Fake Product Detection in Supply Chain Using Blockchain Technology

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Abstract: **To overcome and stop the crucial effects of counterfeiting, a blockchain based system is used in identification of original products and also detects duplicate products to ensure the identification of original goods. In this project, with massive emerging trends in wireless technology, QR (Quick Response) codes provides a technique to cut down the practice of counterfeiting the products. The fake products are identified using QR of the product or goods is linked to a blockchain to store product details and guaranteed unique code of each product stored as blocks in the database. If the code in product matches, the notification will be sent to the customer indicating the authenticity of the product and else if it does not match the code in database, a notification will be sent to customer indicating that product is fake or counterfeited and notification is also sent to manufacturer about the place of purchase if customer accepts the request made by the application.**

Index Terms: **QR (Quick Response) codes, counterfeited, manufacturer, Supply chain etc.**

I. INTRODUCTION

In today's market, counterfeit products pose a significant threat to both consumers and businesses. Detecting fake products is a challenging task that requires efficient and reliable methods. One promising approach is leveraging technology such as QR codes coupled with Python-based algorithms. QR (Quick Response) codes have become ubiquitous in product packaging due to their ability to store information in a compact format. By integrating QR codes with Python, we can develop a robust system for fake product detection. In this project, we aim to implement a Fake Product Detection System using QR codes and Python. The system will utilize image processing techniques to extract QR code information from product labels. Subsequently, it will analyze the extracted data to verify the product's authenticity The project "Fake Product Detection with QR Code" aims to address the pressing issue of counterfeit products by leveraging QR code technology for authentication. The project involves the development of a system that utilizes QR codes embedded on products as a means of verification. The process begins with manufacturers assigning unique QR codes to each genuine product during the production phase. These QR codes contain encrypted information about the product's origin, authenticity, and other relevant details. Consumers can then use a mobile application or a dedicated QR code scanner to scan the QR code on the product. The application decrypt the information stored in the QR code and verifies it against a centralized database maintained by the manufacturer or a trusted third-party organization. If the product is genuine, the application confirms its authenticity, providing consumers with peace of mind regarding their purchase. However, if the QR code is invalid or linked to a counterfeit product, the application alerts the user, indicating that the product may be fake. In addition to providing consumers with a reliable method of authentication, the project also aims to deter counterfeiters by making it more difficult for them to replicate QR codes accurately.

II. LITERATURE SURVEY

counterfeiting. Developing an anti-counterfeit system dedicated to product authentication is its pertinent goal. The project aims to establish robust systems for confirming product authenticity at some point in the supply chain through using the features of blockchain and QR codes. This new strategy aims at solving the major issue of counterfeiting by offering an accurate

method to differentiate real products from fakes. In order to improve consumer acceptance and confidence in the validity of the product, this research aims to develop anti-counterfeit efforts through the proposed integration of blockchain and QR codes[1].

The author of the paper, one appealing solution is a blockchain device designed to combat counterfeit goods while reducing transaction costs. This innovative method ensures transparency across the supply chain and prevents product frauds through the use of Ethereum. Businesses may effectively address the challenge of counterfeit goods in a cost-effective way through the use of blockchain technology, improving safety and protecting their brand. Organizations of all sizes may implement robust anti counterfeiting measures without incurring significant costs thanks to the blockchain machine's capacity to maintain low transaction fees. In the continuous fight against counterfeit products, implementing the blockchain age is a great step forward that will increase customer acceptance and trust in the authenticity of the product [2].

Finding the causes of counterfeit goods and their effects on society has been one of the survey's main goals. There are a number of methods for detecting counterfeit products that include artificial intelligence, blockchain, QR codes, and machine learning. Diverse scholars have proposed various methods for developing a blockchain-based supply chain management system[3]

.A Study on the Detection of Fake Products by Prabhu Shankar and R. Jayavadivel. The amount of counterfeit products on the internet and in the underground market is growing tremendously. Therefore, it is essential to address the challenges in identifying fake products and develop appropriate technologies to improve detection precision. This is one of the current research topics being studied in the modern world. Several methods for detecting fake goods are addressed in this essay[4].

Daoud and Vuet.al focuses on the architecture of AI Application. It has three main parts: the data set, detection models, and trained model. Anti-counterfeiting machine learning-based solution to detect fake products. Two essential steps are involved: training models and detecting logos. Faster

R-CNN delivers superior accuracy while maintaining a relatively fast training speed. [5].

III. PROPOSED SYSTEM

PART-I:

This Research architecture diagram represents a blockchain-based counterfeit product detection system. Admins can add products, while suppliers update them, both triggering blockchain-secured QR code generation. Users browse products, add them to the cart, and place orders. Each order includes a unique QR code stored on the blockchain for authenticity validation. Users can scan and verify product legitimacy through the "Validate QR" module. The system ensures secure transactions and prevents counterfeiting with traceable, tamper-proof records.
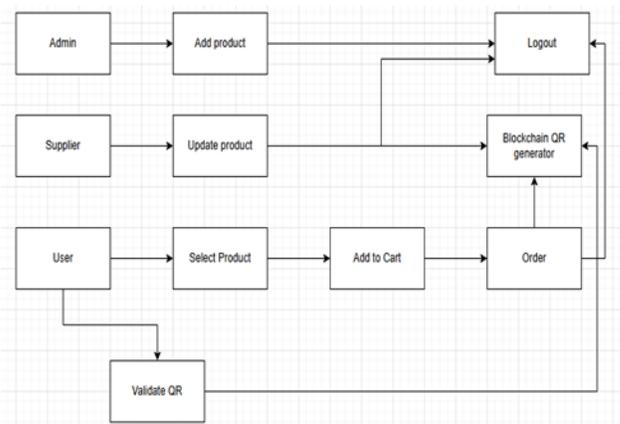

Figure 3.1: System Architecture

A. Admin Module

This module allows the administrator to manage products in the system and oversee blockchain integration. The admin ensures all products are properly registered, traceable, and securely stored using blockchain.

1. Add Product: The admin adds new products into the system with complete details.
2. Logout: After completing tasks like adding products, the admin can securely log out.
3. Blockchain QR Generator: Upon product addition or order placement, a unique QR code is generated and embedded into the blockchain to ensure tamper-proof verification.

B. Supplier Module

The supplier module provides authenticated access to suppliers, allowing them to update product data and participate in the blockchain-secured product flow.

1. Supplier Login: The supplier must be registered and log in using their Email and Password credentials.
2. Update Product: Suppliers can update existing product information such as date and time of dispatch or batch details.
3. QR Code Update: Once a user places an order, the associated QR code is finalized and stored in the blockchain for secure verification.

C. User Module

This module is designed for end users who browse, purchase, and verify the authenticity of products using blockchain-backed QR codes.

1. Select Product: Users can browse the available product catalog and choose items of interest.
2. Add to Cart: Selected products are added to a virtual shopping cart.
3. Order: Once the cart is finalized, users place an order. This triggers QR code generation, which is also emailed to the user for trusted verification.
4. Validate QR: Users can scan and validate the QR code using the system to ensure that the product is genuine and stored on the blockchain.

D. Product Selling Module

This module handles the display and purchasing process of products within the system, showing real-time updates from admin and supplier actions.

1. View Products: Users can see all available products that have been added by the admin and potentially updated by the supplier.
2. Add Quantity & Cart: Users can choose the desired quantity and add products to their cart.
3. Confirm Order: Users finalize the purchase, which triggers blockchain QR generation and initiates the email of the original QR to the customer for future validation.

PART-II:

Blockchain:

In this Research, blockchain technology with the SHA-256 hashing algorithm is used to ensure the authenticity and integrity of product data in a counterfeit detection system. Each product entry (including ID, manufacturer, supplier, and customer) is treated as a transaction and stored in a block. Before a block is added to the blockchain, it undergoes a Proof of Work process and is assigned a unique hash using the SHA-256 algorithm. This hash secures the block and links it to the previous one, forming an immutable chain. The SHA-256 ensures that even a small change in product data alters the hash, helping detect tampering. Users can scan a QR code to verify if the product's blockchain data is valid, enabling secure, transparent, and tamper-resistant verification.

1. SHA-256 (Secure Hash Algorithm - 256 bit):

Table 3.2.1: SHA-256 Algorithm

Step No.	Description
Start	Receive product and stakeholder details from Java via Flask API
1	Combine data: product ID, manufacturer, supplier, customer info
2	Generate a SHA-256 hash of the concatenated string
3	Save this hash as the product's identity
End	Unique product hash is ready for QR code generation and block mining

2. Proof of Work (Mining):

Table 3.2.2: POW Algorithm

Step No.	Description
Start	New product transaction enters the pending transaction pool
1	Initialize nonce and difficulty (e.g., hash must start with '0000')
2	Start iterating nonce to calculate hash of block contents
3	Continue until hash meets difficulty condition
4	Package transaction + hash into a new block
5	Append the block to the existing blockchain

End	New product block securely added to the chain

3. Block/QR Validation:

Table 3.2.3: Block Validation

Step No.	Description
Start	Begin block validation process after mining or during QR verification
1	Retrieve the block to be validated (usually the last block or the one containing the product hash)
2	Extract the stored hash of the block and its contents (product data, previous hash, timestamp, nonce)
3	Recalculate the hash using the same block contents and SHA-256 algorithm
4	Compare the recalculated hash with the stored hash in the block
5	If hashes match, proceed to check if block.previous_hash equals the hash of the previous block in the chain
6	If both checks are true, block is valid (integrity and sequence maintained)
7	If either check fails, block is invalid (indicates tampering or broken chain)
8	Return validation result (True or False) to the verification system

IV. RESULT AND DISCUSSION

This Research blockchain technology is used to prevent product counterfeiting by securely storing product and stakeholder data (manufacturer, supplier, customer) in blocks. Each product is linked to a unique QR code, which, when scanned, verifies the product's authenticity by matching its details with the blockchain. The system uses SHA-256 hashing and Proof of Work to ensure data integrity and tamper resistance. Communication happens between a Java frontend and Python Flask backend, with product data also stored in MySQL. Additionally, the original QR code is emailed to the customer at the time of product entry, providing a trusted reference for later verification. This ensures secure, transparent, and verifiable tracking of products across the supply chain.

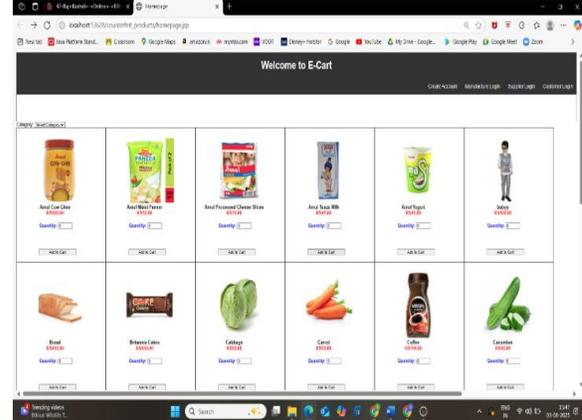Home Page containing Customer Account, Manufacture Login, Supplier Login, Customer Login

Figure 5.1 : Home Page

Account creation for Customer with all the details of Customer

Figure 5.2 : Create Account of Stakeholders

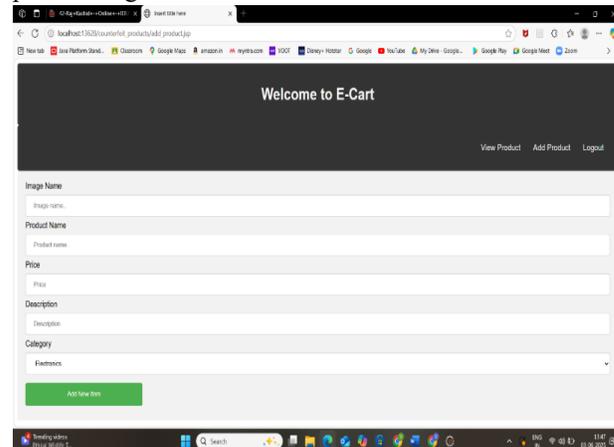Manufacturer will ADD product and the QR of product is generated

Figure 5.3 : ADD product Details

Order placed By Customer At This Point QR of the product is generated at supplier module and they need download QR manually.
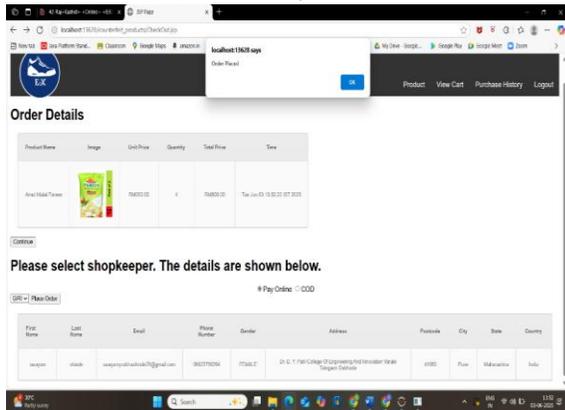

Figure 5.4 : Order placed By Customer

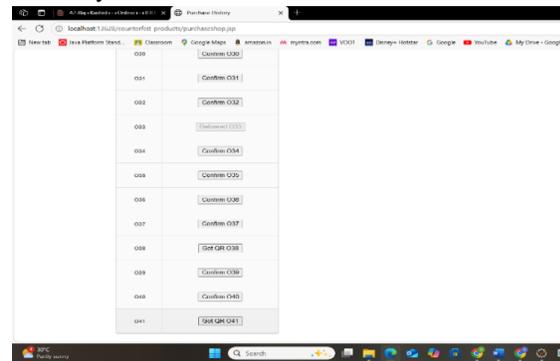Supplier Confirm QR And Download when Order Placed By Customer

Figure 5.5 : Confirm / Download QR

Email To the customer of original QR when order placed

Figure 5.7 : Customer Get QR On Email

Customer Will scan the QR that got on the email if correct show the correct product
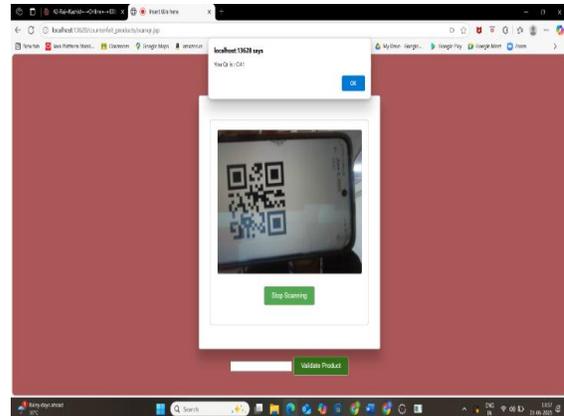

Figure 5.8 : verify product

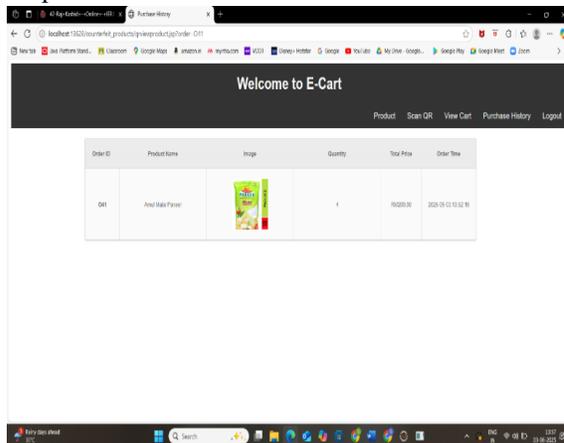Customer Can see the product details by validating the product

Figure 5.9 : validate product

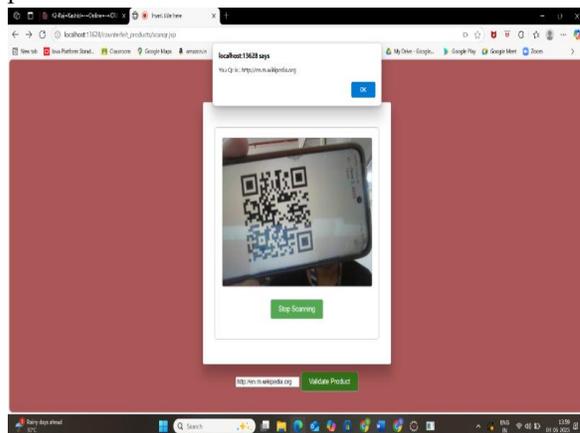QR Validated by customer if fake shows invalid product

Figure 5.10 : Verify Product(fake)

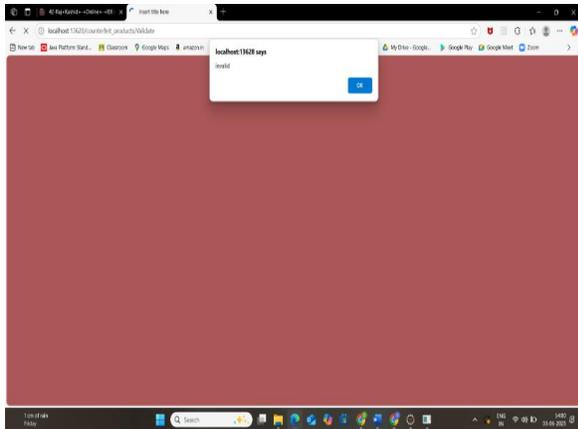Shows Invalid product when fake QR Scanned

Figure 5.11 : Invalid Product.

V. CONCLUSION

This project successfully demonstrates how blockchain can be used to prevent product counterfeiting by securely storing product and stakeholder data and enabling QR-based verification. The integration of SHA-256 hashing, Proof of Work, and QR code email delivery ensures data integrity and trust. It enhances transparency and builds consumer confidence in product authenticity.

In the future, the system can be expanded to include more stakeholders (like retailers), support real-time blockchain explorers, implement smart contracts for automation, and integrate with mobile apps or NFC for easier verification and broader adoption across industries.

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