

# Sort Out: A Smart Inventory Management System Using Descriptive Analytics and Rule-Based Algorithm for Mini Grocery Stores

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## ABSTRACT

This research introduces Sort Out, an Intelligent Inventory Management System tailored to tackle the persistent issues of manual inventory tracking and product management in small grocery stores. Numerous small retailers encounter difficulties like excessive inventory, stockouts, erroneous recordkeeping, and slow reactions to changes in stock levels. To address these challenges, the system combines Descriptive Analytics with a Rule-Based Algorithm to automate essential tasks like product tracking, expiration monitoring, and report creation. The system's design is created according to the System Development Life Cycle (SDLC) approach. Information is collected from chosen mini grocery stores via interviews and observations to identify user needs. The development process employed PHP, MySQL, and XAMPP as main tools, with the interface design refined for ease of use and accessibility.

The assessment of the system is carried out using the ISO 25010 Software Quality Model, which evaluates aspects like functionality, usability, efficiency, reliability, security, and portability. A total of fifty (50) respondents participated in the evaluation. Findings from both technical and user participants showed that the system received high performance scores across all quality attributes, demonstrating that it effectively fulfilled its intended goals. Results indicated that Sort Out offers a more effective and accurate method for inventory management by automating stock updates, creating analytical summaries, and minimizing manual efforts. The incorporation of descriptive analytics enables store owners to easily analyze inventory trends, while the rule-based system guarantees that alerts for low-stock and soon-to-expire items are precise and timely.

In summary, Sort Out has demonstrated its effectiveness in improving the operational efficiency and accuracy of inventory management in small grocery stores. Future enhancements should improve the system's compatibility with various browsers and mobile devices to make it accessible on multiple platforms; simplify the layout and add intuitive navigation features to make the system easier for first-time users; allow online data synchronization and backup to prevent data loss and enable real-time access; conduct usability testing among more store owners and clerks to gather broader insights for improvement; add stronger encryption, authentication, and backup features to ensure user data remains secure; and, incorporate automated analytics, predictive restocking, and sales forecasting features to make the system more intelligent and decision-driven. These improvements would additionally bolster the system's scalability and usability for wider retail uses.

Descriptive Analytics, Rule-Based Algorithm, Inventory Management, Mini Grocery Stores, System Development Life Cycle (SDLC), ISO 25010, Automation, PHP, MySQL, XAMPP, Usability, Efficiency

## INTRODUCTION

Mini grocery stores continue to rely heavily on manual inventory tracking, which often leads to inaccurate stock records, overlooked expirations, and difficulty forecasting product demand. These problems affect store operations and cause financial losses, especially for small retailers with limited manpower. According to Bandara et al. (2019), manual inventory processes create inconsistencies that accumulate over time, making it difficult for small businesses to make data-driven decisions. Similarly, Almeida and Sales (2020) emphasized that human error in recording stocks is one of the main contributors to mismanagement in retail operations.

Digital transformation in micro-businesses has become increasingly necessary. Prasetyo et al. (2021) found that automated systems reduce operational delays and improve accuracy in retail inventory handling. Furthermore, Cruz and Tinio (2018) highlighted that local grocery stores benefit significantly from real-time tracking and automated reporting tools because they streamline routine tasks. In addition, Dizon and Reyes (2020) noted that adopting rule-based systems can enhance decision-making by providing systematic notifications, such as low-stock alerts and expiration reminders.

Analytics-driven systems have also shown positive impacts on retail performance. Hewamalage et al. (2019) demonstrated that descriptive analytics can support small retailers in understanding sales trends and inventory movement, helping them make more informed restocking decisions. Meanwhile, Morales and Santos (2021) stressed that systems utilizing analytical outputs help store owners anticipate shortages, reduce waste, and maintain optimal stock levels.

With these challenges and related findings, this study introduces Sort Out: A Smart Inventory Management System Using Descriptive Analytics and Rule-Based Algorithm for Mini Grocery Stores. The system aims to automate stock monitoring, alert owners of critical inventory updates, and generate analytical reports to support decision-making. By integrating descriptive analytics and rule-based logic, Sort Out intends to address long-standing issues in mini grocery operations and promote efficiency, accuracy, and better resource management.

Specifically, the system covers the following features and functions:

- **User Management:** allows authorized users (admin and staff) to log in securely and manage their access levels.
- **Inventory Control:** manages the addition, modification, and removal of products, while tracking quantity, price, and expiration details.
- **Notification System:** automatically alerts users when stock levels fall below a defined threshold or when products approach their expiry date.
- **Report Generation:** summarizes transactions and inventory data through descriptive analytics for easy monitoring and decision-making.

## Scope

The scope of this study focuses on the development and implementation of Sort Out, a smart inventory management system designed for mini grocery stores. The system covers core inventory functions such as product registration, stock level monitoring, low-stock alerts, expiration tracking, and the generation of basic inventory reports. It is intended for daily use by store owners, cashiers, and staff with basic computer literacy. The system is developed as a desktop- or web-based application depending on the operational needs of the partner store. This study also includes the evaluation of the system using selected ISO 25010 quality attributes to determine its effectiveness, usability, functionality, and overall contribution to improving inventory processes within small retail environments

## Limitation

While Sort Out provides automated and analytical support for mini grocery stores, it also has several limitations that define its current boundaries. The system operates offline using a local server (XAMPP), which means data access is limited to the computer where it is installed. Cloud storage and remote access features are not yet integrated. Other limitations include the following:

- The system is designed exclusively for mini grocery stores and may require further modification to be applicable to other types of businesses.
- The system does not have a mobile version, limiting its accessibility to desktop or laptop computers only.

- It does not include barcode scanning or automated point-of-sale (POS) integration.
- Predictive analytics and machine learning capabilities are not implemented; the system relies solely on descriptive analytics for data summarization.
- The system supports only basic graphical reporting, primarily in the form of tables and simple summaries, without advanced visualizations.

### Theoretical Framework

The development of Sort Out is guided by several established theories that explain the relationship between data, decision-making, and system efficiency.

Information Processing Theory – supports how data is captured, organized, and transformed into useful information for decision-making. Sort Out uses this concept to convert inventory data into summaries and alerts for store management.

- Decision Support System (DSS) Theory – emphasizes computer-aided systems that support human decision-making. The system follows this principle by generating automated reports and real-time alerts that guide users in restocking and expiration management.
- Systems Theory – describes how different components interact to achieve a common goal. Sort Out is structured around this idea, with interconnected modules (user management, inventory control, notifications, and reporting) that function cohesively to ensure operational efficiency.

These theories justify the integration of analytics and automation within Sort Out, aligning its design with proven principles in information systems development.

### Conceptual Framework

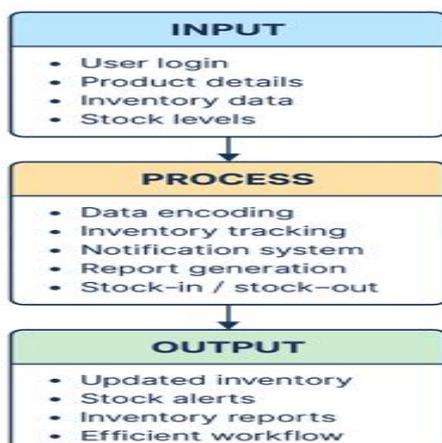


Figure 1: The Input-Process-Output Model

The conceptual structure of Sort Out is represented through the Input–Process–Output (IPO) Model, illustrating how data inputs are transformed into valuable outputs through defined system processes.

1. Input - Product data, stock transactions, and user credentials. These are encoded into the system by authorized users.
2. Process - The system processes the data through its:
  - User Management - authenticates users and controls system access.
  - Inventory Management – updates product and stock details.

- Notification System – executes rule-based checks for stock and expiry alerts.
  - Report Generation – summarizes and analyzes data using descriptive analytics.
3. Output - The system produces reports, notifications, and real-time inventory summaries. These outputs assist store owners and staff in making informed business decisions while minimizing human error.

This conceptual framework shows how the system operates logically and efficiently by integrating inputs, processes, and outputs into one unified platform that enhances store operations and simplifies inventory management.

### **Significance Of The Study**

The development of Sort Out system is valuable to various stakeholders who benefit from efficient and automated inventory processes. This system provides significant contributions to both the practical and academic fields, as it integrates technology and analytics in solving real-world inventory problems faced by small-scale retailers.

The following groups are expected to benefit from the system:

1. Store Owners - The system allows mini grocery owners to monitor their inventory with greater accuracy and convenience. They can reduce manual workload and human error thru automated stock tracking, notifications, and report generation. Real-time insights help them make better purchasing and restocking decisions.
2. Store Employees - Staff members can easily update and check inventory data without needing advanced technical knowledge. The interface simplifies daily operations, improving productivity and efficiency in performing inventory-related tasks.
3. Customers - Through more organized and updated inventory management, customers are assured of product availability and freshness. The system indirectly enhances customer satisfaction by preventing stockouts and expired product sales.
4. Future Researchers and Developers - the study can serve as a reference for future research related to automation, analytics, and rule-based systems. It provides a foundation for enhancing inventory systems by incorporating predictive analytics or cloud-based platforms.
5. Academic Community - The project demonstrates the practical application of system development methodologies such as SDLC, Descriptive Analytics, and ISO 25010 evaluation. It contributes to the growing literature on smart systems for business operations, particularly in small retail environments.

Overall, the Sort Out system is significant because it bridges the gap between manual inventory methods and automated digital solutions. It not only benefits mini grocery stores by improving operational efficiency but also supports academic advancement in the field of information technology and systems development

### **REVIEW OF RELATED LITERATURES**

Effective inventory management is an essential part of retail business operations, particularly for mini grocery stores that rely on accurate product tracking and timely restocking. Various studies have emphasized that efficient inventory systems reduce financial losses, improve customer satisfaction, and ensure operational stability. Manual methods of tracking items using paper logs or spreadsheets often lead to data inconsistencies, slow decision-making, and inventory mismanagement.

Laudon and Laudon (2020) explained that computer-based information systems can significantly improve efficiency by automating data collection and processing, enabling organizations to make better decisions through accurate and real-time information. In the context of small-scale businesses, automation ensures that routine

operations such as stock updates and report generation are streamlined. Similarly, Pressman and Maxim (2020) discussed how systematic software engineering practices enhance the accuracy, usability, and maintainability of business applications, which serve as guiding principles in system development like *Sort Out*.

Data analytics has also been identified as a key factor in modern inventory management. Kumar et al. (2021) highlighted that the integration of analytics into retail systems allows managers to forecast demand, monitor sales trends, and optimize stock levels. Descriptive analytics, in particular, converts collected data into meaningful summaries that support decision-making. Turban, Sharda, and Delen (2018) also stressed that data-driven systems enhance business intelligence by identifying consumption patterns and generating insights for inventory control.

The concept of rule-based algorithms has become increasingly relevant in automated systems. According to Sommerville (2019), rule-based systems operate using logical conditions to execute specific actions, ensuring consistent and reliable results. This principle is used in *Sort Out* to generate alerts automatically when a product's stock level or expiration date meets predefined thresholds.

Local studies in the Philippines also confirm the benefits of digitizing small business operations. Researchers found that automation helps small retailers reduce human error, enhance inventory visibility, and maintain competitiveness in a growing digital marketplace.

According to Reyes and Dela Cruz (2020), small retail stores in the Philippines continue to suffer from losses due to manual stock tracking and the absence of expiry monitoring. Their paper advocated for the integration of low-cost digital inventory systems tailored for perishable goods and small business contexts.

Mendoza (2022) presented a case study of a sari-sari store in Quezon City which implemented a basic inventory system with expiration monitoring. After three months, spoilage dropped by 27%, and the owner reported faster decision-making and better cash flow control. Mendoza emphasized that such systems are vital for business sustainability.

In a study by Flores and Santos (2021), the researchers highlighted that many Filipino grocery owners have limited IT knowledge. They recommended inventory tools with intuitive interfaces, reminder systems, and simplified dashboards to encourage adoption. Their findings helped guide UI/UX principles in locally developed systems like *Sort Out*.

A research study from Valenzuela City (2023) tested a rule-based notification system for inventory monitoring in five mini groceries. It revealed that daily use of automated alerts decreased stockouts and overstock events by half. Owners also expressed increased confidence in their day-to-day operations, demonstrating the positive effect of real-time tracking on small-scale retail environments.

These findings support the significance of developing systems like *Sort Out* to help local grocery stores transition from manual processes to smart, data-driven management solutions.

## Synthesis

The literature reviewed consistently demonstrates that automation, data analytics, and rule-based processing are fundamental in improving the efficiency and reliability of inventory management systems. Prior research confirms that businesses adopting digital tools experience reduced operational errors, improved decision-making, and better control over product movement and expiration.

*Sort Out* is built upon these same principles, applying Descriptive Analytics for data summarization and Rule-Based Algorithms for automation. The system converts raw inventory data into analytical insights and automatic alerts, helping store owners and staff maintain up-to-date and accurate product information. Furthermore, the system's development process follows the System Development Life Cycle (SDLC) methodology, as supported by literature on software engineering best practices.

In summary, the reviewed studies collectively validate the need for systems like *Sort Out* that merge analytics, automation, and user-centered design. This combination not only enhances inventory management but also contributes to the growing body of research promoting technology adoption among small and medium enterprises.

### Data Gathering Procedure

Data were gathered using structured evaluation forms based on the ISO 25010 Software Quality Standards. Both user respondents and technical experts evaluated the system through a 4-point Likert scale to measure its performance across different quality characteristics. The collected data were then organized, summarized, and analyzed to determine the system’s strengths, limitations, and areas for enhancement.

## METHODOLOGY OF THE STUDY

The study used a developmental research design under the technology development category, focusing on the creation of *Sort Out*, an innovative inventory management system designed for mini grocery stores. Observation and interviews with store staff are conducted to identify operational challenges, leading to the inclusion of features such as customizable stock alerts and expiry notifications.

The primary source of data comes from respondents’ assessment of the system using the ISO 25010 standards while other data are collected from secondary sources like research articles, system documentation, and case studies on grocery management. Simulated datasets representing actual store operations are created to test functions including expiry tracking, low-stock alerts, and automated reporting. User testing followed the ISO 25010 standards, where store staff and admin users assessed the system’s usability, reliability, and efficiency.

The development process followed the System Development Life Cycle (SDLC) using the Waterfall Model.



Figure 2: SDLC Waterfall Model

This approach ensured each phase is completed before moving to the next, starting from requirement gathering to design, development, testing, implementation, and maintenance. During testing, user acceptance and integration tests were performed to ensure system stability and accuracy.

Database design played a crucial role in organizing essential information such as product details, quantities, expiry dates, and user accounts. A context diagram illustrated how users interact with the system and its processes, while a data flow diagram showed how data moves between users and system components.

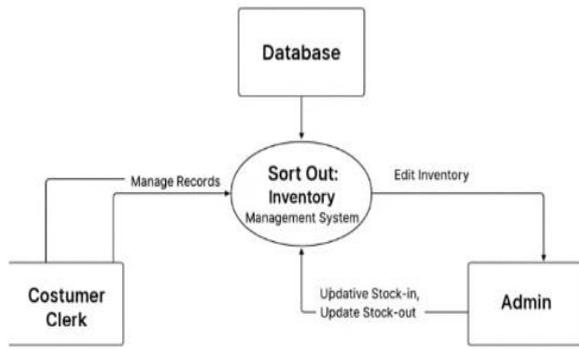


Figure 3: Context Diagram

The entity-relationship diagram outlined the key relationships among entities like Users, Products, Transactions, Notifications, and Reports.

The system is developed using Visual Studio Code, PHP, MySQL, XAMPP, and GitHub. Minimum hardware requirements included a dual-core processor, 4GB RAM, and 500GB storage. Evaluation is conducted to measure the system’s overall quality and effectiveness based on the ISO/IEC 25010:2011 standards.

### Respondents Of The Study

This study involved fifty (50) respondents divided into two groups to evaluate the system based on the ISO 25010 Software Quality Model. Thirty (30) user respondents including store owners, cashiers, and grocery staff assessed the system in terms of Usability, Functional Suitability, and Performance Efficiency, as these attributes reflect how the system supports real inventory tasks. Meanwhile, twenty (20) technical experts such as IT practitioners, system developers, and system analysts evaluated Security, Reliability, Maintainability, and Compatibility to determine the system’s technical quality.

The study is classified under Developmental Technological Research, as it involves creating and improving a functional software prototype, and Applied Technological Research, because the system is designed to provide practical solutions to inventory issues faced by mini grocery stores. Simple random sampling was applied, and Slovin’s Formula was used to determine the appropriate sample size. The combination of user and expert evaluations ensures that the system is reviewed both from operational and technical perspectives, directly supporting the objectives of achieving a functional, reliable, and user-centered inventory management system.

### Development And Evaluation Procedure

The development of *Sort Out* utilized several software tools and technologies to ensure both functional efficiency and user accessibility. The system is primarily developed using modern web-based programming languages and frameworks suited for database management and inventory operations. These tools are selected to create a reliable, responsive, and user-friendly platform capable of assisting users in sorting, tracking, and managing inventory data efficiently. Each tool contributed to the system’s structural integrity, performance optimization, and design consistency, which allowed for smooth interaction between users and administrators.

Tool/Technology	Purpose
Visual Studio Code	Source code editor for system development
PHP	Backend programming language
MySQL	Relational database system
GitHub	Source code version control
XAMPP	Local Server Environment

Table 1: Development Tools Used

To evaluate the effectiveness and quality of *Sort Out*, the researchers implemented a two-phase assessment involving both user and technical respondents. Two evaluation approaches are applied:

1. User Experience Evaluation – Focused on usability, accessibility, and ease of use when interacting with system features such as adding items, setting low-stock thresholds, and monitoring expiry dates.
2. Technical Evaluation – Concentrated on system functionality, reliability, maintainability, and efficiency, ensuring that stock alerts, expiry notifications, and reporting features work as intended under normal operating conditions.

The evaluation process aimed to ensure that the system performed well not only in functionality but also in usability and technical stability. The assessment followed the ISO/IEC 25010:2011 software quality model, which measures the system against the following quality characteristics:

- Functionality – The ability of the system to provide complete, correct, and relevant functions for inventory monitoring and notification.
- Reliability – The system’s ability to perform its tasks consistently without failure during normal operation.
- Efficiency – The system’s performance in terms of response time, resource usage, and processing speed.
- Usability – The ease with which users can learn, operate, and navigate the system.
- Security – The capability of the system to protect data from unauthorized access or modification.
- Portability – The ability of the system to operate across different environments and platforms without requiring major changes.

The evaluation results provided actionable feedback that is used to refine the system’s features, ensuring that it is both technically sound and user-friendly.

Through these evaluations, *Sort Out* is assessed comprehensively in terms of both end-user experience and technical soundness, ensuring that the system met its intended objectives as a reliable and efficient inventory management solution.

### Data Analysis Plan

Statistical tools are applied in the research to analyze the collected data accurately and meaningfully. The following tools are used in the study:

1. Weighted mean is used to determine the average perception of respondents on various evaluation criteria, helping the researchers measure overall satisfaction and agreement levels.
2. Frequency Percentage is applied to present the distribution of responses among different categories, allowing a clearer understanding of respondent patterns.
3. Likert Scale is utilized to quantify attitudes, perceptions, and opinions of respondents. This scale provided numerical weights to responses such as 4 for “Strongly Agree” down to 1 for “Strongly Disagree,” allowing the researchers to interpret quantitative feedback in a structured and measurable way.

### The System

The proposed *Sort Out* system is designed to streamline and digitalize the process of tracking, recording, and managing the department’s equipment, supplies, and materials. It aims to replace the manual record-keeping

process with an automated, accurate, and user-friendly platform. The system provides features such as inventory listing, stock monitoring, item categorization, and report generation, allowing both users and administrators to efficiently manage inventory data. Specifically, it seeks to (1) minimize errors caused by manual recording, (2) improve accessibility of inventory records, (3) enhance transparency and accountability, and (4) ensure faster data retrieval and reporting. Overall, Sort Out promotes efficiency and reliability in managing departmental resources through a secure and organized digital system.

The system is developed using PHP, MySQL, and XAMPP as its primary development tools and is intended for use on a desktop or laptop environment. The scope of the study includes the design, development, and evaluation of the system using ISO 25010 Software Quality Model to assess its functionality, reliability, usability, efficiency, security, and portability.

Shown are some user interfaces of the system:

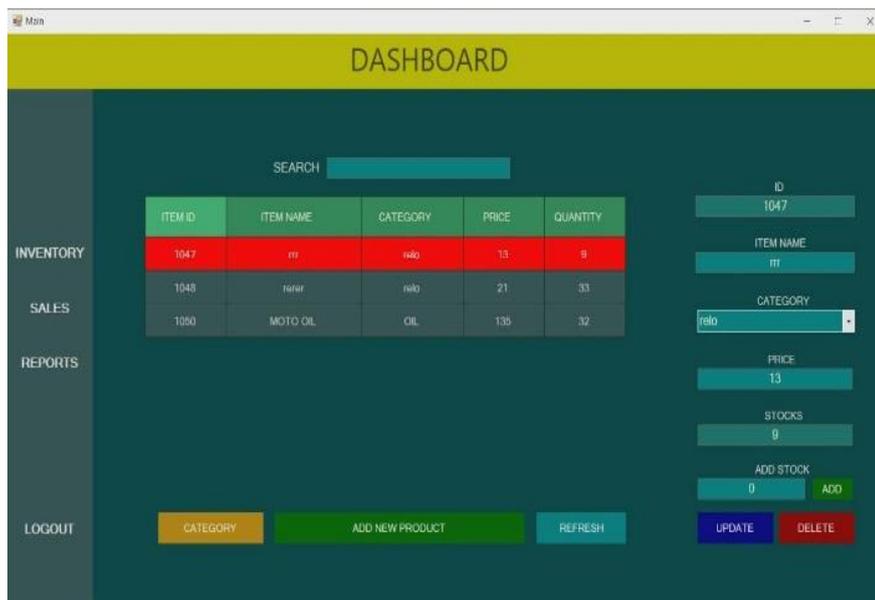
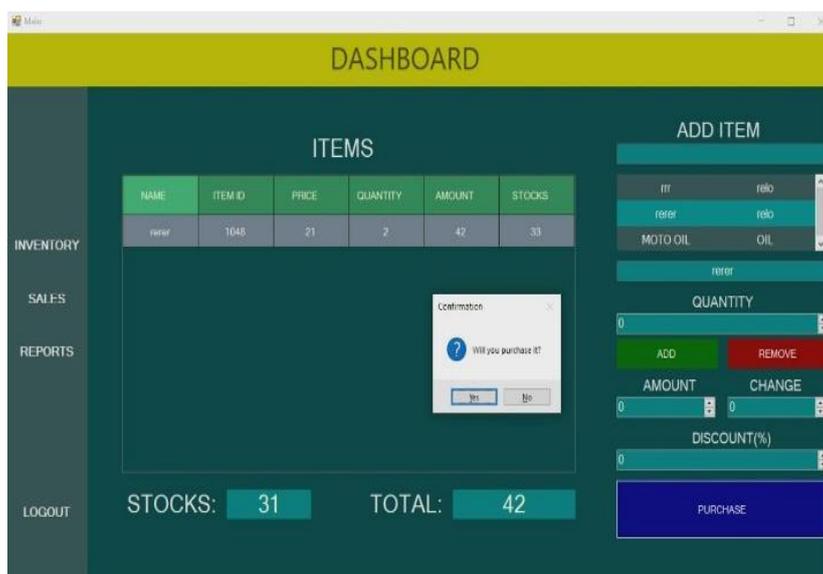
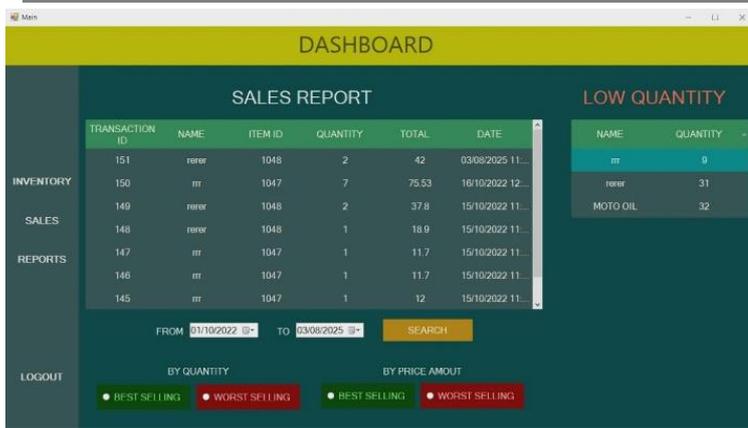


Figure 4: User interface of the inventory, sales and report of Sort Out: A Smart Inventory Management System Using Descriptive Analytics and Rule-Based Algorithm for Mini Grocery Stores



The inventory screen displays item lists along with essential details such as ID, name, category, price, and quantity, allowing users to update, delete, or add stock efficiently. The sales interface provides tools for adding items to a purchase list, calculating totals, managing discounts, and confirming transactions, supporting smooth and accurate sales operations.



Meanwhile, the reports section presents a detailed sales history with transaction IDs, item information, quantities, totals, and dates, along with a low-quantity panel that helps monitor items that require restocking. Overall, the design highlights the system’s focus on clear navigation, real-time item monitoring, and streamlined inventory and sales processing for reliable business management.



Figure: Admin Dashboard and Account Management Interface of SortOut: A Smart Inventory Management System Using Descriptive Analytics and Rule-Based Algorithm for Mini Grocery Stores



The figure presents the administrative and account settings interfaces designed for secure user management and system control. The Admin Dashboard serves as a centralized control panel, featuring input fields to create and update user accounts, a data table displaying registered IDs and credentials, and functional buttons for viewing user logs or deleting entries. Complementing this, the Change Login Info interface provides a dedicated screen for credential modification, allowing administrator to securely update critical details such as email, username, and password. Collectively, these interfaces demonstrate a focus on security and ease of administration, ensuring efficient handling of user access and account maintenance.

### Assessment: Summary Of Respondents On The System

The distribution of respondents along with their size (n) and percentage are shown in the following table.

Respondents	Size (n)	Percentage %
User	30	60%
Technical	20	40%
Total (n)	50	100%

Table 2: Distribution of Respondents

Additionally, a combined summary of the participants' answers is provided.

Criteria (ISO25010)	Respondents (50)			
	Users (30)		Technical (20)	
	WM	VI	WM	VI
1. Functionality	2.8	A	2.8	A
2. Reliability	2.8	A	2.8	A
3. Efficiency	2.9	A	2.9	A
4. Usability	2.9	A	2.9	A
5. Security	2.8	A	2.8	A
6. Portability	2.4	A	2.3	A
Overall Average Mean	2.8	A	2.8	A

Table 3: Summary and Comparison of Evaluations of Respondents

Table 3 shows all respondents agree with the criteria of ISO 25010 with ratings ranging from 2.3 (A) to 2.9 (A) average means. In the final result, they agree with identical 2.8 (A) overall average means, respectively. These findings imply that the system demonstrates strong performance across most quality aspects, but further enhancement of portability such as cross-platform responsiveness or device compatibility is recommended to achieve optimal usability and performance.

In summary, the Sort Out system is considered well-developed and functional according to ISO 25010 standards, offering substantial benefits to its intended users while still having room for enhancement in multi-platform accessibility.

### Ethical Considerations

Strict ethical guidelines are followed in the study to guarantee the confidentiality and integrity of all information collected from participants. No identifiable information is shared without the participants' express consent, and personal information is kept confidential. Because the study adheres to the idea of voluntary participation, participants are allowed to leave the study at any time without facing any penalties or repercussions. To prevent unwanted access, alteration, or misuse of the gathered data, data protection measures are also put in place. In order to preserve the validity and integrity of the study's conclusions, the researchers also pledge to disclose all findings honestly, openly, and accurately—avoidance of bias or data manipulation of any kind.

### Summary

The output of the study is a system titled “Sort Out: A Smart Inventory Management System Using Descriptive Analytics and Rule-Based Algorithm for Mini Grocery Stores”. It is developed to automate inventory processes, reduce human error, and provide store owners with timely insights on product availability and stock performance.

A total of fifty (50) respondents participated in the evaluation. The assessment used the ISO 25010 Software Quality Model. Results showed that all respondents rated the system with identical 2.8 (Agree) overall weighted means respectively. This indicates that both groups found the system satisfactory in meeting its intended objectives.

## CONCLUSION

Based on the evaluation findings, the study successfully designed and implemented an inventory management system that automates essential store operations, including product monitoring, restocking, and sales recording. All respondents expressed positive feedback, recognizing the system's potential to assist small grocery store operations through accurate tracking and streamlined processes. In summary, the developed system proves to be effective, dependable, and easy to use.

## RECOMMENDATION

To further enhance the functionality, accessibility, and long-term usability of Sort Out, the following recommendations are proposed:

- **Develop a Dedicated Mobile Platform:** Prioritize the creation of a mobile version of the system for Android and other mobile platforms in the next release. This will allow store owners and staff to manage inventory, monitor stock levels, and receive notifications anytime and anywhere, significantly improving accessibility and operational flexibility.
- **Enhance Portability Across Platforms:** Improve compatibility across different browsers, devices, and operating systems to ensure consistent system performance on desktops, laptops, and mobile devices.
- **Integrate Point-of-Sale (POS) Functionality:** Incorporate POS features to enable real-time sales tracking, automatic stock updates, and seamless transaction processing, ensuring better synchronization between sales and inventory data.
- **Refine Interface Design:** Simplify the user interface and implement mobile-responsive layouts with intuitive navigation to ensure ease of use across both web and mobile platforms.
- **Adopt Cloud-Based Storage:** Implement cloud integration to support real-time data synchronization, remote access, and automated backups, especially beneficial for mobile users accessing the system outside the store premises.
- **Broaden User Testing:** Conduct extensive usability testing that includes both desktop and mobile users to gather comprehensive feedback and improve user experience across platforms.
- **Advance Future Development:** Explore the integration of automated analytics, predictive restocking, and sales forecasting features to further enhance decision-making and system intelligence.

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