

Design and Development of an E-Commerce System for Electronic Goods with Integrated Ordering and Payment using Next.js

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Abstract Rizqi Elektronik has been operating conventionally, with its marketing reach still limited to the local area, while inventory tracking is still done manually, meaning customers do not receive real-time stock information and the store risks missing out on sales opportunities. This research aims to design and build a web-based e-commerce system for electronic goods using the Next.js framework, equipped with an integrated ordering and payment system to expand the store's market reach to the regional level. The approach used is Research and Development (R&D) with the Rapid Application Development (RAD) model. The system was built using TypeScript, the Firebase Firestore database, and the Midtrans payment gateway for digital transaction processing. It implements the Inventory First algorithm to validate stock availability during transactions and the Reorder Point (ROP) method to determine reorder thresholds and timing. System testing was conducted through three phases: Black-box Testing, Expert Validation, and User Acceptance Testing (UAT), yielding results of 97.62%, 95.83%, and 93.33%, respectively—all falling within the “very acceptable” to “very good” categories. Based on these results, the developed system is deemed technically and functionally suitable to support store operations, online transactions, and inventory control at Rizqi Elektronik.

Keywords: *e-commerce, Next.js, Rapid Application Development, Midtrans, Inventory First, Reorder Point.*

I. INTRODUCTION

Advances in digital technology and internet penetration have transformed the way people carry out their daily activities, including buying and selling. These developments have fueled the growth of electronic commerce (e-commerce) as a trading platform that offers convenience, efficiency, and flexibility in conducting transactions without being limited by time or place. The value of e-commerce transactions in Indonesia continues to rise, with electronics emerging as one of the categories with the highest demand. This shift in consumer behavior indicates that people are increasingly opting for online shopping services because they provide more comprehensive product information, ease in comparing prices, and a fast and convenient transaction process [1].

The rise in e-commerce usage presents new challenges for conventional electronics retailers. Competition with nationwide marketplaces, limited

marketing reach, and high operational costs for physical stores are factors that affect business competitiveness. Therefore, digitalization through the development of e-commerce systems is no longer an option but has become a necessity for expanding market reach while improving business process efficiency. This is consistent with findings on web-based customer engagement systems for micro and small enterprises, which show that digital platforms help local businesses reach and retain customers more effectively than manual, in-person interaction [16]. E-commerce systems not only serve as a promotional medium but also integrate ordering and payment processes, enabling transactions to be conducted more effectively [2].

Developing an e-commerce system requires technology capable of delivering high performance and a good user experience (UX). Websites with slow loading times can reduce user comfort and increase the likelihood that users will leave the page before completing a transaction. Additionally, payment systems that are not optimally integrated can erode customer trust in the services provided. The Next.js framework was chosen because it supports Server-Side Rendering (SSR) and Static Site Generation (SSG), thereby improving page loading speed, optimizing Search Engine Optimization (SEO), and facilitating integration with various third-party services, including payment gateways [3][4].

Based on observations at Rizqi Electronics, the sales process still faces several challenges, including limited marketing reach, the lack of real-time inventory management, and an inventory management process that is still carried out manually. These conditions prevent customers from accurately determining product availability, which could potentially reduce sales opportunities and lower the store's competitiveness. Additionally, the store faces difficulties in monitoring inventory levels and determining the optimal time for restocking [5].

Several previous studies have developed web-based e-commerce systems to support online sales processes, and studies addressing web-based inventory management and the Reorder Point method are among the most relevant to this research, as both share the goal of controlling stock availability and determining reorder timing in a more structured way. However, in most of these studies, stock management is still positioned as a supporting function that is decoupled from the ongoing

sales transaction: inventory-focused studies concentrate on recording incoming and outgoing stock and calculating reorder points, while e-commerce-focused studies concentrate on the transaction and payment process, with limited direct integration between the two. This indicates a research gap in which few studies combine stock-availability-based transaction control with a reorder-point mechanism within a single, fully integrated e-commerce system.

This study addresses that gap by positioning stock management as a core part of transaction control rather than a supporting record-keeping function. The Inventory First algorithm is applied as a transaction-control mechanism in which stock availability becomes a prerequisite before a sale can proceed, so the system does not merely log stock but actively governs the sales process based on real-time inventory conditions. This is further combined with the Reorder Point method, which is directly linked to the live stock data used during transaction validation, so that reorder timing is determined from the same data the transaction engine relies on rather than from a separate inventory record. The integration of stock-availability-based transaction control, automated reorder-point calculation, and payment-gateway processing within one Next.js-based platform is the main contribution that distinguishes this study from prior e-commerce and inventory research reviewed above.

METHODS

This study applies the Research and Development (R&D) method, which aims not only to examine a phenomenon but to produce and validate an applicable product, namely a web-based e-commerce system, through a systematic research process [6][7]. The R&D approach is combined with the Rapid Application Development (RAD) model at the system development stage, since RAD emphasizes fast and iterative development through prototyping together with continuous feedback from users [8][9]. This combination allows the research to proceed systematically from problem identification and requirements gathering to system design, development, and evaluation, so that the resulting system is not merely conceptual but directly addresses the operational needs of the research partner [10].

A. Research Location and Time

The research was conducted at Rizqi Elektronik, an electronic-goods store located in Ngrobong, Jiwut, Nglegok, Blitar Regency, East Java (66181). This store was selected as the case study because it still operates conventionally, has not yet implemented an integrated web-based e-commerce system, and represents the typical challenges faced by local electronics retailers, including a limited marketing reach and manual stock recording. The research was carried out over approximately eight months, from October 2025 to June 2026, covering the stages of literature review and data collection, system design, application development, and testing, in accordance with the iterative nature of the RAD model.

B. Data Collection Techniques and Data Types

Data required for designing and developing the system were obtained through three techniques, namely observation, interview, and literature study. Direct observation was carried out on the daily operational activities of Rizqi Elektronik, including customer service, product negotiation, payment procedures at the cashier, and the recording of incoming and outgoing stock, in order to identify concrete problems such as delays in checking stock availability and the store's dependence on walk-in customers. Interviews were conducted with the store owner as the main informant, both face-to-face and through the WhatsApp application, using structured and semi-structured questions to explore the required system features, the constraints faced by the store, and the expectations toward the e-commerce system to be developed. Literature study was carried out on scientific journals, books, and technical documentation related to e-commerce, the Next.js framework, Firebase, payment gateways, and system development methods, to strengthen the theoretical basis of the research.

The collected data consist of primary data, obtained directly from the sales process, product inventory, and the manual stock-recording practices at the store, and secondary data, consisting of technical documentation on the Next.js framework, the Midtrans payment gateway, the Firebase real-time database, and previous studies on e-commerce and marketplace development. Both data types were used as the basis for determining the system features, the business process flow, and the appropriate technology to support the development of a Next.js-based e-commerce system with an integrated ordering and payment mechanism.

C. System Development Stages Using the RAD Model

Following the requirements analysis, the system was developed through three iterative cycles adopted from the RAD model, namely Build, Demonstrate, and Refine, as illustrated in Fig. 1.

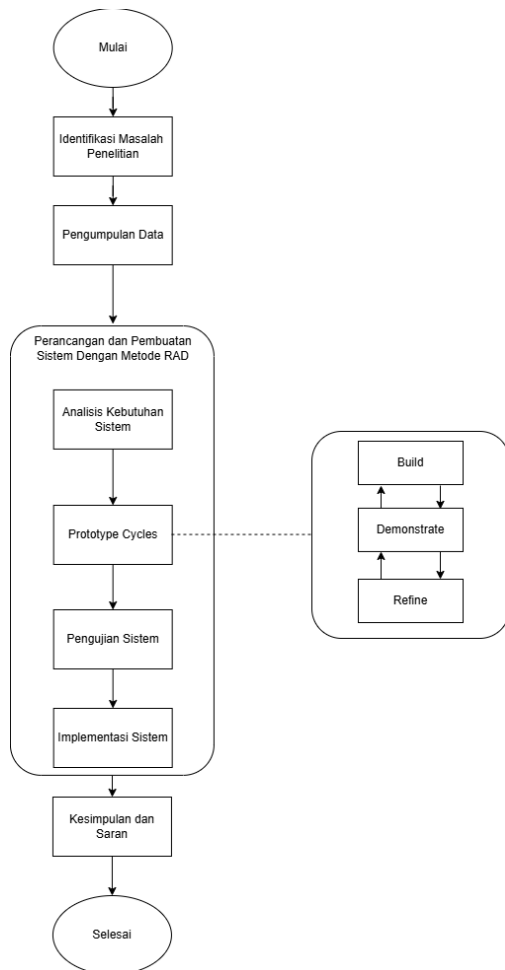


Fig. 1 Research and System Development Stages

In the Build stage, the system architecture and flow were modeled using the Unified Modeling Language (UML) together with flowchart diagrams, covering the design of the use case diagram, the ordering flowchart, the stock validation and stock monitoring flowcharts, the payment flowchart, the activity diagrams, and the interface wireframe. This modeling integrates the transaction flow of electronic-goods sales with a stock-control mechanism based on the Inventory First algorithm and the Reorder Point (ROP) method, so that the system is able to control transactions while continuously monitoring stock conditions. In the Demonstrate stage, the resulting prototype was presented to the store owner and staff to obtain feedback on ease of use, the suitability of the features with operational needs, and the interface design. In the Refine stage, the prototype was improved based on the feedback obtained, covering functional aspects, process flow, and interface display, until the system was considered ready to proceed to the testing stage.

Inventory First and Reorder Point Mechanism

The Inventory First algorithm is implemented as a rule-based validation that checks product stock before a transaction is processed. When a customer proceeds to checkout, the system retrieves the current stock quantity from the database and compares it with the ordered quantity; the transaction is only allowed to continue if

the available stock is sufficient, which prevents overselling and keeps the displayed stock information consistent with the actual condition in the store.

The Reorder Point (ROP) is calculated automatically from the average daily sales and the procurement lead time of each product, using the standard formula $ROP = \text{average daily sales} \times \text{lead time (in days)}$. The resulting ROP value is then compared with the current stock level to classify each product into one of three status categories: a product is labeled Safe Stock when its stock quantity is above the ROP value; it is labeled Needs Restock when the stock quantity is at or below the ROP value; and it is labeled Critical Stock when the stock quantity reaches a fixed critical threshold of 2 units or fewer. These labels are displayed in real time on the stock-monitoring dashboard (Fig. 8) so that the admin can prioritize which products require immediate reordering.

As an illustration, if a product has an average daily sales of 3 units and a procurement lead time of 4 days, the system computes $ROP = 3 \times 4 = 12$ units. When the remaining stock reaches 12 units or below, the product is flagged as Needs Restock; if it further drops to 2 units or below, it is flagged as Critical Stock, regardless of the calculated ROP value.

D. Use Case Diagram

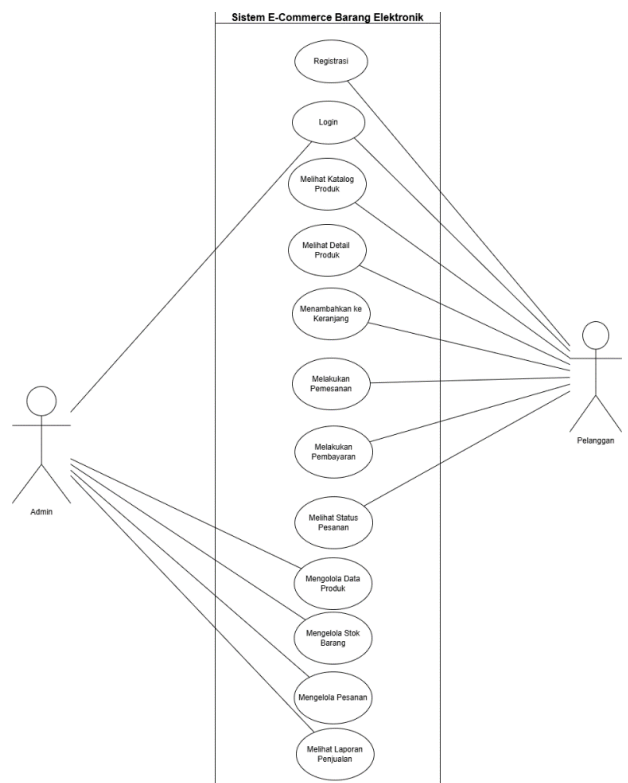


Fig. 2 Use Case Diagram

Fig. 2 presents the use case diagram of the developed e-commerce system, which involves two main actors, namely Admin and Customer. The customer acts as the end user who performs the core activities of the system, such as registration, login, browsing the product catalog, placing orders, and completing online payment. The admin is responsible for managing product and stock

data, as well as monitoring incoming orders and transactions. This diagram shows that the entire electronic-goods sales process has been integrated into a single web-based system, in which customers can obtain complete and real-time product information, place orders through the shopping-cart and checkout features, and complete payment through an integrated payment gateway, resulting in a safer and more efficient transaction process.

E. Ordering, Stock Validation, and Stock Monitoring Flowcharts

The system's transaction flow is modeled using several interconnected flowcharts, linked through connectors A, B, C, and D, so that each process can be visualized in a structured manner without losing the relationship between processes.

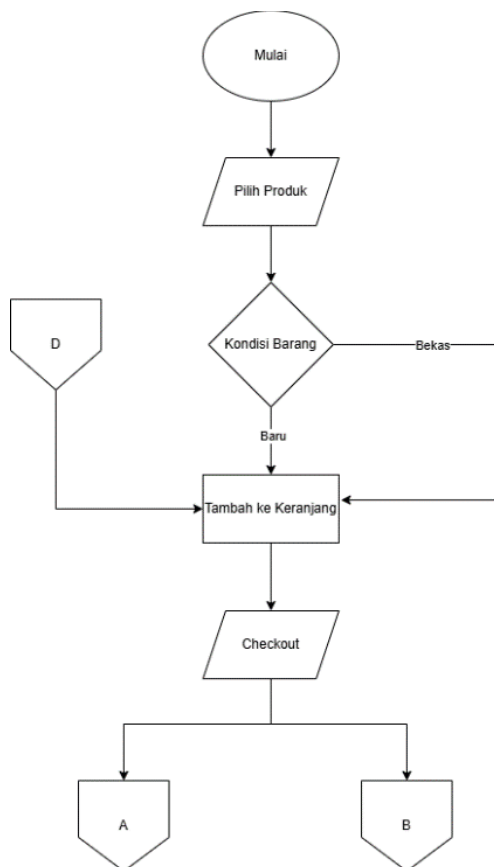


Fig. 3 Ordering Flowchart

Fig. 3 shows the main ordering flowchart. The process begins when the customer selects a product from the catalog; the system then identifies whether the item is new or used, a branch that only provides information to the customer without affecting the transaction flow. The selected product is added to the shopping cart, and if a stock-validation failure occurs afterward, the flow returns to this step through connector D so that the customer can adjust the order. Once the customer proceeds to checkout, the flow continues through connector A, which leads to the stock-validation process.

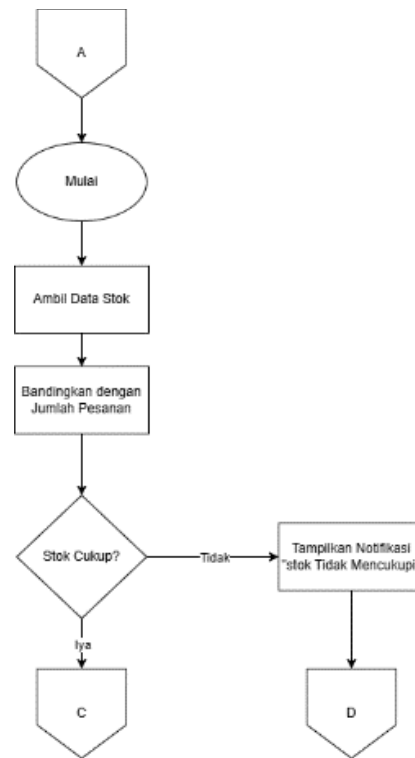


Fig. 4 Stock Validation Flowchart Using the Inventory First Algorithm

Fig. 4 illustrates the stock-validation flowchart based on the Inventory First algorithm. Entering through connector A, the system retrieves the current stock data and compares it with the ordered quantity. If the stock is insufficient, the system displays a notification and returns the flow to the cart through connector D so that the customer can adjust the order; if the stock is sufficient, the system updates the stock quantity according to the transaction and proceeds through connector C to the stock-monitoring process.

Fig. 5 presents the stock-monitoring flowchart based on the Reorder Point (ROP) method. Entering through connector C, the system checks the current stock level against the reorder-point threshold. When the stock level is at or below the threshold, the system displays a minimum-stock notification to the admin as an early warning; if the stock remains above the threshold, the monitoring process ends without further action. The reordering process itself is beyond the scope of this study. Payment processing, reached through connector B after checkout, is completed once the transaction status is confirmed by the payment gateway. These flowcharts are complemented by activity diagrams that describe, in three separate diagrams, the dynamic interaction between the customer, the admin, and the system during ordering, stock validation and monitoring, and payment, so that each business process can be traced clearly without cluttering a single diagram.

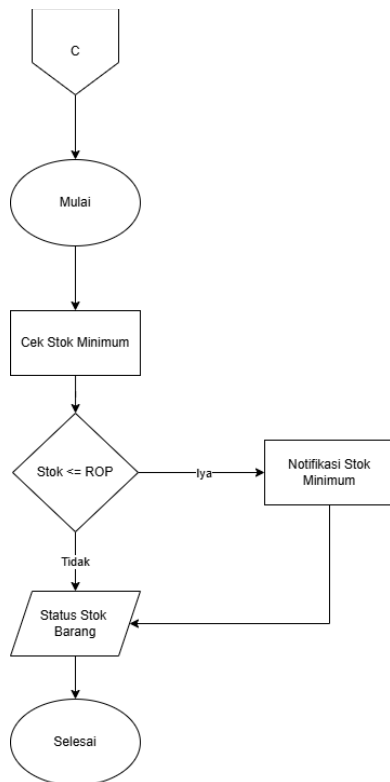


Fig. 5 Stock Monitoring Flowchart Using the Reorder Point Method

F. System Testing

The developed system was evaluated through three testing stages, namely Black-box Testing, Expert Validation, and User Acceptance Testing (UAT).

Black-box Testing was conducted to examine the system's functional behavior without reference to its internal code structure, by comparing the actual output produced by each feature with the output expected in the test scenario [11][12]. The scenarios covered user authentication, product management, the shopping cart, payment integration through Midtrans, and stock synchronization, so that each core transaction and inventory feature could be verified from the user's point of view.

Expert Validation was carried out after the Black-box Testing stage to assess the technical feasibility of the system, involving validators competent in information systems and software engineering. Expert Validation involved two validators holding relevant academic and professional backgrounds in information systems and web-based application development. Each validator assessed 12 statement items using a five-point Likert scale (1 = strongly disagree to 5 = strongly agree), covering the aspects listed above. The assessment covered the system's functional suitability, the implementation of the Next.js, TypeScript, Firebase, and Midtrans technologies, the validation of the Inventory First algorithm and the Reorder Point calculation, system security and integration, and the quality of the interface structure.

User Acceptance Testing (UAT) was conducted to measure the level of user acceptance from the usability

perspective, involving the store owner as the system administrator and one store employee as the operational user [3][7]. The two respondents each rated 12 statement items on the same five-point Likert scale, covering operational efficiency, stock transparency, ease of transaction, security and trust, and interface quality. The resulting percentage scores were interpreted using a five-level feasibility scale (0–20% Not Feasible, 21–40% Less Feasible, 41–60% Sufficient, 61–80% Feasible, 81–100% Very Feasible/Very Good), consistent with the criteria applied to the Black-box Testing results. The assessment instrument was designed as a questionnaire covering operational efficiency, stock transparency, ease of transaction, security and trust, and interface quality, so that the results reflect the extent to which the system supports the store's daily operations. One scenario in the Black-box Testing did not fully meet the expected result: the automatic update of the Midtrans payment status still required a manual status check by the user before the transaction was marked as paid, rather than updating automatically. This limitation is discussed further in Section III.C.

RESULTS AND DISCUSSION

A. System Implementation

The designed system was implemented as a functional web application using Next.js and TypeScript, with Firebase Firestore and Firebase Authentication for data storage and user authentication, Supabase Bucket for product-image storage, and Midtrans as the payment gateway. The implemented features include user registration and login, a real-time product catalog, a shopping cart, checkout, an admin panel for managing products, orders, and coupons, and a stock-monitoring module that applies the Inventory First algorithm and the Reorder Point (ROP) method.

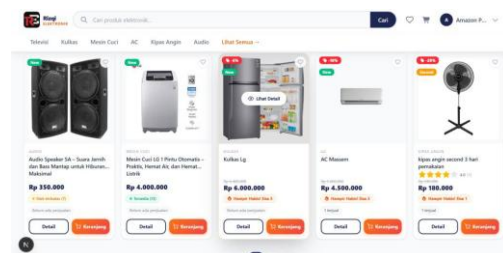


Fig. 6 Product Catalog Page



Fig. 7 Admin Dashboard

Fig. 6 and Fig. 7 show the customer-facing catalog and the admin dashboard, which summarizes transactions, registered users, and stock conditions in real time. Fig. 8 shows the stock-monitoring page,

where each product is automatically labeled Safe Stock, Needs Restock, or Critical Stock based on the ROP threshold, while every successful payment through Midtrans reduces the corresponding stock according to the Inventory First mechanism described in Section II.

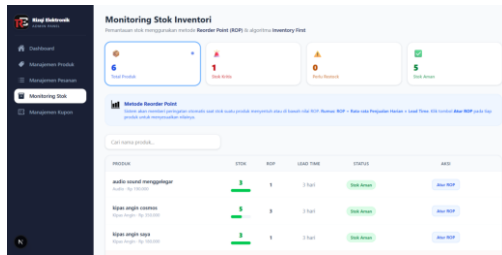


Fig. 8 Stock Monitoring Page

B. Testing Results

The system was evaluated through Black-box Testing, Expert Validation, and User Acceptance Testing (UAT), covering authentication, product management, the shopping cart, payment integration, and stock synchronization. Table 1 summarizes the results of the three testing stages.

Stage	Score	Category
Black-box	41/42 (97.62%)	Very Feasible
Expert Validation	115/120 (95.83%)	Very Feasible
UAT	112/120 (93.33%)	Very Good

Table 1. Summary of System Testing Results

All three testing stages fall within the “very feasible” to “very good” categories. The only scenario that did not fully match the expected result was the automatic update of the Midtrans payment status, which still required a manual status check before being marked as paid; every other scenario, including stock validation and synchronization, behaved as expected.

C. Discussion

These results indicate that integrating e-commerce transactions with the Inventory First algorithm and the Reorder Point method inside a single Next.js platform allows stock conditions to be validated during checkout and continuously monitored afterward, rather than being managed manually as before. This is in line with findings on real-time web-based monitoring applications, which show that continuous digital monitoring improves the timeliness and accuracy of information available to the responsible party compared to periodic manual checks [14]. This finding is in line with [15], who found that a web-based sales information system improves the management of transaction and stock data compared to manual processes, and with [14], who found that web-based sales systems ease transaction handling and broaden market reach. Compared with prior studies reviewed for this research, most of which treat sales and inventory control as

separate systems, the present system combines both concerns in one platform so that every transaction is evaluated against real-time stock availability.

This study is nonetheless limited to functional and usability testing through Black-box Testing, Expert Validation, and UAT, so the system's performance under concurrent user load and its resistance to security threats such as penetration attacks have not been evaluated. In addition, the Inventory First algorithm is currently limited to stock validation and does not yet provide predictive reordering. Performance testing, security testing, and predictive stock management are therefore recommended as directions for further development.

CONCLUSION

This study successfully designed and developed a web-based e-commerce system for electronic goods at Rizqi Elektronik using the Next.js framework with the Research and Development (R&D) method and the Rapid Application Development (RAD) model. The system integrates Firebase Firestore and Firebase Authentication, Supabase Bucket, and the Midtrans payment gateway, and provides product catalog, shopping cart, checkout, and digital payment features together with a stock-management module based on the Inventory First algorithm and the Reorder Point (ROP) method. System evaluation through Black-box Testing, Expert Validation, and User Acceptance Testing (UAT) produced scores of 97.62%, 95.83%, and 93.33%, respectively, all within the “very feasible” to “very good” categories, indicating that the system is technically sound, meets its functional requirements, and is well received by its intended users. Overall, the developed system helps Rizqi Elektronik reach customers beyond its local area, replaces manual stock recording with real-time monitoring, and provides an integrated online ordering and payment process. Future work may extend the system to a mobile platform, add shipment tracking, automate the payment-status update from the payment gateway, and combine the Reorder Point method with sales-forecasting techniques for more accurate inventory planning.

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