Tamper Evident Inventory and Sales Recording System Using Chain-Based Data Integrity to Ensure Audit Reliability for Mashikketta Restaurant Main Branch

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ABSTRACT

This project created a web-based application called Tamper-Evident Inventory and Sales Recording System Using Chain-Based Data Integrity to Ensure Audit Reliability for Mashikketta Restaurant. The system was designed to address common problems in small restaurant operations, particularly the risk of unauthorized modification of sales and inventory records and the lack of reliable audit mechanisms in traditional point-of-sale systems. By improving record integrity and traceability, the system aims to support accurate reporting and strengthen accountability in daily business operations. The web-based application utilizes cryptographic hashing and chain-based data linking to ensure that each transaction record is securely connected to previous entries, making any form of data tampering detectable. Transaction histories are preserved instead of being overwritten to support auditing and review processes. The system includes role-based access control, secure user authentication, real-time inventory monitoring, basic sales analytics, and tamper-evident audit logs. It was developed using C# with the .NET framework, React.js for the user interface, and MySQL for database management, with password hashing and structured data logging implemented to enhance security.

The study employed a quantitative developmental research design focused on system development, testing, and evaluation. Data were gathered through structured questionnaires and system testing involving operational users and technical experts. An Agile software development methodology was followed to allow iterative improvements based on feedback. To evaluate system quality, the ISO/IEC 25010 Software Quality Model was used, as it is suitable for assessing software performance and usability from both user and technical perspectives.

The evaluation results indicate that the system achieved a high level of overall acceptability based on the ISO/IEC 25010 criteria. The findings confirm that the system effectively delivers tamper-evident and audit-ready sales and inventory records for small-scale restaurant environments. The system improves accountability, reduces the risk of unnoticed data manipulation, and supports management decision-making. Future enhancements may include mobile platform support, offline functionality for areas with unstable internet connectivity, and expanded analytics features to improve usability and long-term adoption.

Keywords: Web-Based Application, Tamper-Evident System, Chain-Based Data Integrity, ISO/IEC 25010, Inventory Management

INTRODUCTION

Restaurants, like many small businesses, continue to face persistent challenges in maintaining accurate and reliable sales and inventory records. Inaccurate reporting, undetected data tampering, and weak audit trails remain common issues that disrupt daily operations and undermine financial stability. Traditional methods such as manual recording or basic point-of-sale systems are limited in their ability to secure records, making businesses vulnerable to inconsistencies, stock shortages, and difficulties during audits. With the growing

importance of data transparency and accountability, there is a pressing need for systems that ensure not only operational efficiency but also data integrity and audit readiness.

Mashikketta Restaurant, a local food service establishment, reflects these common challenges. Like many small restaurants, it relies on accurate transaction records to monitor performance and ensure accountability. However, its existing methods for sales and inventory management leave room for errors and manipulation, reducing confidence in reports and complicating management decisions. To strengthen its operations, the restaurant requires a system that secures data, enhances transparency, and provides timely insights for decision-making.

In response to this need, the researchers developed a web-based inventory and sales recording system that integrates tamper-evident mechanisms through chain-based data integrity. The system employs cryptographic hashing and linked transaction records to ensure that every sales and inventory entry remains verifiable and cannot be altered without detection. Features such as role-based access control, secure authentication, automated inventory tracking, and descriptive sales analytics are included to improve accountability and streamline operations. Implemented with C# under the .NET framework, React.js for the user interface, and MYSQL for database management, the system combines robust security with practical usability for small restaurant environments.

The study aimed to create a solution that addresses the specific problems faced by Mashikketta Restaurant while demonstrating how similar businesses can benefit from tamper-evident systems. By strengthening record authenticity and reducing the risks of undetected manipulation, the project contributes to improving operational transparency and audit reliability in small-scale food service enterprises.

Thus, a tamper-evident inventory and sales recording system is created that enhances data integrity and audit readiness for Mashikketta Restaurant. Specific Objectives are:

1. Design and implement a system that applies chain-based data integrity for secure and traceable transaction recording.
2. Integrate role-based access and activity logging to establish accountability among staff and administrators.
3. Provide sales analytics and inventory monitoring features that support accurate and data-driven decision-making.
4. Evaluate the system using ISO 25010 software quality standards, focusing on functionality, reliability, usability, performance efficiency, security, and portability.

SCOPE

The study is about employing chain-based concepts to identify unauthorized changes in sales transactions and inventory movements. The system ensuring data integrity covers the following:

- Oversee and record inventory movements, including receipts.
- Keep track of and verify everyday sales transactions.
- Securely update product and stock information.
- Keep an eye on user activity to stop unwanted modifications.
- Use the order simulation interface to handle sales transactions.
- User Dashboard – Handles sales transactions, order simulation, inventory viewing, and basic sales reports.

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- Admin Dashboard – Manages inventory movements, product and stock updates, user activity monitoring, transaction verification, and data integrity control.

- Create rudimentary sales reports.

LIMITATION

These are the limitations of the study:

- The system is designed specifically for the main branch only;

- The system is for inventory management and sales recording;

- Order process is not a full POS system;

- Analytics is limited to descriptive reporting; no predictive insights;

- Offline mode is unavailable;

- Access is restricted to authorized staff.

THEORETICAL FRAMEWORK

This study is guided by several ideas and concepts that help explain how the proposed system works and why it is expected to improve the integrity of sales and inventory records.

1. Cryptographic Hash Functions for Tamper Detection

Cryptographic hash functions are used to convert data into a fixed-length value called a hash. When sales or inventory data is entered into the system, a hash is created for that record. If the data is changed later, even by a small amount, the resulting hash will no longer match the original one. This makes it possible to detect unauthorized changes in stored data (Hamamreh & Jamoos, 2014).

In this study, each sales and inventory record is saved together with its corresponding hash value. When records are checked, the system recomputes the hash and compares it with the stored one. If the values are different, it indicates that the data may have been altered. Through this process, cryptographic hashing supports the goal of making sales and inventory records tamper-evident.

This approach allows the system to generate a unique hash for every record and helps ensure that unauthorized changes can be detected during audits or reviews.

2. Chain-Based Data Integrity and Linked Transaction Records

Chain-based data integrity builds on cryptographic hashing by linking records together in sequence. In this method, each new transaction record includes its own hash as well as the hash of the previous record. Because of this connection, changing one record affects all the records that come after it. As a result, any attempt to alter past data becomes noticeable (Crosby & Wallach, 2009).

The proposed system uses this concept to create a continuous record of sales transactions and inventory movements. Each entry is connected to the one before it, forming a clear history of how the data was recorded. This makes it easier for users and auditors to trace transactions and verify their authenticity. Chain-based data integrity therefore supports secure auditing by making hidden changes difficult to carry out without detection.

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3.Data Analytics and Data-Driven Decision Making (DDDM)

Data analytics focuses on examining collected data to understand what is happening within a system. Data-driven decision making refers to using these results to support decisions instead of relying only on assumptions or manual checking (Mandinach, Honey, & Light, 2006).

In this study, the system uses basic descriptive analytics to summarize sales and inventory data. The system produces reports, tables, and simple graphs that show item movement, stock levels, and changes over time. These outputs help users notice unusual patterns, such as sudden drops in inventory or unexpected changes in sales records, which may need further investigation.

By presenting data in an organized and visual form, the system supports better monitoring and review of sales and inventory records.

CONCEPTUAL FRAMEWORK

The study's conceptual framework, which is based on the Input-Process-Output (IPO) model. It leads the flow of data through the tamper-evident inventory and sales system and displays how inputs are processed to produce relevant outputs, with feedback assuring continual development.

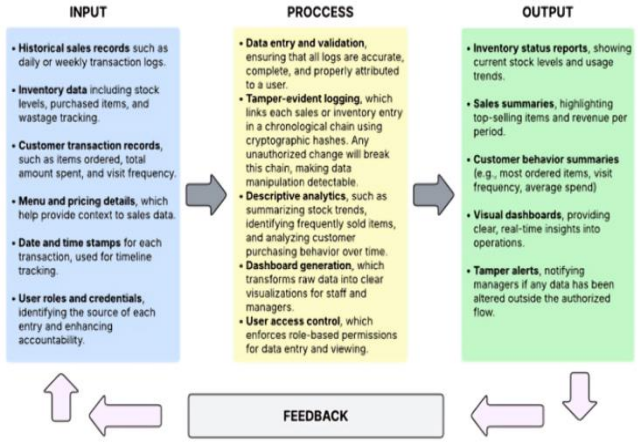

Figure 1. IPO Model of the Tamper Evident Inventory System

Input

The daily operations of Mashikketta Restaurant supply the system with essential operational data. This includes transaction records, menu details, timestamps, inventory logs, historical sales data, and user access credentials. These inputs serve as the foundation for producing reliable outputs and ensuring accurate system functionality. Process

Before analysis, the system validates and securely records the collected data through a chain-based integrity mechanism that is resistant to tampering. Each entry is cryptographically linked to the preceding one, enabling the detection of any unauthorized alterations. Once verified, the data is processed using descriptive analytics to generate visual summaries of sales performance, inventory movement, and usage behavior. This stage ensures both the protection of records and the transformation of raw data into actionable insights. Output

The system delivers outputs such as real-time inventory summaries, graphical sales reports, and automated alerts for low stock levels or irregular transaction activity. These outputs provide management with accurate and timely information that supports effective decision-making, improved inventory control, and enhanced operational efficiency.

SIGNIFICANCE OF THE STUDY

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This study is significant as it contributes to improving the operations of small food service businesses through the use of tamper-evident digital systems, secure data management, and automated analytics.

The beneficiaries of the study are:

- Owners and Managers - The system provides dependable tools to track inventory and sales, helping them make informed, data-driven purchasing and operational decisions.
- Staff - Employees benefit from reduced manual workload since the system automates record-keeping, allowing them to focus more on customer service and efficiency.
- Customers - While they do not directly interact with the system, customers experience better menu availability and consistent service quality because of improved inventory management.
- Small Business Operators - Other food service enterprises can use this study as a guide for adopting digital systems that improve accountability, minimize shrinkage, and support transparent operations.
- Researchers and Developers - This study offers practical insights into tamper-evident technologies that can be adapted in future projects focusing on secure and efficient digital solutions for small businesses.

REVIEW OF RELATED LITERATURE

This section presents the existing studies and scholarly works that support the development of the proposed system, titled "Tamper-Evident Inventory and Sales Recording System Using Chain-Based Data Integrity to Ensure Audit Reliability for Mashikketta Restaurant's Main Branch." These related works establish the foundation of the study by highlighting current trends, research gaps, and technological approaches relevant to tamper-evident data systems and digital transformation in small businesses. Recent studies emphasize the importance of adopting tamper-evident and blockchain-inspired systems to strengthen data integrity and operational transparency. George et al. (2020) and Ahmad et al. (2018) demonstrated that linking transactions through secure, immutable chains prevents unauthorized data alterations and ensures audit reliability in restaurant and supply chain operations. Likewise, Salman et al. (2018) and Iftekhar et al. (2020) highlighted that blockchain technology enhances accountability and fraud prevention by creating verifiable digital records. These concepts provide a strong foundation for this study, which applies chain-based data integrity to improve record security for small food service enterprises. Local research also reveals the continuing need for reliable and structured digital systems among small businesses. Bolanos et al. (2024) and Borromeo et al. (2024) found that many micro and small enterprises still depend on manual or informal methods of tracking sales and inventory, leading to data inconsistencies and inefficiencies. Bautista and Young (2022) and Magallanes et al. (2021) developed digital inventory tools that improved accuracy but lacked tamper-evident mechanisms, leaving data vulnerable to modification. Meanwhile, Natividad et al. (2024) and Ercilla et al. (2021) showed that cloud-based and automated systems enhance reliability, data accuracy, and operational speed. Altogether, these studies establish the relevance of developing a tamper-evident, web-based sales and inventory recording system that enhances data integrity, transparency, and audit readiness for small-scale food enterprises such as Mashikketta Restaurant. By addressing the lack of tamper-evident features in previous systems, this study provides a secure and practical solution that strengthens accountability and ensures the reliability of business records.

Synthesis

The need of creating safe, effective, and verifiable systems for handling sales and inventory data is emphasized throughout the studied literature. International research shows how well chain-based and tamper-evident technologies such as blockchain, ensure data integrity, transparency, and auditability. On the other hand, local data shows that a large number of small businesses in the Philippines still use manual or semi-digital processes, which frequently lead to inefficiencies and inaccurate records. The suggested Tamper-Evident Inventory and Sales Recording System Using Chain-Based Data Integrity for Mashikketta Restaurant bridges these insights by

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meeting the demand for a visible, useful, and safe digital platform. Data reliability, operational accountability, and audit preparedness are all improved by the study's tamper-evident solution, which applies blockchain-inspired methods to a small business setting. This synthesis lays the groundwork for converting conventional restaurant inventory procedures into a cutting-edge, technologically advanced framework that encourages precision and reliability.

METHODOLOGY OF THE STUDY

This study utilized a quantitative, design-based research approach under the category of technological development. It focused on building and evaluating a secure web-based Inventory and Sales Recording System Using Chain-Based Data Integrity for Mashikketta Restaurant.

Primary data is collected through structured assessment, direct user observation, and scenario-based testing. These methods are designed to assess both functional performance and user experiences according to ISO 25010 software standards. In the meantime, secondary data is acquired via internet and library research, using previously published works and related studies to bolster and contextualize the results.

For the system development life cycle, the study adopted the Agile software development methodology, as shown in Figure 2.

Figure 2: SDLC Agile Model

The Agile model allows flexible, iterative development where client feedback is continuously integrated throughout the project cycle. The development process is completed over a six-month period with regular testing, review, and refinement after each sprint. This approach ensured continuous improvement, active collaboration, and a final product that accurately met user requirements.

The database design defines how data are structured, stored, and linked to maintain integrity and support tamper-evident operations. It involves creating both logical and physical representations of the system’s data flow.

The context diagram in Figure 3 illustrates high-level interactions between the system and its users. It shows how administrators and staff communicate with the central database, emphasizing secure role-based workflows and audit logging.

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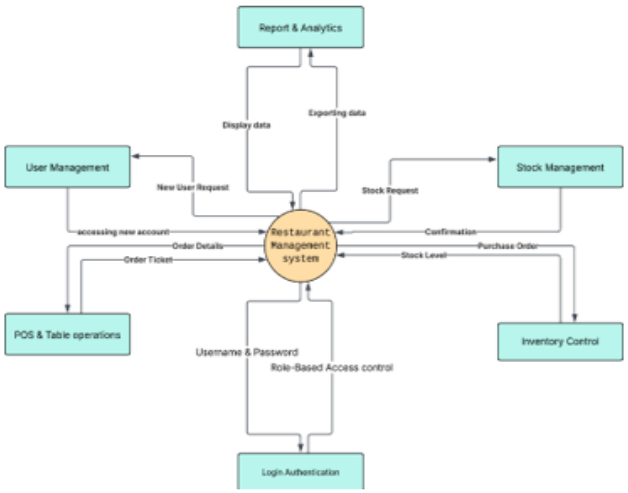

Figure 3: Context Diagram

All data transactions such as sales entries, inventory updates, and report generation are securely validated and recorded through the system's chain-based mechanism, ensuring that no data modification can occur without detection.

RESPONDENTS OF THE STUDY

The respondents of this study are divided into two groups for a total of fifty (50) individuals: (a) user respondents and (b) technical experts. The user group is composed of thirty (30) individuals who are directly involved in restaurant operations such as sales transactions and inventory management. Their roles are to assess the usability and practicality of the system in day-to-day activities.

The technical experts, on the other hand, consisted of twenty (20) professionals with backgrounds in information technology. They evaluated the system's functionality, security, and overall design based on software quality standards. by including both groups, the study ensured that the system is assessed from the perspective of actual users as well as technical experts, providing a balanced and reliable evaluation.

Development and Evaluation Procedure

The development of this web-system is a combination of different programming languages from front-end to back-end making sure it is a fully functional working website.

Tool/Technology	Purpose
C# (.NET Framework)	Server-side logic, data management, and secure transaction processing
MYSQL	Relational database for reliable data storage and complex query handling
React.js	JavaScript library for building dynamic, component-based user interfaces
Sass	CSS preprocessor for maintainable and scalable styling
bcrypt	Password hashing algorithm for secure credential storage
Role-Based Access Control	Restricts system functions based on user roles (Admin, Staff.)
Git/GitHub	Collaborative code management and version control

Table 1: Development Tools & Purposes

The evaluation involved systematically assessing the system's performance, features, and overall effectiveness to guide improvements (Patton, 1987). Using an ISO 25010-compliant form, two evaluation approaches are applied: (a) user satisfaction to measure ease of use and (b) technical performance to assess functionality. The system is evaluated based on ISO 25010 criteria, which include:

- Functionality – Accuracy in performing inventory and sales tasks.

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- Reliability – Stability and data protection.
- Efficiency – Response time and processing performance.
- Usability – Interface intuitiveness and learnability.
- Portability – Compatibility across devices.
- Security – Protection of data confidentiality, integrity, and access control.

DATA ANALYSIS PLAN

The evaluation of the system is based on the ISO/IEC 25010 Software Quality Model, which is a recognized framework for measuring software quality. This standard is chosen because it highlights the most important attributes of a system, such as functionality, usability, reliability, security, and efficiency. These qualities are important to ensure that the system can meet the needs of both its users and technical evaluators.

To analyze the responses from the participants, the study made use of simple statistical tools. The weighted mean is applied to summarize the overall feedback from the two groups of respondents, while frequency percentage is used to show how the answers are distributed. These tools provided a clear way to see how the system was rated in each of the ISO 25010 attributes.

The study also used a four-point Likert scale to gather the responses. Participants rated each statement according to their level of satisfaction, ranging from a scale of "1" interpreted as "Strongly Disagree" to "4" interpreted as "Strongly Agree." This method made it easier to organize the feedback and connect it directly to the software quality standards. By doing this, the researchers are able to determine if the system is effective in terms of usability, reliability, security, and other important factors.

This process ensured that the evaluation is both structured and objective. The use of ISO 25010 standards, combined with straightforward statistical tools, allowed the researchers to assess the system fairly and to identify its strengths as well as the areas where improvements may still be needed.

The System

The study developed a tamper-evident inventory and sales recording system designed for Mashikketta Restaurant to strengthen data integrity, transparency, and audit reliability. The system is created using C# under the .NET framework, React.js for the interface, and MYSQL for database management. Its main features include chain-based data logging, cryptographic hashing, role-based access control, and descriptive sales analytics. These functions work together to secure transaction records, provide accountability among users, and support data-driven decision-making.

Some of the user interfaces are shown as follows:

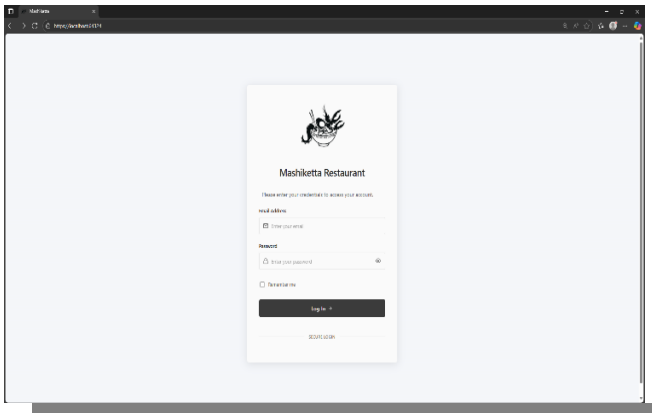

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Figure 4: Login and Authentication Page

Users enter their credentials and access their assigned roles (Super Administrator, Administrator, or User). This is critical because it controls security and role-based access.

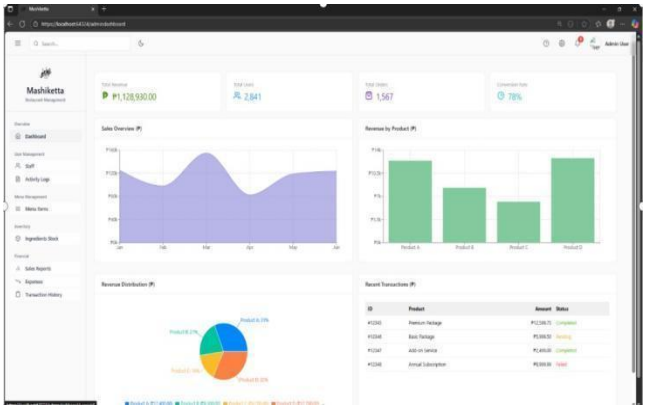

Figure 5: Admin Dashboard

This interface provides administrators with real-time sales and inventory information. It includes reports, summaries, and notifications that help in monitoring stock levels, tracking transactions, and ensuring accurate decision-making.

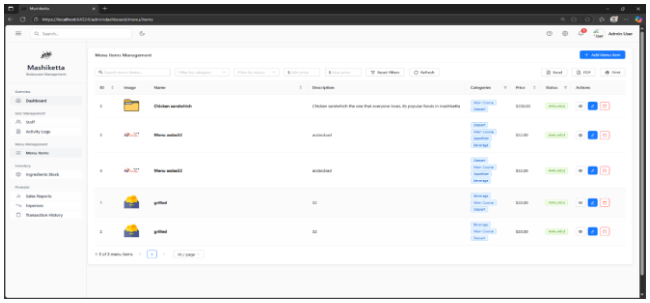

Figure 6: Menu Item Dashboard

This interface provides administrators with real-time information on menu items, stock levels, and item availability. It includes summaries and notifications that support monitoring inventory status, tracking item usage, and ensuring accurate and timely decision-making.

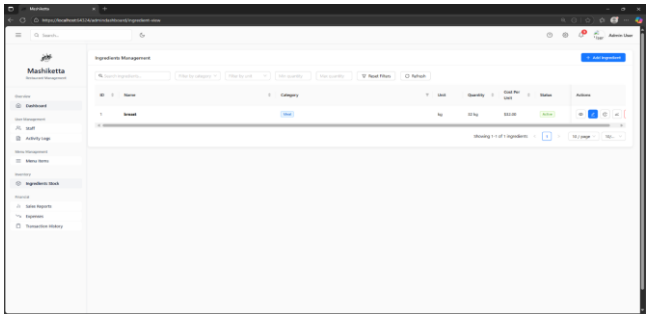

Figure 7: Ingredient Item Dashboard

This interface provides administrators with real-time information on ingredients, including current stock levels, usage, and availability. It includes summaries and notifications that help monitor ingredient consumption, prevent shortages, and support accurate inventory planning and decision-making.

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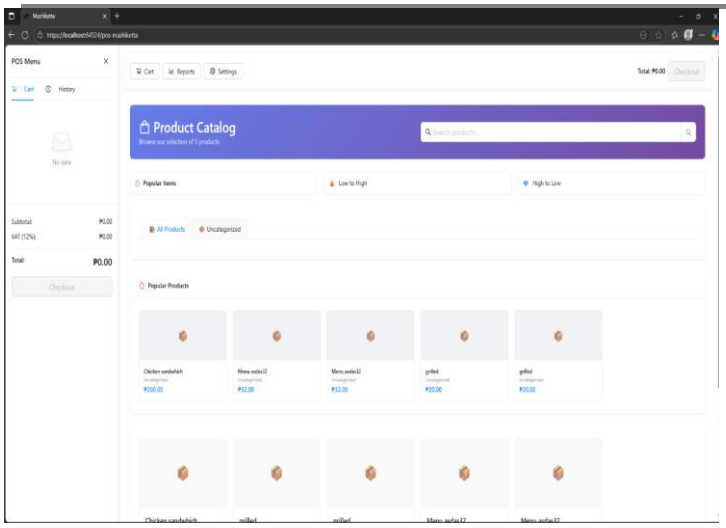

Figure 8: The Point of Sale

This POS interface enables administrators to view real-time menu offerings, track current stock levels, and manage item availability. It provides inventory summaries and alerts to help monitor stock status, analyze item sales performance, and support timely restocking decisions—ensuring smooth and accurate point-of-sale operations.

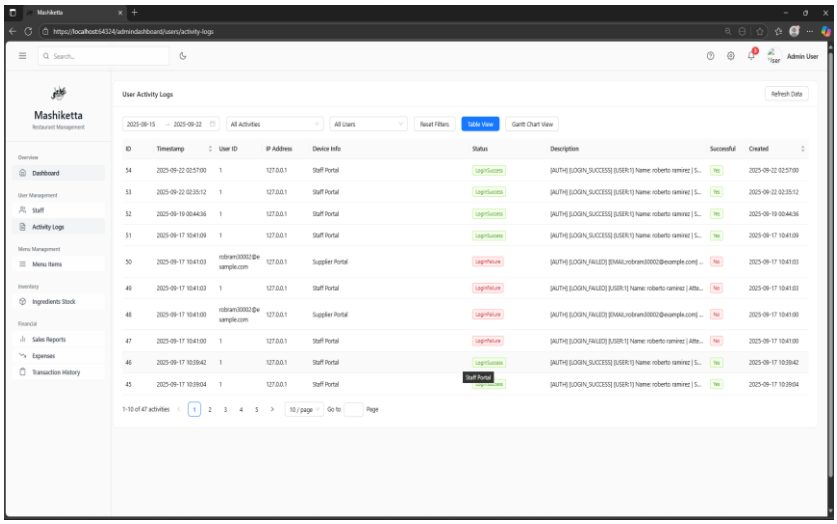

Figure 9: The User Logs

This interface provides administrators with access to user activity logs, displaying recorded actions, timestamps, and transaction details to support monitoring user behavior, detecting unauthorized activities, and ensuring system accountability.

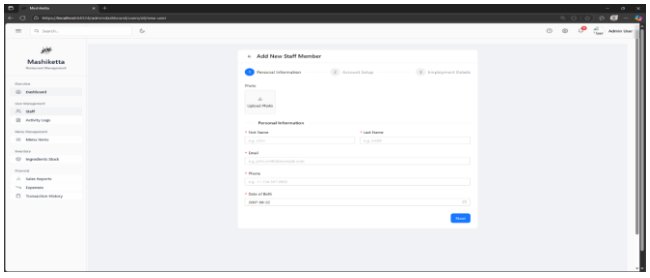

Figure 10: The Add New Staff Member

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This interface guides administrators through the steps for adding new staff, including entering staff details, assigning roles and access permissions, and confirming account creation to ensure proper system access and management.

Assessment: Summary of Respondents on the System

The table presents the distribution of respondents who participated in the evaluation of the system. They are divided into user and technical groups, and the assessment is carried out using the ISO/IEC 25010 Software Quality Model to ensure fairness and reliability in evaluating usability, functionality, and performance. This breakdown provides a clearer picture of the individuals who contributed feedback according to their role and expertise.

Respondents (groupings)	Size (n)	Percentage
Users	30	60.0
Technical	20	40.0
Total (n)	**50**	**100.0%**

Table 2: Distribution of Respondents

Table 2 shows the total number and percentage of participants in the evaluation.

7. Criteria (ISO25010)	Respondents (50)			
	Users (30)		Technical (20)	
	WM	VI	WM	VI
1. Functionality: The system performs all inventory and sales tasks accurately.	3.95	SA	4.00	SA
2. Reliability: The system handles errors without crashing and preserves data.	3.67	SA	3.93	SA
3. Efficiency: New users can learn the system within 15 minutes.	3.79	SA	3.55	SA
4. Usability: Generates reports in under 5 seconds.	3.79	SA	3.75	SA
5. Security: Prevent unauthorized access and Ensures data remains unaltered unless authorized.	3.89	SA	4.00	SA
6. Portability: Works across all modern devices (PC, tablet,).	3.72	SA	3.93	SA
Overall Average Mean	3.80	SA	3.86	SA

Table 3: Summary and Comparison of Evaluations of Respondents

The combined evaluation results of both groups across the ISO 25010 criteria are shown in Table 3. Users recorded an overall mean of 3.80, while the technical group provided a slightly higher average of 3.86, both interpreted as “Strongly Agree”. Among the quality attributes, usability received the highest rating from the user group, reflecting that the interface is easy to use and understand. However, functionality and security are rated by technical experts with the highest score, showing confidence in the system’s ability to meet its intended operations. In general, the results confirm that the system satisfies ISO 25010 standards, with notable strengths in usability, functionality, and security.

ETHICAL CONSIDERATIONS

The researchers ensured that all ethical criteria are followed during the creation and testing of the Tamper-Evident Inventory and Sales Recording System Using Chain-Based Data Integrity for Mashikketta Restaurant.

All participants provided informed consent after being explained the study's objectives, procedures, and advantages.

Participants are completely free to withdraw from the study at any moment with no repercussions. Because the study involves the processing of business-related data, strong data confidentiality and security standards are applied. No personally identifiable or sensitive information is revealed, and all acquired data is securely stored in encrypted files accessible only to the researchers. The ethical usage of data integrity methods is upheld to ensure that no manipulation or falsification happened throughout system testing and evaluation. The researchers also verified that participants are treated fairly and impartially, minimizing any potential psychological, professional, or operational hazards. Furthermore, the team reported no conflicts of interest to ensure transparency and legitimacy throughout the research process.

SUMMARY

The study is effective in developing a Tamper-Evident Inventory and Sales Recording System using chain-based data integrity to enhance audit reliability and transparency at Mashikketta Restaurant. According to the ISO 25010 criteria, the system performed satisfactorily in terms of functionality, usability, efficiency, and reliability. Users confirmed that the platform facilitated accurate, organized, and secure record-keeping, thereby reducing errors associated with manual operations. Moreover, the chain-based technique safeguarded data integrity by preventing unauthorized modifications. In the long run, the system achieved its objectives by providing a practical, tamper-proof, and dependable solution for sales and inventory management.

CONCLUSION

The Tamper-Evident Sales and Inventory System proved to be a useful and dependable tool for Mashikketta Restaurant's main branch. The evaluation results, with overall mean scores of 3.80 and 3.86, show strong agreement between users and technical evaluators, verifying the system's conformity with ISO 25010 requirements. Its primary strengths are functional suitability and security, which provide accurate sales recording, data protection, and seamless daily operations. While a few users suggested enhancements in processing speed, device compatibility, and user onboarding, these are viewed as potential for future development rather than system flaws. In conclusion, the study shows that the developed system is practical, competent, and meets the restaurant's operational requirements, hence improving accountability, transparency, and data integrity in sales and inventory management.

RECOMMENDATION

Based on the system evaluation and identified shortcomings, the following recommendations are made to improve the Tamper-Evident Sales and Inventory System Using Chain-Based Data Integrity for Mashikketta Restaurant:

- Cloud Deployment – Move the system to a cloud platform to enhance accessibility, backup, and recovery while addressing portability concerns.

- Role-Based Notifications – Add alerts for low stock levels, failed login attempts, and unusual transactions to improve responsiveness and strengthen security.

- Customizable User Roles – Allow administrators to create and adjust roles beyond the default settings to provide greater flexibility in task assignments.

- Backup and Restore Tool – Integrate an export-and-import function for database backups to minimize the risk of data loss or corruption.

- Mobile Dashboard (View-Only) – Develop a lightweight mobile interface that displays key summaries such as sales, inventory, and audit logs.

These recommendations aim to strengthen the system's performance and ensure long-term efficiency, security, and reliability in restaurant operations.

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