantages it is boasting, the system faces several challenges as it is related to the high cost of implementing blockchain technology, scalability, and the trustworthiness of IoT devices.

VII. COMPARISON

Aspect	Traditional Carbon Credit System	Blockchain-Based Carbon Credit System
Transparency	Limited; prone to opaque dealings	High; decentralized and visible to all participants
Trust & Accountability	Difficult to audit and verify transactions	Immutable records on blockchain ensure accuracy
Fraud Prevention	High risk due to manual oversight	Blockchain's cryptographic algorithms ensure fraud prevention
Real-Time Data Monitoring	Not available	IoT integration enables continuous monitoring
Cost of Implementation	Lower but inefficient	Higher initial cost but more efficient and scalable
Scalability	Limited to large corporations	Open to small companies, individuals via tokenization
Transaction Speed	Slow due to manual processes	Fast using smart contracts

VIII. CONCLUSION

While blockchain and DAOs offer promising solutions for improving transparency and decentralization in carbon management, the literature reveals key areas that require further development. By addressing the gaps in incentive systems and integrating broader environmental activities into these platforms, the proposed research provides a new direction for using emerging technologies to drive sustainability.

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IX. REFERENCES

[1] N. M. Dowell, P. S. Fennell, N. Shah, and G. C. Maitland, "The role of CO2 capture and utilization in mitigating climate change," Nature Climate Change, vol. 7, pp. 243-249, April 2017.

[2] G. Althor, J. E. Watson and R. A. Fuller, "Global mismatch between greenhouse gas emissions and the burden of climate change," Sci Rep, vol. 6, p. 2028 1, February 2016.

[3] R. Martin, M. Muûls and U. J. Wagner, "The Impact of the European Union Emissions Trading Scheme on Regulated Firms: What Is the Evidence after Ten Years?" Review of Environmental Economics & Policy, vol. 10, p. rev016, 2016.

[4] L. Liu, C. Chen, Y. Zhao, and E. Zhao, "China's carbon- emissions trading: Overview, challenges and future," Renewable and Sustainable Energy Reviews, vol. 49, pp. 254-266, September 2015.

[5] L. Tang, J. Wu, L. Yu, and B. Qin, "Carbon allowance auction design of China's emissions trading scheme: A multi-agent-based approach," Energy Policy, vol. 102, pp. 30-40, 2017.

[6] M. Memon, S. S. Hussain, U. A. Bajwa, and A. Ikhlas, "Blockchain Beyond Bitcoin: Blockchain Technology Challenges and Real-World Applications," in 2018 International Conference on Computing, Electronics & Communications Engineering (iCCECE), 2018, pp. 29-34.

[7] B. Jana, M. Chakraborty, T. Mandal, and M. Kule, "An Overview on Security Issues in Modern Cryptographic Techniques," SSRN Electronic Journal, 2018.

[8] W. Wang, D. T. Hoang, Z. Xiong, D. Niyato, P. Wang, Y. Wen, and P. Hu, "A Survey on Consensus Mechanisms and Mining Strategy Management in Blockchain Networks," IEEE Access, vol. 7, pp. 22328- 22370, July 2019.

[9] C. Xu, S. Jia, L. Zhong, and G. Muntean, "Socially aware mobile peerto-peer communications for community multimedia streaming services," IEEE Communications Magazine, 53(10): 150-156, October 2015.

[10] S. Wang, L. Ouyang, Y. Yuan, X. Ni, X. Han, and F. Wang, "Blockchain-Enabled Smart Contracts: Architecture, Applications, and Future Trends," IEEE Transactions on Systems, Man, and Cybernetics: Systems, pp. 1-12, February 2019.

[11] E. A. Kawasmi, E. Arnautovic, D. Svetinovic, E. A. Kawasmi, E. Arnautovic, and D. Svetinovic, "Bitcoin-Based Decentralized Carbon Emissions Trading Infrastructure Model," Systems Engineering, vol. 18, pp. 115-130, March 2015.

[12] K. N. Khaqqi, J. J. Sikorski, K. Hadinoto, and M. Kraft, "Incorporating seller/buyer reputation-based system in blockchain-enabled emission trading application," Applied Energy, vol. 209, pp. 8-19, January 2018.