Blockchain-based Lightweight Fish Auction Marketplace Platform for Traceability Seafood Supply Chain

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***Abstract*—The seafood supply chain has an immersive affection for certain nations with a high demand of food and economic needs from the sea or a country with a big sea area to be explored. The proposed lightweight fish auction marketplace smart contract is built and deployed on various blockchain-based networks, which provides the solution for the transparency and consistent issue of overall auction; also, traceability from the blockchain network follows the benefits from smart contract usage that solved the issue from the seafood supply chain in general. The cost to fully function the smart contract was relatively low on gas cost; therefore, from every user's view, they all received the benefits from the blockchain without being burdened by the gas cost required to do the transaction.**

***Index Terms*—Auction, Blockchain, Lightweight, Smart Contract, Supply Chain, Traceability.**

I. Introduction

Archipelago countries certainly have an immersive amount of demand for seafood markets, which counts as a critical business for the nations, including fish auction marketplaces that are one of the vital parts of the supply chain for the seafood sector [1]. Overall, supply chain conditions have their open challenges, one of which and one of the most important is the non-transparency inside the supply chain. Lacking an open supply chain for the seafood sector would allow people in the fishery business to access and manipulate data, which will lead to violations of standards and behaviour such as over-fishing, human rights violations, and even fraud that often happen on the market [2], [3].

The blockchain-based smart contract provides the solution of traceability and transparency fish auction marketplace in the open supply chain environment. Smart contracts use automation for information exchange under a predetermined condition through an algorithm developed. Using a smart contract effectively removes the intermediaries and entrusts the smart contract to handle the transactions, reducing the transaction cost. In regards to the auction marketplace, aspects like fairness, consistency, and bias are also essential elements of the overall auction process, that certainly achieved by using a smart contract [4], [5].

Blockchain technology has its natural decentralized behaviour of a network that provides immutable and tamper-proof against data scam attempts due to its shared database validated by a wide community as nodes connected to the blockchain network, making every transaction through smart contracts safer [6]. Within this paper, we developed a smart contract-based seafood auction platform along with its contributions to the fish auction marketplace as part of the seafood supply chain, listed as follows,

- Blockchain-based auction smart contract would provide traceability and transparency during the auctioning process, giving fairness and legitimate transaction for both the goods seller and the auction participant.
- Decentralized network architecture from blockchain gives secured and tamper-proof transactions on the smart auction contract.
- Auction smart contract would provide fairness and consistent rule of the auction without bias due to its predetermined condition of auction.
- Lightweight developed auction smart contract would cost a lower gas cost for effectiveness and less burden the network.

II. Proposed Smart Contract

This section briefly explains the designed system of a fish auction marketplace platform in the form of a

TABLE I
GAS COST INFORMATION OF PROPOSED SMART CONTRACT

Functions	Caller	Gas Used (Gas)	Gas Average Cost (ETH)
Smart Contract Deployment	Admin	2147125	0.0307039
Member Registration (Buyer and Seller)	Buyer	151729	0.0021697
Make a List of Seafood (Auction Start)	Seller	172392	0.0024652
Make a Bid	Buyer	199711	0.0028559
Auction End Manually	Seller / Admin	40452	0.0005785
Receipt Confirmation	Buyer	25857	0.0003698

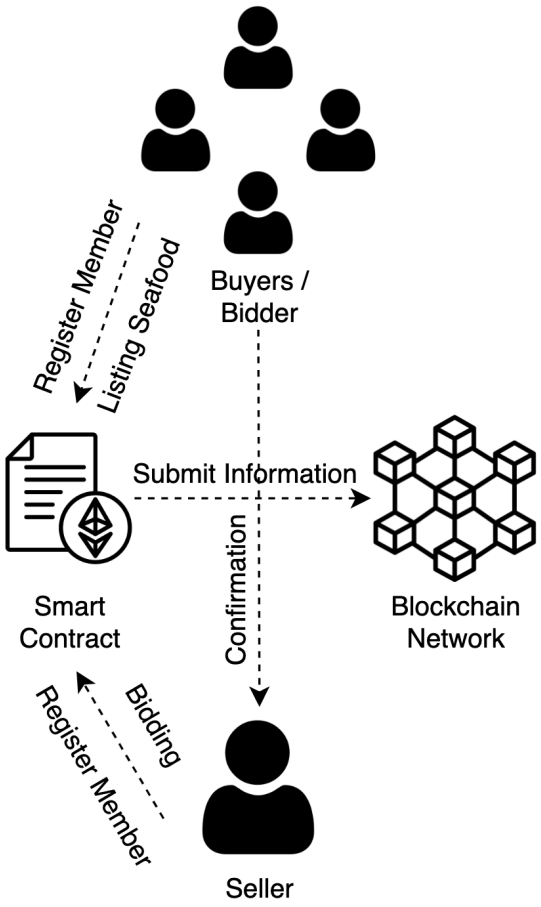

Fig. 1. Fish Auction Marketplace Smart Contract Architecture

blockchain-based smart contract, including a detailed explanation for each function.

The proposed smart contract, shown in Fig. 1, consists of a number of functions to be a fully functioning auction marketplace platform, explained as follows,

- **RegistrationPerson()**: Register the person as seller or buyer to the smart contract.
- **RegisterSeafood()**: Make a listing of the selling product for the seller.
- **StartAuction()**: start the auction by the seller, and the buyer that registered would be able to see the listed item and start to make a bid or buy directly.
- **EndAuction()**: End the auction by the seller; the listed item sold through the buy now would automatically end its auction process.
- **ReceivedConfirmation()**; Confirming the recipient of the listed items from the seller to the winner of the auction or buyer.

The smart contract, as our focus of lightweight, is built on an optimal algorithm for every function inside. Therefore it could reach its lightweight potential. The optimal algorithm could be developed by putting only the necessary line of code, instruction, and feedback return, trying not to add unnecessary loop iteration and data structure or even data matrices. Moreover, another effective method to improve the lightweight of a smart contract is by separating each function to be only accessible to certain users or entities. Some functions could only be used by authority and others by particular roles; therefore, users do not have to use every function to successfully fulfil their transaction or auction needs. The purpose of a smart contract to be lightweight is that not having a high gas cost for each action or transaction that happened through the smart contract would not burden the blockchain network.

III. RESULT AND ANALYSIS

The proposed lightweight smart contract was built on solidity computer language using Remix IDE for the developing editor application. The smart contract was deployed and tested on the Goerli test network and Remix VM London, with multiple transactions being held successfully. Using the smart contract deployed based on the blockchain network, every auction transaction is recorded and distributed along all the connected participants or nodes on the network.

With that, all the nodes on the network would frequently verify each other stored information, and there

would be no mismatch or missing information along the network, making the transaction on the smart contract secure and tamper-proof against various attacks. Also, Table. 1 shows that the proposed smart contract requires a fairly reasonable gas cost to operate optimally, with every function does not require every type of participant to use it. Therefore, the auction participants would be heavily burdened by the gas cost to do the auction and have all the benefits of the smart contract.

IV. Conclusion and Future Work

The proposed lightweight fish auction marketplace smart contract was developed and deployed on different blockchain-based networks to address the issue of overall auction transparency and consistency. Traceability from the blockchain network comes as a result of the use of smart contracts, which also addressed the problem with the seafood supply chain as a whole. From every user's point of view, they all experienced the benefits of the blockchain without being burdened by the gas cost required to complete the transaction because the gas cost to completely operate the smart contract was relatively cheap. Indeed, the conducted research has much more potential to expand for a grander idea and use, one of which is by applying Non-Fungible Token (NFT) for seller certification and a proper blockchain-based network for lower latency, as our next goal for the research.

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