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Implementation of a Web-Based Smart Water Ordering System with Telegram Notification and Monitoring Dashboard for Olivia MSME

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Abstract: Many micro, small, and medium enterprises (MSMEs) selling refillable drinking water still manage customer orders manually through phone calls and instant messaging, resulting in scattered transaction records, delayed responses, and limited operational monitoring. This study aimed to design, implement, and evaluate a web-based Smart Water Ordering System for Olivia MSME by integrating Quick Response Code Indonesian Standard (QRIS) payment, Telegram Bot notifications, and a centralized monitoring dashboard. The system was developed using the Waterfall Software Development Life Cycle (SDLC), encompassing requirement analysis, Unified Modeling Language (UML)-based system design, implementation using PHP and MySQL, and comprehensive system testing. The platform incorporates customer order placement, coordinate-based shipping-distance calculation, cashless transaction processing, and a moderated customer feedback mechanism. Functional validation through Black Box Testing confirmed that all core modules executed successfully without functional discrepancies, with the asynchronous Telegram webhook delivering order alerts in under two seconds. User Acceptance Testing involving 23 respondents (one administrator and twenty-two customers) yielded average satisfaction scores ranging from 4.7 to 4.9 out of 5, demonstrating high user acceptance across usability, interface clarity, feature suitability, information accessibility, and operational support. Practically, the system replaced conventional phone-based communication by centralizing transaction records, automating payment verification workflows, and providing real-time sales analytics through an integrated dashboard. These findings indicate that unifying transactional, payment, instant alert, and administrative monitoring components into a single web application effectively improves operational efficiency and accelerates the digital transformation of small-scale water-refill enterprises.

Keywords: Smart Water Ordering System; Qris Payment; Telegram Bot Notification; Monitoring Dashboard; Waterfall Method.

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1. Introduction

The ongoing digital transformation has significantly changed how micro, small, and medium enterprises (MSMEs) operate, encouraging business owners to transition from manual, paper-based processes toward integrated web-based systems that enhance service reliability and operational efficiency. Information technology enables enterprise managers to record transactions, maintain customer records, and monitor inventory with higher precision and speed than conventional manual bookkeeping. While MSMEs play an indispensable role in maintaining local economic stability and driving employment, many still operate with minimal technological support and continue to rely on redundant, manual operational workflows. In the refillable drinking water sector, operational delays and logistical miscalculations directly compromise customer retention and increase operational overhead. Olivia MSME, a local drinking water refill depot, exemplifies these operational constraints. Prior to this study, the depot processed orders primarily through telephone calls and instant messaging applications without a centralized repository for transactional records. This reliance on unstructured, peer-to-peer communication caused transaction data to become scattered across individual chat threads, obstructed historical record retrieval, and frequently led to discrepancies between customers and depot personnel regarding delivery locations and payment statuses. Furthermore, the absence of an integrated data management mechanism prevented the proprietor from compiling accurate daily sales reports or monitoring water inventory levels in real time, creating an administrative bottleneck that hindered business growth.

Prior studies on MSME information systems have generally addressed these challenges in isolation. Several initiatives developed basic transactional platforms focused on Create, Read, Update, and Delete (CRUD) operations without incorporating automated payment gateways. Concurrently, empirical inquiries into Quick Response Code Indonesian Standard (QRIS) payment systems predominantly examined technology acceptance factors rather than embedding payment generation directly into an operational checkout flow. Similarly, implementations of Telegram Bot notifications have focused largely on hardware monitoring or Internet of Things (IoT) alert mechanisms rather than synchronizing transactional web databases, while administrative dashboards have typically functioned as standalone visualization tools. Consequently, a notable gap remains for an integrated platform that combines customer ordering, coordinate-based delivery distance calculation, cashless payment processing, automated administrative notification, centralized performance monitoring, and customer feedback management into a single architecture tailored to small-scale water refill enterprises.

To bridge this operational and technological gap, this study designs, implements, and evaluates a web-based Smart Water Ordering System for Olivia MSME. The system incorporates a customer ordering interface with automated shopping cart management, coordinate-based shipping-distance estimation, and transaction history tracking. It embeds a cashless QRIS payment mechanism alongside an asynchronous Telegram Bot notification service that alerts administrators upon new order submissions. Additionally, the platform provides a centralized monitoring dashboard for tracking sales and inventory metrics, complemented by a moderated testimonial module to evaluate customer feedback. The research scope centers on the development and validation of these transactional, payment, notification, monitoring, and feedback components. Shipping distances are determined using a straight-line Haversine formula rather than dynamic road-network routing APIs, QRIS payment verification is managed administratively through manual confirmation rather than an automated gateway aggregator, and the system prototype excludes native mobile device features such as live courier tracking via GPS. These boundaries ensure that the developed prototype remains technically feasible and verifiable within the available operational context. The remainder of this paper is structured with Section 2 detailing related studies and the novelty matrix, Section 3 presenting the development methodology and system design, Section 4 examining the implementation outcomes and evaluation results, and Section 5 summarizing the conclusions alongside future research directions.

2. Related Work

The digitalization of operational workflows among micro, small, and medium enterprises (MSMEs) has been widely investigated across diverse domains, reflecting varying degrees of technical complexity. Research in this area predominantly centers on four major streams: web-based transaction processing, digital payment integration, automated notification protocols, and administrative monitoring dashboards. In the context of transaction management, several studies developed web-based ordering and point-of-sale systems tailored to local enterprises, including water refill depots, catering providers, and retail stores (Aryantoro *et al.*, 2025; Devansyah *et al.*, 2025; Fakih *et al.*, 2025; Khairunnisa *et al.*, 2026; Pranatawijaya, 2022; Sari *et al.*, 2023; Wahyudi *et al.*, 2022). These platforms established the foundational architecture for managing inventory records and customer data; however, most remained confined to standard database operations without

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incorporating automated logistics or integrated financial clearance. Parallel inquiries have addressed the operational and economic dimensions of Quick Response Code Indonesian Standard (QRIS) adoption, highlighting how contactless payment methods improve transaction efficiency and business productivity (Alfiana *et al.*, 2025; Fahrudin & Isnaini, 2023; Febriani *et al.*, 2023; Kusumawati & Kartikasari, 2025; Natsir *et al.*, 2023; Puriati *et al.*, 2023; Sholihah & Nurhapsari, 2023). Nevertheless, these inquiries primarily evaluated user adoption behavior and economic performance through survey instruments rather than integrating dynamic payment workflows into web checkout architectures. Furthermore, research involving Telegram Bot interfaces demonstrated effective real-time alerting for hardware monitoring and transactional reminders (Tibyani, 2021; Yudhistira & Suharjo, 2025), while dashboard studies focused on visualizing aggregated business performance data independently of transactional pipelines (Ismail *et al.*, 2026; Sumampow *et al.*, 2023; Widiyanto & Wicaksono, 2022). To synthesize these diverse contributions and delineate their relationship with the system developed in this research, Table 1 summarizes the most relevant prior studies across the four operational domains.

Table 1. Summary of Related Studies

No.	Author(s) and year	Research focus	Relation to this study
1	Poerwandono *et al.* (2025)	Web-based attendance information system	Demonstrates a real-time web recording architecture without transactional or payment capabilities
2	Pranatawijaya (2022)	Location-based service for catering delivery	Provides a distance-based delivery concept relevant to shipping-cost estimation
3	Devansyah *et al.* (2025)	Laravel-based refill water ordering system	Represents the closest prior work on water-refill ordering, lacking QRIS or Telegram integration
4	Sari *et al.* (2023)	Marketing and sales system for a water refill depot	Focuses on product marketing without integrating payment gateways or instant alert mechanisms
5	Wahyudi *et al.* (2022)	Web-based sales system for refill gallon water	Implements CRUD-based order processing without digital payment or monitoring dashboards
6	Khairunnisa *et al.* (2026)	Sales information and analysis system for an RO water-refill depot using the incremental method	Operates within the same refill-water domain, focusing on RO reporting without payment or alert integrations
7	Fakih *et al.* (2025)	Web-based POS system for BruleeBites MSME	Enhances point-of-sale efficiency without distance calculation or automated messaging features
8	Yudhistira & Suharjo (2025)	Multi-room fire detector with Telegram Bot notification	Employs Telegram Bot notifications for hardware-based IoT alerts rather than web transactions
9	Saputra, Pakpahan, & Andriawan (2025)	Information system design for a general retail MSME	Serves as a reference for general web-based sales, omitting payment gateways and centralized dashboards
10	Indriani *et al.* (2024)	Agile development of a web-based sales system for an employee co-op	Provides architectural guidance for web sales systems under agile development frameworks
11	Hibatullah *et al.* (2025)	Waterfall method in a web-based e-commerce sales system	Supplies a methodological reference for structured SDLC execution without integrated external APIs
12	Angel *et al.* (2025)	MSME e-commerce platform using Black Box testing and the Waterfall method	Demonstrates testing and development procedures for retail platforms without digital payment gateways
13	Sholihah & Nurhapsari (2023)	Digital payment adoption in MSMEs via the Technology Acceptance Model	Investigates adoption intentions regarding QRIS without embedding it into an active checkout workflow
14	Febriani *et al.* (2023)	Behavioral intention and use of QRIS among MSMEs using UTAUT2	Evaluates user perceptions of QRIS rather than technical system implementations

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15	Puriati *et al*. (2023)	Effectiveness of QRIS implementation among MSMEs	Assesses financial effectiveness from a business perspective without web platform integration
16	Natsir *et al*. (2023)	QRIS as a digital payment tool to improve MSME productivity	Analyzes operational productivity gains without embedding QRIS into transactional architectures
17	Alfiana *et al*. (2025)	QRIS adoption among MSMEs	Examines behavioral adoption patterns among micro-enterprises rather than technical checkout flows
18	Fahrudin & Isnaini (2023)	Effect of QRIS usage on MSME business revenue	Evaluates economic impacts without incorporating automated verification into software systems
19	Kusumawati & Kartikasari (2025)	Optimizing financial performance through QRIS implementation	Focuses on accounting efficiency without automated logistics or instant notification modules
20	Ismail *et al*. (2026)	Sales monitoring dashboard for MSMEs	Develops an administrative reporting interface as a standalone tool detached from ordering portals
21	Sumampow *et al*. (2023)	Monitoring dashboard for sales analysis using a star schema	Provides data warehouse and dashboard structures independent of live ordering systems
22	Tibyani (2021)	Telegram Bot for customer reminder systems	Demonstrates Telegram integration for transactional reminders without payment or dashboard links
23	Aryantoro *et al*. (2025)	Online sales information system for culinary MSMEs	Offers general e-commerce references lacking third-party payment and instant alert mechanisms
24	Widiyanto & Wicaksono (2022)	Multi-branch sales monitoring system using the prototype method	Focuses on multi-branch sales reporting detached from direct customer checkout portals
25	Rizal *et al*. (2026)	Web-based ordering and monitoring system for MSME products	Combines ordering and tracking modules but excludes QRIS digital payment and Telegram alerts
26	Saputra *et al*. (2025)	Web-based sales system for food and beverage MSMEs	Outlines general transaction workflows for food enterprises without automated delivery calculations
27	Anggara *et al*. (2022)	Customer relationship management in web sales systems	Serves as a reference for integrating customer feedback and retention mechanisms

The reviewed studies demonstrate that web-based ordering, QRIS digital payment, Telegram notifications, and monitoring dashboards have been widely examined in enterprise computing. However, these investigations address each component independently rather than as a cohesive system. Research on QRIS has consistently concentrated on user acceptance, adoption intentions, and financial performance, without embedding code generation directly into an automated web checkout flow. Similarly, Telegram Bot implementations have focused on hardware-based IoT alerting or standalone reminder scripts, while dashboard inquiries emphasize periodic data aggregation detached from operational ordering workflows. Consequently, no prior study integrates web-based water ordering, coordinate-based shipping-distance calculation, QRIS transaction processing, instant Telegram notifications, centralized monitoring, and moderated testimonials into a unified architecture designed for a drinking water depot. Table 2 details the comparative analysis establishing this research gap.

Table 2. Research Gap and Novelty Analysis

Aspect	Previous studies	This study
Web-based water ordering system	Addressed in selected studies	Yes
QRIS digital payment integration	Evaluated primarily through adoption surveys	Yes
Telegram Bot notification	Deployed mainly for IoT or reminder tasks	Yes
Centralized monitoring dashboard	Implemented as standalone reporting tools	Yes
Automatic shipping-distance calculation	Not reported in reviewed domain studies	Yes

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Moderated customer testimonial feature	Rarely incorporated into water-depot systems	Yes
End-to-end integration of all modules	Not identified in reviewed literature	Yes

The novelty of this study resides in the architectural unification of these previously isolated technologies into a cohesive web platform tailored to small-scale water refill enterprises. Upon customer checkout, the system calculates delivery distance from geographic coordinates, computes total costs, generates a transaction-specific QRIS code, updates the relational database, and triggers an asynchronous webhook delivering an immediate Telegram alert to the depot administrator. The administrator monitors sales volumes and order stages through an integrated visual dashboard while managing customer feedback through a moderation pipeline. This cohesive architectural integration constitutes the primary contribution of this research to the practical digitalization of micro-enterprises.

3. Methodology

3.1 Research Method

This research adopts an applied development methodology to build a web-based information system prototype for digitalizing the operational workflow of Olivia MSME. System construction was conducted using the Waterfall Software Development Life Cycle (SDLC) model, selected for its systematic, sequential progression where each development milestone must be completed and validated before transitioning to the subsequent phase. Development advanced through five interconnected phases: requirement analysis to elicit operational needs from depot workflows; system design to model functional interactions and data structures; software implementation to construct program modules and integrate third-party services; system testing to validate functional integrity and user acceptance; and operational maintenance to address post-deployment adjustments and system optimization.

3.2 Requirement Analysis

The functional specifications defined for the system comprise several interrelated operational capabilities. Customers require modules for account registration, authentication, dynamic product catalog browsing, automated shopping-cart management, delivery-coordinate selection, and real-time transaction history review, along with an order cancellation option prior to depot verification and a public testimonial submission form. On the administrative side, the depot operator requires a centralized dashboard, complete product catalog and inventory management through CRUD operations, transaction-status updates across five defined stages (Waiting, Processing, Delivered, Completed, and Cancelled), automated revenue recapitulation, and testimonial moderation. A core functional requirement involves automatic delivery-distance calculation to determine shipping fees based on customer coordinates relative to the depot base location. The system executes this calculation using the Haversine formula, which computes the great-circle distance between two geographic coordinate points on a spherical surface. The mathematical formulation is defined in Equation (1) and Equation (2):

$$a = sin^2\left(\frac{\Delta\emptyset}{2}\right) + cos(\emptyset 1)cos(\emptyset 2)sin^2\left(\frac{\Delta\lambda}{2}\right) \quad (1)$$

$$d = 2r \cdot arcsin(\sqrt{a}) \quad (2)$$

Where $\emptyset 1$ and $\emptyset 2$ represent the latitudes of the depot and customer locations in radians, $\Delta\emptyset$ denotes the difference between latitudes, $\Delta\lambda$ is the difference between longitudes, r is the mean radius of the Earth ($r \approx 6{,}371$ km), and d represents the calculated delivery distance. The non-functional requirements emphasize cross-platform accessibility, ensuring responsive rendering on both mobile and desktop browsers via standard HTTP protocols. Security parameters focus on persistent session handling to prevent unauthorized administrative escalation, data integrity through normalized relational schema constraints, and asynchronous transmission efficiency to deliver Telegram notifications without inducing interface latency.

3.3 System Design

The design phase translated requirement specifications into structural models, entity relationships, and client-server architecture diagrams. Functional interactions are governed by two primary human actors, the Customer and the Administrator, alongside an external Telegram Bot service actor.

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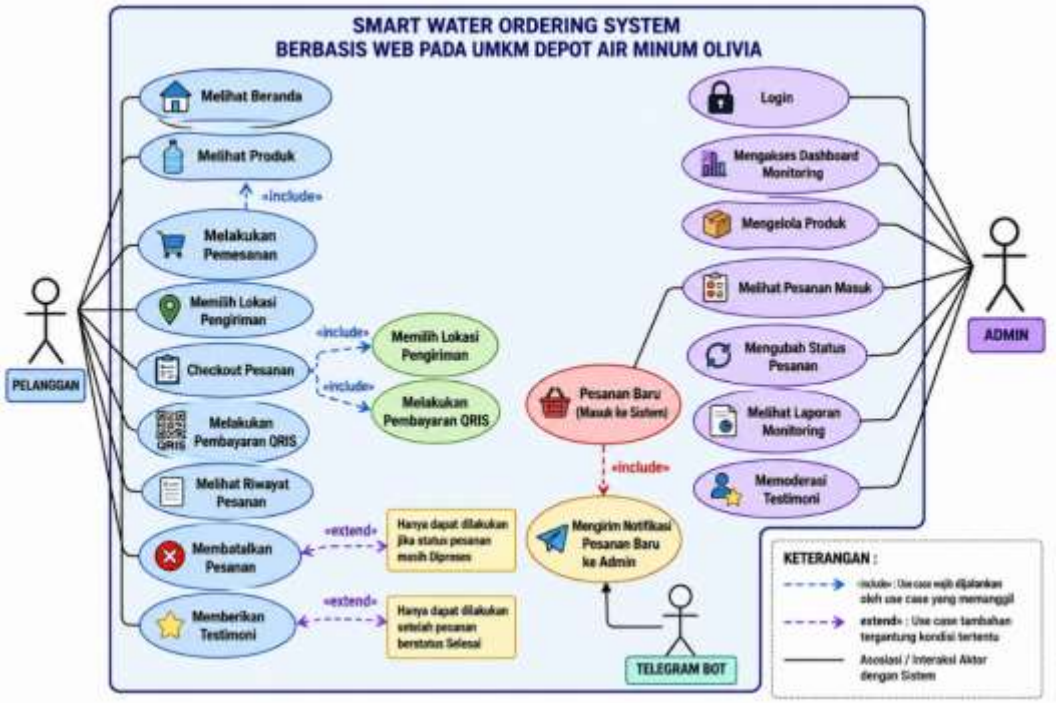

Figure 1. Use Case Diagram of the Smart Water Ordering System

Figure 1. illustrates the operational boundaries of the system. The Customer interacts with modules for registration, authentication, product browsing, location setting, order checkout with QRIS payment, and feedback submission. The Administrator oversees the centralized dashboard, executes CRUD operations on inventory, updates order progression, and moderates incoming testimonials. The Telegram Bot functions as an automated external actor, triggered via webhooks upon successful order insertion to dispatch real-time alerts directly to the administrator.

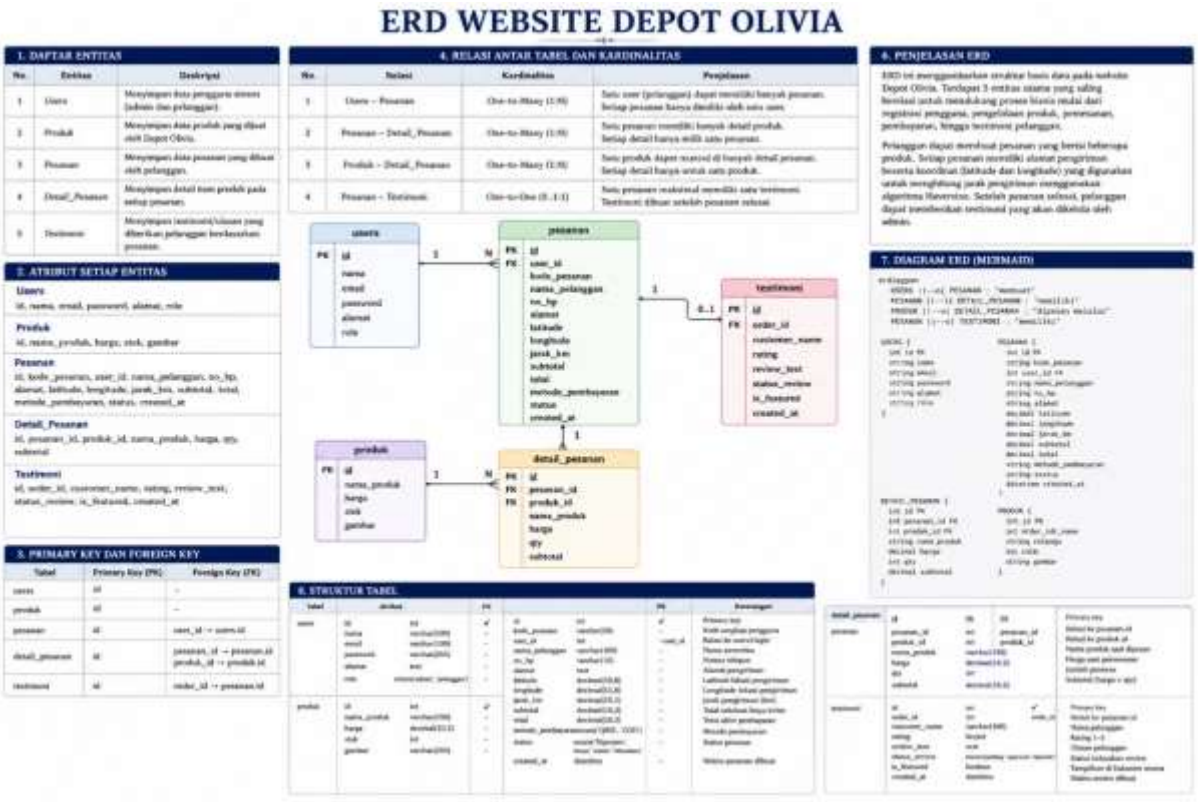

Figure 2. Entity-Relationship Diagram of the Database

Figure 2. delineates the normalized relational database architecture supporting transactional persistence. The structure is organized into five primary entities: Users, Products, Orders, Order Details, and Testimonials.

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Referential integrity is strictly maintained through primary-foreign key relationships, such as linking user identifiers from the Users entity into the Orders table and referencing product entities within individual Order Details records, thereby preventing data anomalies during concurrent order entries.

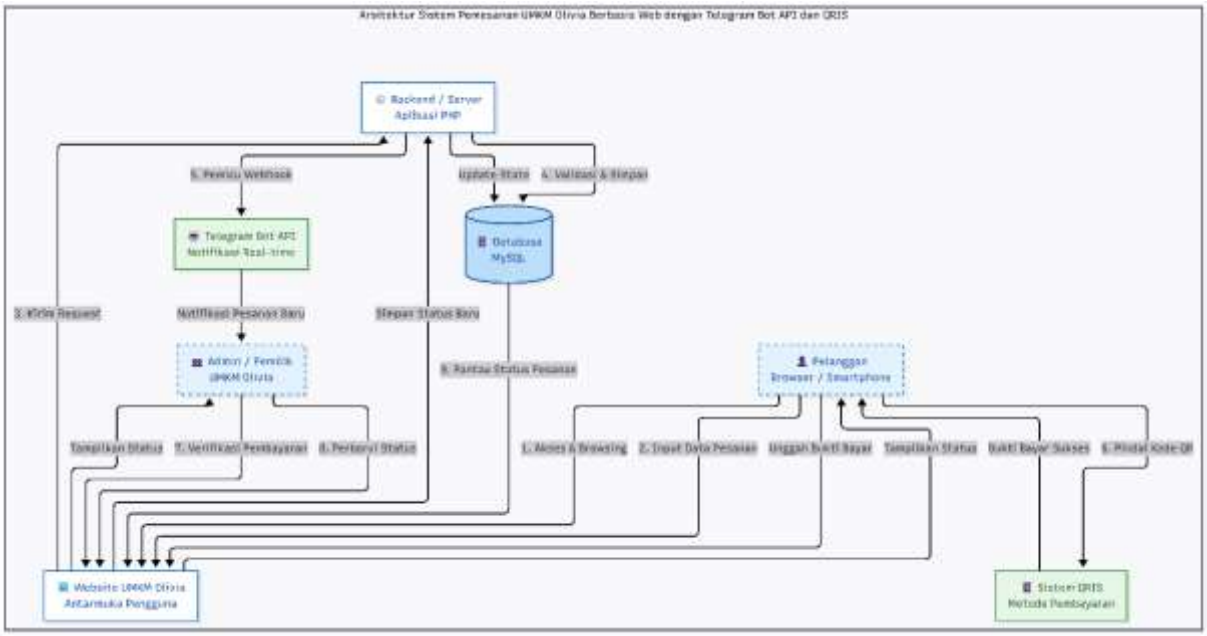

Figure 3. System Architecture of the Smart Water Ordering System

Figure 3. demonstrates the multi-tier client-server topology of the platform. The front-end client interface communicates over standard HTTP/HTTPS protocols with the PHP backend application server hosted on an Apache environment. The backend processes business logic, executes parameterized queries to the MySQL relational database, and coordinates external communication. When an order is saved, the application executes an asynchronous cURL request to the Telegram Bot API webhook while simultaneously generating a transaction-specific QRIS payload for customer settlement. The system prototype was implemented using an integrated open-source software stack supported by standard development hardware, as detailed in Table 3.

Table 3. Hardware and Software Specifications

No	Component	Technology / specification
1	Operating system	Windows 10/11
2	Integrated development environment	Visual Studio Code
3	Local web server environment	XAMPP (Apache HTTP Server and PHP)
4	Database management system	MySQL Relational Database
5	Client web browser	Google Chrome
6	Notification gateway	Telegram Bot API (cURL Webhook)
7	Front-end framework	Bootstrap 5, HTML5, CSS3, JavaScript
8	Development workstation	Intel Core i3/i5 processor, 8 GB RAM
9	Mobile test environment	Android smartphone
10	Connectivity environment	High-speed Wi-Fi and mobile hotspot

3.4 Testing Methods

System evaluation comprised two sequential validation stages: Black Box Testing and User Acceptance Testing (UAT). Black Box Testing assessed the functional execution of core software modules without referencing internal code structures, verifying that each input produced expected system behaviors across user authentication, transaction recording, distance calculations, QRIS generation, and Telegram webhook delivery. Following functional validation, User Acceptance Testing was conducted to evaluate user satisfaction and operational suitability within the actual business environment of Olivia MSME. The testing cohort involved 23 respondents, comprising 1 depot administrator and 22 active customers (n = 23). Participants interacted directly with the deployed web platform and subsequently completed a standardized five-point Likert-scale questionnaire. The evaluation measured five dimensions: ease of use, interface clarity, feature suitability, information accessibility, and operational support. User responses were analyzed by calculating the mean score for each criterion to establish the overall level of system acceptance.

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4. Results and Discussion

4.1 Results

The Smart Water Ordering System was successfully implemented and deployed to the production environment of Olivia MSME. Customers can browse the dynamic product catalog, manage items within a digital cart, and complete transactions without requiring direct telephone contact with depot personnel. During checkout, the platform captures customer delivery coordinates to determine shipping distances relative to the depot base location. Upon order submission, the system generates a transaction-specific QRIS code corresponding to the total invoice amount and simultaneously triggers an asynchronous webhook dispatching order parameters to the administrator's Telegram account.

Figure 4. Telegram Notification Received by the Administrator

Figure 4 illustrates the instant push notification received on the administrator's Telegram account following order placement. The notification payload includes the invoice identifier, customer credentials, ordered product items, itemized price calculations, and destination coordinates, enabling the administrator to process incoming requests promptly without continuously refreshing the web administration portal.

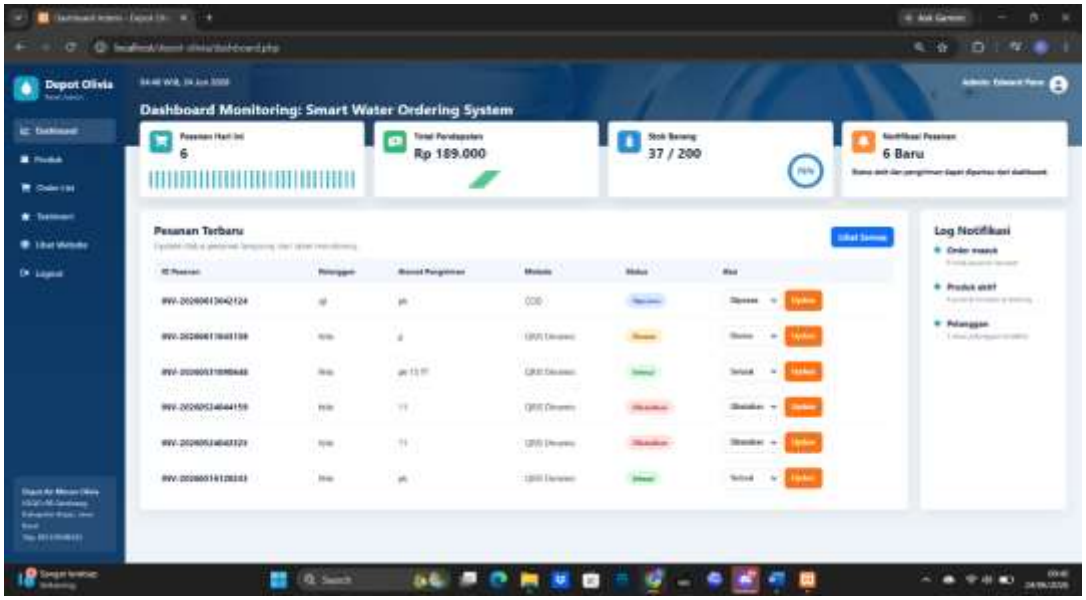

Figure 5. Monitoring Dashboard for the Administrator

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Figure 5. shows the centralized monitoring dashboard utilized by the administrator to supervise daily operational performance. The dashboard aggregates relational database records into dynamic visualization cards detailing total revenue figures, daily transaction counts, and active order distributions, supported by a structured data table for updating delivery stages and reviewing transaction logs. Furthermore, submitted customer testimonials are routed to a moderation queue prior to publication on the landing page, and persistent session authentication restricts administrative management tools from unauthorized access. Functional validation of the platform was conducted through Black Box Testing across eight primary operational modules, as summarized in Table 4.

Table 4 Black Box Testing Results

No.	Feature	Test scenario	Expected result	Result
1	Login	Enter valid user credentials	System grants account access	Passed
2	Registration	Submit complete registration inputs	Account record is stored in database	Passed
3	Ordering	Select catalog items and execute checkout	Transaction is recorded successfully	Passed
4	QRIS payment	Access payment settlement page	Transaction-specific QRIS code is generated	Passed
5	Telegram notification	Finalize new order submission	Instant webhook notification is dispatched	Passed
6	Dashboard	Navigate to administrative dashboard	Aggregated operational metrics are displayed	Passed
7	Order history	View user transaction logs	Historical order records render correctly	Passed
8	Testimonial	Submit feedback via customer form	Testimonial is queued for moderation	Passed

All eight core operational modules satisfied their respective functional criteria without execution errors. The Telegram webhook operated asynchronously with an observed notification dispatch latency of less than two seconds, and database transaction simulations confirmed data integrity under concurrent multi-user submissions. User Acceptance Testing was subsequently conducted using a five-point Likert-scale instrument administered to 23 respondents, comprising 1 depot administrator and 22 active customers. The evaluation outcomes are detailed in Table 5.

Table 5 User Acceptance Test Results (n = 23)

No.	Statement	Average score (out of 5)
1	The system is easy to use	4.8
2	The interface is easy to understand	4.7
3	The features match user needs	4.9
4	Information is easy to obtain	4.8
5	The system helps the ordering process	4.9

The evaluation produced average satisfaction ratings ranging from 4.7 to 4.9 out of a maximum of 5, indicating high user acceptance. Qualitative remarks from customers underscored the seamless checkout progression and the transparency of calculated shipping costs prior to transaction confirmation. Concurrently, administrative feedback highlighted that real-time Telegram alerts and centralized dashboard analytics substantially eliminated the manual overhead formerly associated with transaction bookkeeping.

4.2 Discussion

The empirical findings confirm that all research objectives formulated in Section 1 were accomplished. The customer ordering portal, QRIS payment generation, Telegram alert mechanism, administrative monitoring dashboard, and testimonial moderation workflow operated in accordance with functional expectations, receiving positive evaluations from both consumer and administrative stakeholders. When contrasted with the prior studies compiled in Table 1, which examined ordering systems, digital payments, notification bots, or analytics dashboards as isolated tools, this investigation establishes that integrating these technologies into a single web platform is technically achievable for small-scale enterprises while delivering substantive gains in response latency and bookkeeping accuracy. From an operational standpoint, the implemented solution directly benefits Olivia MSME by replacing informal, unstructured communication channels with an integrated transactional pipeline. Furthermore, because the underlying software architecture relies on mature open-source technologies—specifically PHP, MySQL, and Bootstrap—the platform provides a

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viable blueprint that can be replicated by other water-refill depots facing comparable logistical constraints. Table 6 delineates the comparative operational conditions of the enterprise before and after system deployment.

Table 6. Comparison Before and After System Implementation

Aspect	Before implementation	After implementation
Ordering method	Phone calls or instant messaging	Integrated web portal
Transaction recording	Manual paper records	Automated relational database storage
Order notifications	Unstructured chat inquiries	Real-time automated Telegram alerts
Operational monitoring	Periodic manual recaps	Centralizedreal-time monitoring dashboard
Transaction history	Fragmented across chat logs	Systematically recorded and retrievable
Payment processing	Cash or manual bank transfers	Cashless QRIS transaction generation

Notwithstanding these positive outcomes, several operational and technical limitations warrant consideration. The automated delivery estimation relies on the Haversine formula, which measures great-circle distances across coordinate pairs without accounting for physical road networks, traffic congestion, or terrain topology; consequently, estimated distances may diverge from actual transit routes. In addition, QRIS settlement verification is currently conducted semi-automatically, requiring manual payment reconciliation by the administrator before order statuses advance, which introduces potential administrative bottlenecks during transaction surges. Furthermore, because alert delivery relies on external Telegram Bot API servers, upstream third-party service disruptions could occasionally introduce notification delays. An additional constraint relates to the evaluation methodology. The User Acceptance Testing cohort comprised 23 participants within a single enterprise setting. While these metrics confirm operational viability for Olivia MSME, user perceptions may differ across enterprises operating under alternative logistical environments. Future inquiries should therefore expand empirical evaluations to larger, multi-depot cohorts to assess the broader generalizability of the integrated platform across diverse micro-enterprise settings. Despite these constraints, the prototype successfully demonstrates that unifying web transactions, contactless payments, automated alerting, and visual performance monitoring into a coherent platform effectively accelerates operational digital transformation for small drinking-water depots.

5. Conclusion and Recommendations

The implementation and empirical evaluation conducted through the Waterfall Software Development Life Cycle (SDLC) confirm that the web-based Smart Water Ordering System was successfully deployed to the production environment of Olivia MSME, effectively replacing conventional, phone-based transaction workflows. Functional validation demonstrated that the customer ordering interface—incorporating automated shopping cart handling, coordinate-based delivery location selection, and transaction history tracking—operates reliably, achieving User Acceptance Testing scores between 4.7 and 4.9 out of 5 across all measured dimensions. Furthermore, integrating the QRIS payment mechanism established a viable cashless settlement workflow that reduces the administrative overhead associated with physical cash handling. Concurrently, the asynchronous Telegram Bot notification service delivered new-order alerts to the depot administrator in under two seconds without operational errors, substantially decreasing order-processing latency. Finally, the centralized monitoring dashboard successfully provided actionable operational intelligence, enabling the enterprise administrator to supervise inventory changes, monitor order progression across five fulfillment stages, and review cumulative revenue data within a unified interface.

To address the technical and operational boundaries identified during system deployment, several directions are recommended for future research and engineering development. First, the static Haversine calculation should be replaced with a road-network routing Application Programming Interface (API) or distance-matrix service to provide shipping fee estimates that reflect actual road geometry and traffic conditions. Second, incorporating a licensed payment-gateway aggregator would enable fully automated QRIS settlement verification and immediate order-status progression, eliminating the need for manual administrative reconciliation during high-volume periods. Third, extending the web application into a Progressive Web App (PWA) or native mobile platform would support direct device-level features, including real-time GPS tracking for delivery personnel. Fourth, the monitoring dashboard could be augmented with machine learning forecasting models to predict demand patterns based on historical sales volumes. Finally, deploying an asynchronous message-broker architecture, such as RabbitMQ or Redis, would ensure that outgoing alert payloads are queued and retried automatically during temporary interruptions in upstream notification services.

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