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Integrating Blockchain for Advanced Supply Chain Solutions

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ABSTRACT —

The rise of Counterfeit products pose a significant challenge in manufacturing industries, impacting company reputation, sales, and profits. To address this issue, this project proposes a novel solution leveraging blockchain technology and Quick Response (QR) codes to authenticate products. Blockchain, a distributed and decentralized ledger, ensures the integrity and immutability of product records. QR codes, linked to the blockchain, serve as unique identifiers for each product. The system allows users to scan QR codes using a web application, which interacts with the blockchain through Metamask integration. Smart contracts on the blockchain verify the authenticity of products, providing real- time notifications to users. By combining blockchain, QR codes, and Metamask, this solution offers a secure and efficient method to combat counterfeiting and safeguard consumer trust. The proliferation of counterfeit products presents a formidable challenge to manufacturers, posing risks to brand reputation, revenue, and consumer safety. This project proposes an innovative approach to tackle this issue by harnessing the power of blockchain technology and Quick Response (QR) codes. Blockchain, renowned for its decentralized and immutable nature, serves as the foundation for securely storing product information and transactional data. Each product is assigned a unique QR code, which is linked to its corresponding blockchain record. Through a web- based application, users can scan QR codes to verify the authenticity of products in real-time. Integration with Metamask ensures secure interactions with the blockchain, facilitating seamless authentication processes. Smart contracts deployed on the blockchain enable automated verification, providing instantaneous feedback to users. By combining blockchain, QR codes, and Metamask, this solution offers a robust mechanism to detect counterfeit products, enhance consumer confidence, and foster transparency in supply chains.

Keywords — Blockchain, Metamask, Ethereum, Smart Contract, QR codes, Decentralized.

I. INTRODUCTION

Product Counterfeiting has emerged as a pervasive issue plaguing industries worldwide, with detrimental effects on businesses, consumers, and economies. The proliferation of counterfeit products not only undermines the integrity of brands but also jeopardizes consumer safety and erodes trust in markets. In response to this growing challenge, innovative technologies have been sought to combat counterfeiting and safeguard the authenticity of products. Among these technologies, blockchain and Quick Response codes have garnered significant attention for their potential to revolutionize product authentication and supply chain transparency.

This project explores the synergistic integration of blockchain technology and QR codes to develop a robust system for detecting counterfeit products. By leveraging block chain's immutable ledger to store product details and transactional information, coupled with QR codes serving as unique identifiers linked to blockchain records, the proposed system aims to empower consumers with the ability to verify product authenticity in real-time. Furthermore, integration with Metamask, a popular crypto currency wallet browser extension, ensures secure interactions with the blockchain, enhancing user confidence in the authentication process.

Through the development of a web-based application, users will be able to scan QR codes associated with products, triggering automated verification processes facilitated by smart contracts deployed on the blockchain. This seamless integration of blockchain technology, QR codes, and Metamask promises to offer a comprehensive solution to the pervasive problem of counterfeiting, fostering transparency, accountability, and consumer trust in supply chains.

A. Blockchian:

Blockchain is collection blocks that are linked together which stores information. Each block has a timestamp, transaction data and hash of its own and hash of previous block, so it is difficult to tamper with data. Blockchain is a decentralized system. It ensures that every new block added to the blockchain is the one and only true version that is agreed upon by all nodes in the Blockchain. It refers to the collective maintenance of a technical solution that maintains a continuous record file as a reliable database through decentralization.

B. Working of Blockchain:

When a new transaction is entered, it is then transmitted in a network of peer-to peer computers scattered across the world.

The network of computers then solve the equations to confirm the validity of the transaction. They are called miners. Once confirmed to be legitimate transactions, they are clustered together into blocks. The miner then receives an award as a proof of work. These blocks are then chained together creating a long history of all transactions that are permanent, The transaction is complete.
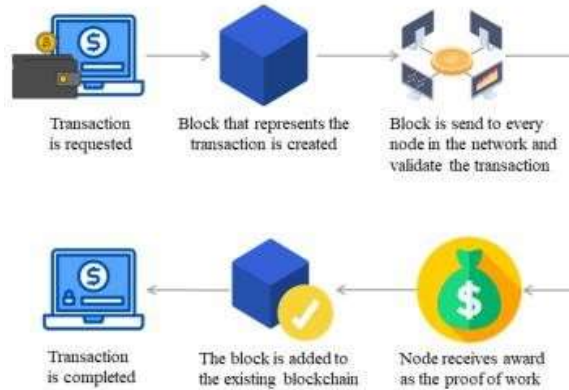

Figure:1 Working of Blockchain.

II. LITERATURE REVIEW

A Blockchain-Based Application System for Product Anti- Counterfeiting : The proposed system uses Ethereum as the back end Blockchain operating system and uses Ethereum's proprietary programming language Solidity as the high-level programming language for writing smart contracts. Solidity supports inheritance, library importing, etc. Solidity is designed for Ethereum Virtual Machine (EVM). Unlike Bitcoin's script, Solidity provides loops and it is Turing complete.

The total cost of running an application on the Ethereum public chain is directly related to the code simplicity of the distributed application. The future work of this system can be proof of code simplicity. The customer can trust that the distributed application because of the simplicity of code, and no redundancy code in it will have additional consumption.

sharing is proposed. The information is in the control of the owner so third-party interference is difficult. Users are always aware of the data that is being collected about them and how it is used. The blockchain block contains sender, amount, receiver, transaction id, product id and metadata. Ethereum is an open-source Blockchain. Ethereum is a technology that's home to digital money, global payments and applications. The process is simple as to get into the portal, pick a wallet that lets you connect to Ethereum and manage your funds, Get the ETH, use applications powered by Ethereum, start building.

III. PROPOSED SYSTEM

The proposed system uses Ethereum as the back end Blockchain operating system and uses Ethereum's proprietary programming language Solidity as the high-level programming language for writing smart contracts. Solidity supports inheritance, libraries importing, etc. Solidity is designed for Ethereum Virtual Machine (EVM). Unlike Bitcoin's scripts, Solidity provides loops and it is Turing complete. On the system, the public smart contract is based on Ethereum's Blockchain. In this project, for ease of testing, we use Geth to build a private chain and push the smart contract on this Private chain, so that the Private chain simulates the situation of the public chain. We use MetaMask for account balance and contract information management. The user interface seen by the user is a web page. The server side of the web page is made using the http-server suite, which was provided by node.js and web3.js is used as the link between the smart contract and the user interface. The Private Chain and Address information can be connected after setting the server.

A. System Design:

Blockchain-Based Fake Product Identification in Supply Chain: Proposed system to detect fake product with the help of QR code. End users can scan the QR code assigned to product to get the product details and transaction history, the steps involved Product enrolment, ship product to distributor, and ship product to retailer, end user gets details about the products.

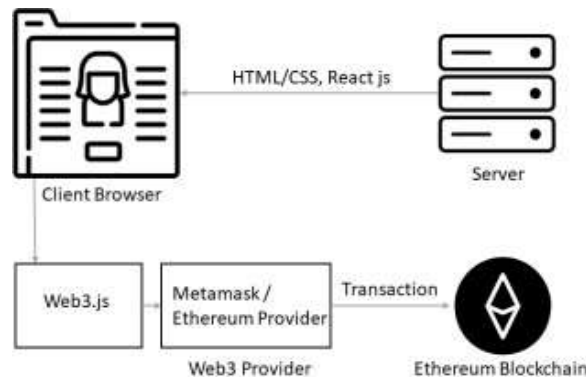In a Blockchain based system the data is stored on each node,

B. Ethereum:

Figure: 2 System Design.

then the nodes exchange information with each other over the network. Each node maintains all Blockchain data. The node verifies the received transactions and include them in the new block based on its own Blockchain data, and try to obtain the rights of the new block. Ethereum as the backend Blockchain operating system. Store relevant information on product sales in Blockchain which is accessible to everyone. It is cost efficient. In this blockchain technology for information

Ethereum is a Blockchain platform that can build smart contracts using a Turing-completeness programming language. Anyone can write smart contracts or other decentralized applications on Ethereum. Users can set access permissions, transaction formats, state conversion equations, and so on, and build any desired rules.

Users of Ethereum will first write a smart contract using Solidity, then they will change their smart contract Solidity code into Ethereum bytecode, and add the bytecode into a transaction and deploy the transaction into the network. When miners of Ethereum receive the transaction, they will record the transaction in a block and run the bytecode in the Ethereum virtual machine each time a transaction of this smart contract is called. To interact with a smart contract on Ethereum, the user has to send the information packaged in a transaction to communicate with the smart contract and interact with the smart contract by following the rule established within the smart contract. If successful, the smart contract will then have state changed on each miner's local storage.

C. Smart Contract:

Smart contract Smart contracts are programs that are stored inside Blocks. Smart contracts replaces the involvement of third party members. These are basically protocols that execute when the conditions are satisfied. They never change, that means no one can tamper with the contract.
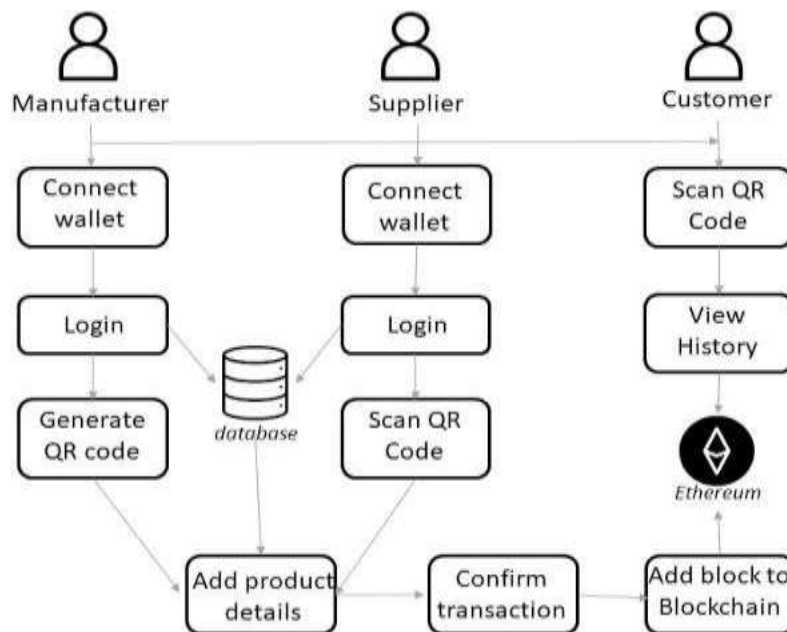
D. System Flow:

Figure: 3 System Flow.
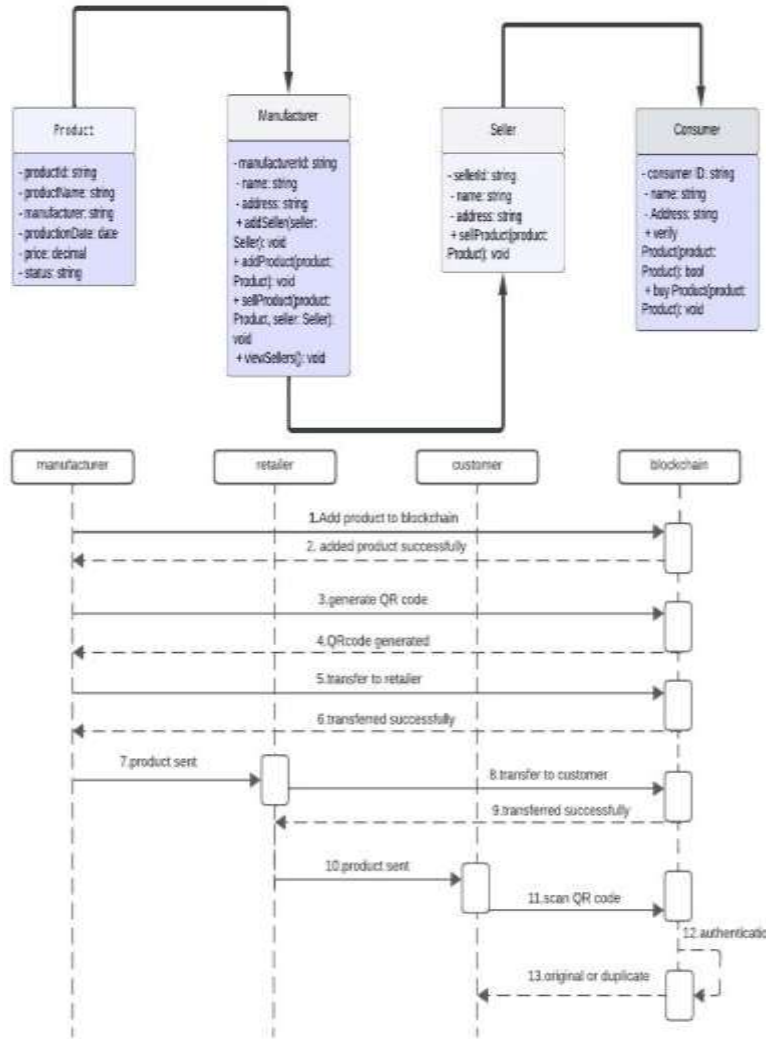
IV. METHODOLOGY

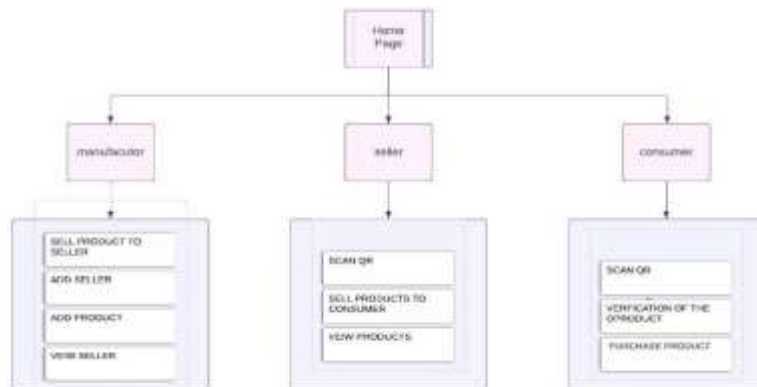Figure: 4 Class Diagram.

Figure: 5   Sequence Diagram.

Figure: 6 Front End Design and Features.

A.   Manufacturer:

The Manufacturer can Add Products by giving required product details and generates QR code for the product, and manufacturer can Add Sellers, and sell the products to sellers, and also view sellers. and by using Metamask, the manufacturer adds a block to Ethereum blockchain.

Figure: 7 Manufacturer.

B.   Seller:

The Seller Scans the Product QR code and sells the products to customers and the seller can view products.
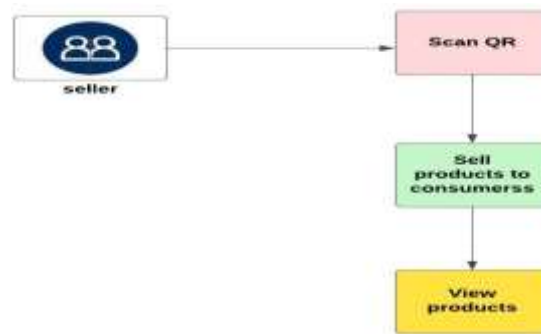

Figure: 8 Seller.

C.   Customer:

The Customers will Purchase the products from seller, and once after receiving the product the customer can verify the product and also view purchasing history.
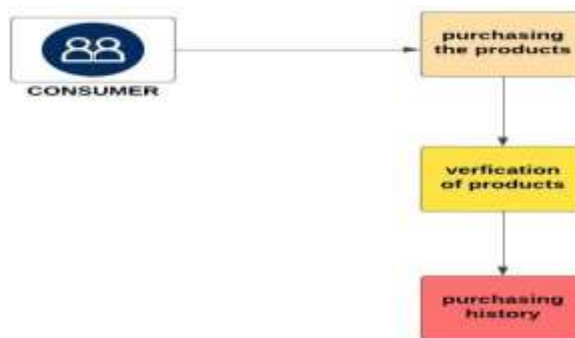

Figure: 9 Customer.

V. IMPLEMENTATION & RESULTS

The proposed system uses Ethereum as the back end Blockchain operating system and uses Ethereum's proprietary programming language Solidity as the high-level programming language for writing smart contracts. Solidity supports inheritance, libraries importing, etc. Solidity is designed for Ethereum Virtual Machine (EVM). Unlike Bitcoin's scripts, Solidity provides loops and it is Turing complete. On the system, the public smart contract is based on Ethereum's Blockchain.

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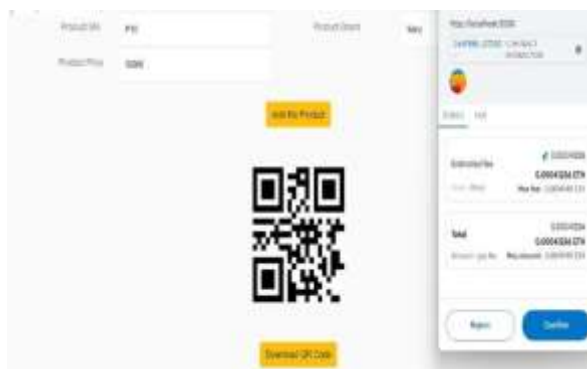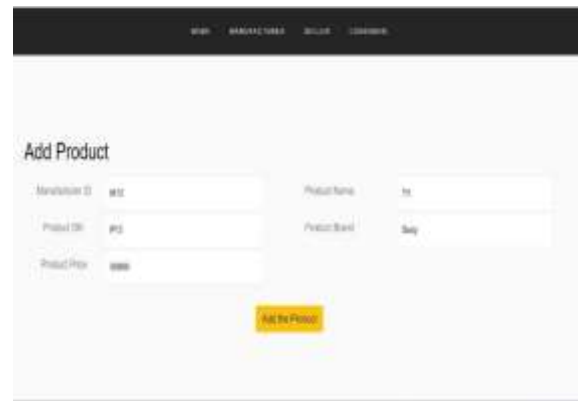
VI. CONCLUSION

Through this project, consumers can gain trust in the products they purchase, leading to increased confidence and loyalty. Moreover, the integration of block chain technology streamlines verification processes, reducing the risk of counterfeit products entering the market and enhancing supply chain integrity. While challenges such as integration complexity, scalability concerns, regulatory compliance, and user adoption may arise, addressing these issues through careful planning, education, and collaboration can pave the way for successful implementation. Ultimately, fake product identification using block chain, Ganache, and Metamask represents a promising endeavour that has the potential to transform product authentication practices, fostering trust and transparency across various industries.

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