

Research and Implementation of Food Traceability and Data Collection System in the E-Era

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Abstract: Traditional management of food ingredients mostly relies on manual information recording, which presents issues such as non-standardized data entry and potential data loss. With the rapid development of the Internet, digital supervision has gradually entered the food industry, and consumers' awareness of food safety has continuously increased, hoping to intuitively understand the entire process information of food ingredients. To address the aforementioned pain points, this paper designs and implements a food ingredient traceability collection system. To ensure the safety and reliability of food ingredients, this study integrates blockchain and network technologies to design and implement a traceability data collection system for ingredients, aiming to track information on production, processing, and sales, thereby ensuring high transparency in the ingredient supply chain.

Keywords: Food Traceability; Information Acquisition; Digitalization.

1. Introduction

With the development of the internet in the E era and people's growing health awareness, demands for food safety are getting higher and higher [1]. Traditionally, the tracing of food ingredients is often done through paper-based registration, which is not only cumbersome to complete but also poses certain difficulties in later information retrieval. In the era of E-commerce, Internet of Things (IoT) collection technology can be utilized to complete the full-process information entry and traceability of food from production to processing and then to sales. Digital supervision of the food industry is a major trend. This study aims to explore how ingredient traceability collection systems can make the food supply process more transparent, hoping to provide useful insights for the field of food safety. This system employs a front-end and back-end separation B/S architecture, choosing Spring Boot as the back-end framework. The front-end is developed based on Vue and ElementUI component libraries, using MySQL database to store business data. It implements scanning and tracing through QR code generation technology, and reserves a blockchain certificate storage interface to prevent tampering with ingredient information.

2. Background and Significance of the Ingredient Traceability Collection System

Food safety has always been a hot topic in society, especially with the frequent food safety incidents in recent years, which have made people worry about the source and quality of ingredients. In traditional food material management, there is a heavy reliance on manual record-keeping to manage food material information, which has obvious drawbacks such as the potential for information tampering or loss, making it difficult to trace the source in case of any issues. This ingredient traceability and collection system uses information technology to monitor and track every step of ingredient production, processing, and distribution, to ensure the safety and quality of food. For safety management departments, the food traceability and

collection system enables real-time monitoring of food safety risks, rapid traceability, and precise accountability, enhancing the digital supervision capability of food safety and effectively preventing food safety accidents. For businesses, the system improves the efficiency of food control; for consumers, scanning the traceability QR code allows them to view all circulation information of the food, ensuring food safety and traceability; In conclusion, The system not only improves the efficiency of food safety supervision but also provides consumers with reliable information about food safety, boosting their trust and satisfaction, It holds certain practical significance [2].

3. Key Technologies for Food Ingredient Traceability Collection System

(1).QR Code Technology: A QR code is like an 'ID card' for ingredients. By assigning a unique barcode to each ingredient, it allows for identification and tracking. QR code technology is the core function of this system. Through the Java QR code tool class, the information of the ingredients is generated into their exclusive QR codes for traceability. Generate traceability QR codes based on different food ingredient information, allowing consumers to access the traceability page by scanning the code with their mobile phones. The barcode can include information such as the ingredient's origin, production date, and batch number, making it easy for consumers to check and trace after purchase.

(2).Blockchain technology: stores ingredient information on the blockchain and uses unique identifiers to mark the data, ensuring its authenticity and validity [3]. With blockchain technology backing it up, consumers can check the ingredient information saved in data points anytime, making sure the food supply is transparent and trustworthy.

(3).Database Technology: This system employs a MySQL database for storage, encompassing basic information of ingredients, user information, circulation records, and more, to facilitate traceability. By utilizing primary key indexes and foreign key associations in database tables, various information pertaining to ingredients is stored and managed,

thereby enabling swift querying, modification, and updating of data, ensuring data accuracy and integrity.

(4).Spring Boot: The backend is developed using Spring Boot as the core framework, which simplifies the complex configuration process of Spring and boasts advantages such as automatic configuration, rapid development, and lightweight efficiency, enabling the quick setup of stable backend business services. The framework integrates a Tomcat container, eliminating the need for additional server configuration. It supports layered development, allowing precise separation of the data access layer, business logic layer, and control layer. This framework is well-suited to the development needs of multiple modules and businesses in food traceability, ensuring efficient processing of business requests such as data collection, storage, querying, and modification.

(5).Vue:The front end adopts the lightweight Vue.js framework, which is based on component-based development concepts, featuring strong page reusability and fast rendering speed, making it suitable for developing interactive visual interfaces. Combined with the Element UI component library, it allows for the rapid construction of login interfaces, data collection interfaces, traceability query interfaces, and data statistics interfaces. The interfaces are simple and beautiful, with convenient operation, adapting to computer-based usage scenarios while ensuring smooth and compatible system operations.

4. Design of Ingredient Traceability Collection System

(1).Requirement Analysis :This food traceability and collection system adopts a front-end and back-end separation technology architecture. The front end utilizes the Vue framework, while the back end employs the Spring Boot framework. The database is MySQL, ensuring overall technical controllability and a certain degree of technical feasibility. The functional modules of this food traceability and collection system can be divided into three major categories, each corresponding to its specific function. These mainly include the administrator management module, the merchant information entry module, and the consumer traceability module. Administrators are the system's highest-privileged users, with the ability to manage and review merchant information, food ingredient information, traceability data, QR code information, and data statistics. Their main functions include managing merchant and consumer accounts, reviewing merchant qualifications, managing food ingredient data, and managing basic system data. Merchants, also known as food ingredient suppliers, are primarily responsible for entering food ingredient information, including traceability data such as the origin, logistics, and inspection reports of the ingredients. Consumers mainly use the system to query traceability information, entering a page by scanning a QR code to view information such as food batch numbers and inspection reports.

(2). Hardware equipment: According to the system requirements, the hardware of this system mainly includes servers and user terminals. A regular PC server can be used to support backend services and MySQL operations. Merchants can use a regular desktop computer to enter ingredient information, while consumers can scan the traceability code via their mobile phones. The system reserves hardware

interfaces that can be connected to blockchain servers to complete information certification.

(3). Development Language: The development language used for the system includes Java, C#, and HTML, with MySQL being the chosen database. Data collection and display are achieved through the integration of blockchain technology and network technology [4].

(4). Database Design: Based on the business requirements of this system, design four core data tables, standardize field types, primary keys, and foreign key associations to ensure data integrity and associativity;

1) User information table: used to store the account, password, role permissions, contact information, etc. of various users (administrators, merchants, and consumers) on the platform, for system login and permission control;

2) Merchant information table: Stores fields such as merchant ID, name, origin, qualification documents, expiration date, status, and audit results to facilitate merchant management;

3) Ingredient Basic Information Table: Record basic information such as ingredient name, origin, and introduction;

4) Traceability code information table: Stores the traceability QR code number, corresponding batch number, generation time, binding status, etc.

(5). System Design: This system employs a B/S three-tier architecture with front-end and back-end separation. The presentation layer utilizes Vue front-end to display the traceability pages and handle user interactions. The business layer employs Spring Boot technology to handle various business logic processes. The data layer utilizes MySQL database to store traceability data. According to the system implementation requirements, the entire system is divided into an administrator management module, a merchant data entry module, and a consumer traceability module. The relationship among them is that the traceability code service module primarily provides traceability services for consumers; the data entry module allows merchants to record traceability information [5]. The business data entry module is the core of the system, which targets food ingredient suppliers. Suppliers need to complete the entry of food ingredient information, such as production location information, inspection reports, and circulation information. After review by the administrator, the system immediately generates a corresponding QR code, which consumers can scan to view the complete traceability chain of the food ingredients. The system usage process is as follows: users enter the traceability system through an account and password, and the backend checks the account permissions. After logging in, users enter different functional menus. With administrator permissions, users can add, review, and delete business accounts, as well as manage consumer accounts. With business permissions, users can upload documents such as business licenses and food production licenses for review by the administrator. After passing the review, businesses can complete the entry of food ingredient batch information. With ordinary consumer permissions, users can scan the QR code to query food traceability information such as food ingredient name, batch number, and supply time, enabling rapid traceability and precise positioning of problematic food ingredients.

5. Issues and Prospects of the Food Traceability and Collection System

(1). High Costs: The traceability system requires blockchain records from the production of ingredients to their sale. The cost of using blockchain is not low, and significant investment is also needed for subsequent system maintenance, promotion, and popularization.

(2). Insufficient consumer awareness: Many consumers lack sufficient understanding of product traceability systems, and when purchasing goods, they still rely solely on the barcode of the production date and assume there is no issue.

Although the current food traceability and collection system faces a series of challenges, with the continuous support of government policies and the influx of corporate investment, these issues are expected to be properly addressed, and it is anticipated to play a more significant role in the field of food safety.

6. Conclusion

Based on the E-era background and issues in the food safety traceability industry, this study designs a set of food ingredient traceability collection systems. The system is built on a Spring Boot+Vue front-end and back-end separation architecture, combining QR codes and blockchain encryption

technology to establish a full-process food ingredient traceability management system, achieving the goal of ensuring the safety and traceability of food ingredients. This provides strong support for the construction of China's food safety supervision system.

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