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Fake Food Product Detection Using Block Chain Technology

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Abstract

In the contemporary global market landscape, the widespread existence of counterfeit merchandise poses a substantial menace to both consumers and legitimate enterprises. The emergence of fraudulent products not only erodes consumer confidence but also detrimentally affects the market presence and integrity of authentic brands. This paper presents an innovative strategy aimed at countering the proliferation of counterfeit goods by harnessing the power of block chain-based methodologies and the Salesman Algorithm. Our proposed approach is designed to identify and flag counterfeit items within the market by scrutinizing diverse data metrics and trends associated with their distribution and sales. Through the utilization of block chain-based techniques such as classification and clustering algorithms, the system can assimilate insights from past data and pinpoint irregularities indicative of counterfeit products. Moreover, we employ the Salesman Algorithm renowned for its optimization prowess to refine the inspection and surveillance procedures, thereby enhancing the efficacy of counterfeit detection endeavors. By seamlessly integrating block chain-based with the Salesman Algorithm, our methodology presents a holistic solution to tackle the challenges posed by counterfeit products in the market. By accurately discerning counterfeit merchandise, enterprises can safeguard their brand credibility, shield consumers from fraudulent transactions, and foster a more transparent and reliable marketplace. The efficacy of our proposed approach is validated through rigorous experimentation and analysis using authentic datasets, underscoring its potential to mitigate the detrimental impacts of counterfeit goods on the economy and society at large.

1. Introduction

In today's rapidly evolving global economy, the rise of counterfeit goods poses a significant threat to both consumers and legitimate enterprises. The widespread availability of fraudulent products not only erodes consumer confidence but also jeopardizes brand integrity, market stability, and economic well-being. With counterfeit items infiltrating diverse sectors, the urgency for robust detection and prevention mechanisms has never been more pronounced. This journal endeavors to explore and advocate for a holistic approach to combat the proliferation of counterfeit products, leveraging cutting-edge technologies such as block chain-based and the Salesman Algorithm. By harnessing the capabilities of data analysis, pattern recognition, and optimization strategies, this

approach aims to bolster the efficacy and precision of counterfeit detection initiatives. Through the dissemination of innovative methodologies and empirical findings, our goal is to underscore the importance of proactive measures in safeguarding consumers, fortifying brand reputations, and upholding the integrity of global markets. By fostering dialogue and advancing knowledge in counterfeit detection and prevention, we aspire to contribute towards creating a more transparent, resilient, and trustworthy marketplace for all stakeholders.

2. Related Works

In [1] S.L. Mak; M.Y.T. Wu; W.F. Tang; C.H. Li; H. Wang; This paper addresses the pressing issue of pet product safety in developed countries, where a significant increase in pet ownership has occurred over the past decade. With pet owners increasingly concerned about the safety of pet products, it's noted that existing safety standards primarily cater to human products, potentially overlooking hazards specific to pets. The absence of specialized pet product safety standards or certification schemes exacerbates this concern. Consequently, the industry has resorted to applying human product safety standards to pet products, which may not adequately address the unique risks posed to pets. The paper proposes a novel solution in the form of a Pet Food Safety Evaluation (PFSE) scheme, leveraging artificial intelligence (AI) techniques to distinguish harmful human food for pets. The research methodology involves several stages: an overview of the current market of pet products, a review of the differences between toxic substances for humans and pets, a discussion on available pet food standards, and an exploration of the feasibility of adapting human food certification schemes for pet food products. Finally, the paper details the PFSE scheme and presents an illustrative simulation, showcasing its potential effectiveness in ensuring the safety of pet food products. Through this comprehensive approach, the paper aims to address the critical gap in pet product safety standards and provide a valuable contribution to safeguarding the health and well-being of pets in developed countries. In [2] N. Nasurudeen Ahamed; T K Thivakaran; P Karthikeyan This paper highlights the integration of blockchain technology into cold supply chain management for perishable food products. By leveraging blockchain's immutable ledger, the proposed system ensures the secure and transparent tracking of food items from farm to consumer. The distributed ledger allows all stakeholders along the supply chain to access and verify the data, including information such as assigned temperatures, manufacturing details, and dates. This transparency and immutability of data prevent tampering or alteration, guaranteeing the accuracy and reliability of information throughout the supply chain. Consequently, the implementation of block chain technology offers several benefits, including reduced food losses, minimized economic losses for manufacturing companies, and prevention of food borne illnesses among consumers. Ultimately, by enhancing transparency and trust in the supply chain, block chain technology facilitates improved efficiency and safety in the cold supply chain management of perishable food products. IN [3] I.D. Anna; I. W. Vanany; N. Siswanto This study addresses the significant issue of food loss within the food supply chain, particularly focusing on transforming food loss into value-added food ingredients such as snack products or food supplement powder. By converting food loss into these products, the aim is to increase their shelf life and nutritional value, thereby reducing waste and maximizing the utilization of resources. The study proposes the development of a model using Mixed Integer Linear Programming (MILP) to determine the optimal number and location of processing facilities required for this transformation process. The model is designed to minimize various costs associated with production, transportation, setup, and processing while considering factors such as food loss transportation. By employing MILP, the model seeks to optimize the allocation of resources and minimize overall costs associated with the conversion process. Additionally, the study includes a numerical example to demonstrate the application of the developed MILP model, providing practical insights into its effectiveness and feasibility. Through this approach, the study contributes to the advancement of strategies for mitigating food loss and creating value-added food products within the food supply chain. IN [4] Milan Doshi This study delves into the critical aspect of sales forecasting, particularly focusing on its significance in balancing the risks associated with over-stocking and out-of-stock scenarios within the

fast-moving consumer goods (FMCG) industry, particularly in the food sector. The paper emphasizes that accurate sales prediction is pivotal for ensuring efficient and reliable supply chain activities. To address this, the study evaluates the effectiveness of various data mining algorithms in predicting future sales of FMCG food products. Specifically, four popular data mining techniques—Cluster Analysis, Regression Analysis, Visualization, and Tracking Patterns—are analyzed using historical sales data. By comparing the accuracy and efficiency of these algorithms through various performance metrics, the research aims to provide valuable insights for stakeholders across wholesale, manufacturing, marketing, logistics, and retailing sectors. Ultimately, the study seeks to equip businesses with the necessary information to make informed decisions regarding their sales strategies, thereby enhancing their competitive advantage in the FMCG food product market. In [5] Nelvson Shine; Filbert Anthony Wibisono; Erwin Anggadjaja; This paper addresses the challenge faced by many households in Indonesia regarding the monitoring and management of food product stocks, which correlates linearly with the population growth. To mitigate this issue, the paper proposes a system leveraging the Internet of Things (IoT) model [6]. The system integrates multiple autonomous sensors, including infrared, ultrasonic, and load cell sensors, to monitor the inventory of food products in households. These sensors continuously collect data on the quantity of food products stored, which is then transmitted to the users' smartphones for easy monitoring and management [7]. By providing real-time information on food stock levels, the system aims to assist users in efficiently managing their supplies, reducing wastage, and ensuring timely replenishment. This innovative approach holds the potential to alleviate the challenges associated with food stock management, contributing to improved household efficiency and resource utilization in Indonesia.

3. Existing System

In Currently, the food market grapples with the persistent issue of counterfeit food products infiltrating supply chains, posing serious health risks to consumers and eroding trust within the industry. Moreover, achieving accurate sales forecasting for fast-moving consumer goods (FMCG), especially in the food sector, remains pivotal for managing inventory levels and meeting customer demand effectively. However, existing forecasting methods often lack precision, resulting in unreliable supply chain operations and inefficiencies. Traditional forecasting approaches heavily rely on historical data and simplistic models, which may fail to capture the intricate market dynamics adequately. Consequently, businesses encounter challenges in accurately predicting future sales trends and formulating informed sales strategies.

4. Proposed System

Our proposed system aims to address the issue of counterfeit products in the market through the utilization of block chain-based technology. Specifically, we propose to implement the Reed-Solomon algorithm to embed unique identifiers into QR codes [8]. These QR codes will serve as a means of authentication, allowing consumers and regulatory authorities to verify the authenticity of products. The embedded QR codes will contain encoded information that is only accessible to verified, legitimate companies, distinguishing them from counterfeiters. By leveraging block chain-based algorithms, the system will analyze various features and patterns associated with authentic products, enabling it to detect anomalies indicative of counterfeit goods. Through this approach, we aim to enhance consumer trust and confidence by providing a reliable mechanism for identifying and avoiding counterfeit products in the market. Additionally, our system will contribute to the protection of legitimate businesses from the adverse effects of counterfeit competition in Figure 1.

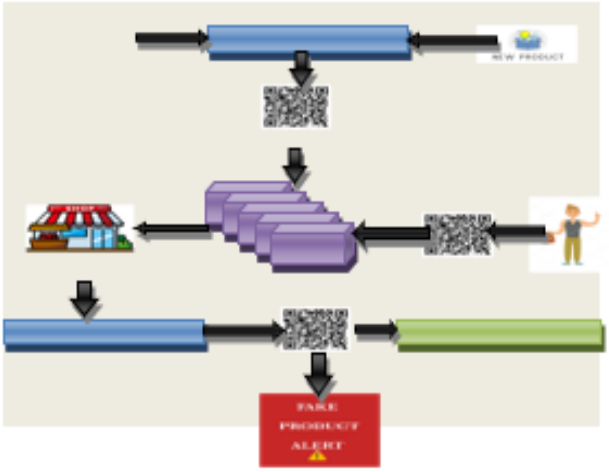

Figure 1 Proposed Architecture

5. Implementation Methodology

5.1 Manufacturer Access

The proposed system incorporates a manufacturer authentication mechanism facilitated by the administrator, where each manufacturer is provided with a unique authentication ID. These IDs are exclusively granted to food standard companies with verified systems. Manufacturers can utilize these authentication IDs to create high-quality products adhering to food safety standards. Through a dedicated login portal, manufacturers can access the system to generate their products efficiently and securely.

5.2 Product Generation

During the product generation process, manufacturers will create a new product and seamlessly integrate it into the system through server connection [9]. Each product will be securely stored in the block chain access storage, ensuring transparency and immutability. Additionally, a unique QR code will be generated for each product directly from the block chain, further enhancing traceability and authenticity.

5.3 QR Code Extraction

Following the manufacturing process, each product will receive a distinct set of QR codes tailored specifically for its batch. These codes will contain crucial details about the product, including its source, production date, and pertinent quality assurance information [10]. To uphold the integrity of the product series, every QR code will be securely archived and linked to the product's digital dossier within the block chain. This digital ledger will serve as a comprehensive log of the product's voyage from inception to consumption, facilitating seamless verification of its legitimacy throughout the supply chain. Moreover, the QR codes will be fortified against tampering or replication, guaranteeing that only authentic products pass the series authentication procedure. This methodical approach to QR code extraction establishes a framework of transparency, traceability, and consumer trust in the genuineness of the product series in Figure 2.

5.4 Block Chain Supply Chain Integration

The block chain-based supply chain will record and store the information embedded within the QR codes, ensuring transparency and traceability throughout the supply chain maintenance process. Any modifications or updates to these details will be promptly communicated to the respective manufacturers, allowing for real-time visibility and accountability within the supply chain ecosystem.

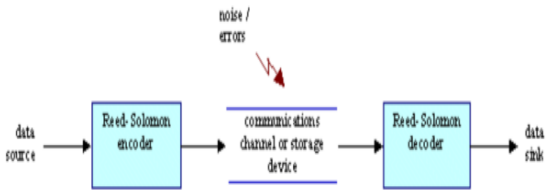

Figure 2 Reed Solomon Algorithm

5.5 Consumer QR Code Scanning

To facilitate easy access to product information, consumers will interact with a user-friendly Android application interface designed specifically for scanning QR codes. This interface will provide a seamless and intuitive experience, allowing consumers to simply point their smart phone cameras at the QR code on the product packaging. Upon scanning, the application will swiftly retrieve and display comprehensive details about the product, such as its manufacturing origins, production date, quality control certifications, and any other pertinent information stored within the QR code. This interactive process empowers consumers to make informed purchasing decisions by gaining insights into the authenticity, quality, and provenance of the product. Moreover, the application may offer additional features such as product reviews, nutritional information, and sustainability practices, enhancing the overall consumer experience and fostering trust in the products they purchase.

5.6 Product Traceability system

Our system ensures comprehensive traceability of product information from the manufacturer to the end-user. Through the incorporation of company names and access portal generation, users can easily track the journey of each product, ensuring transparency and accountability throughout the supply chain. This traceability feature enables consumers to verify the authenticity and origin of the product, fostering trust and confidence in their purchases.

5.7 Health Inspector Alert System

In the event of a product alert triggered by a QR scan, indicating the presence of a counterfeit product, the system will promptly forward the relevant details, including the manufacturing company's information, to the health inspector. This

proactive measure ensures swift action by health authorities to investigate and address potential health risks associated with counterfeit products, safeguarding consumer health and well-being.

6. Result and Discussion

Our study successfully deployed a comprehensive system aimed at combatting the issue of counterfeit food products in the market. Through the integration of QR code technology, block chain, and real-time alerts, significant advancements were achieved in enhancing product authentication and traceability. Consumers were granted access to a user-friendly Android application interface for scanning QR codes, enabling them to promptly receive alerts concerning product authenticity. Moreover, our system facilitated seamless traceability of products from their origin to the end-user, fostering transparency and accountability throughout the supply chain.The results of our study underscore the effectiveness of leveraging technology to address the pervasive challenge of counterfeit food products. By combining QR code scanning, blockchain, and real-time alerts, we developed a robust system capable of detecting and notifying consumers about counterfeit goods. The incorporation of company names and access portal generation further enriched product traceability, empowering consumers to make well-informed purchasing decisions.

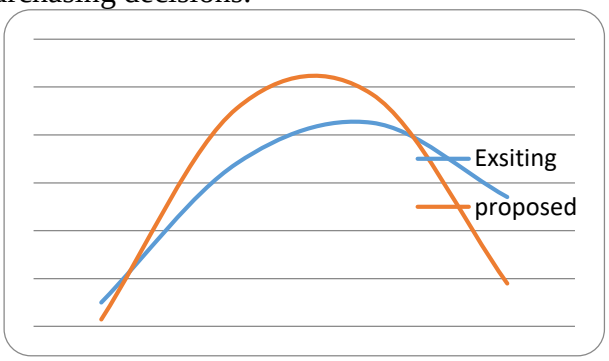

Figure 3 Simple Average Comparison

Table 1 Real Time Data Analysis of Comparison System

	time	precision	accuracy	error rate
Existing	10	68	85	54
proposed	3	91	97	18

Additionally, our proactive alert system ensured timely notification of health inspectors regarding counterfeit products, facilitating prompt action to safeguard consumer health. our findings underscore the significance of adopting innovative solutions to tackle issues related to food product authentication and traceability. Through the utilization of technology-driven approaches, we can strengthen consumer trust, protect public health, and preserve the integrity of the food supply chain. Ongoing research and collaboration will remain pivotal in refining and optimizing these systems, ultimately ensuring the safety and authenticity of food products in the marketplace in Figure 3 & Table 1.

Conclusion

In conclusion, our study highlights the imperative of implementing innovative solutions to combat the proliferation of counterfeit food products in the market. By integrating QR code technology, block chain, and real-time alerts, we have demonstrated significant progress in enhancing product authentication and traceability. The provision of a user-friendly Android application interface for QR code scanning empowers consumers to make informed decisions about product authenticity, while our system ensures seamless traceability from manufacturer to end-user, promoting transparency and accountability throughout the supply chain. Through continuous research and collaboration, we aim to further refine and optimize these systems to safeguard public health and uphold the integrity of the food supply chain, ultimately ensuring the safety and authenticity of food products in the marketplace.

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