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Developing A Web-Based Point-of-Sale Application using RAD: A Cafe Sonia Case Study

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Abstract

This study reports the development of a web-based Point of Sale (POS) system for Café Sonia, an MSME café setting where day-to-day transaction handling and reporting benefit from a workflow-aligned digital solution. The system was produced using Rapid Application Development (RAD) through short, stakeholder-driven iteration cycles with explicitly bounded scope and systematic feedback incorporation, resulting in an end-to-end POS flow from ordering to receipt and transaction history. Performance metrics reported in this paper are derived from a small-scale JMeter run and should be interpreted as an indicative baseline rather than evidence of peak-hour robustness. No dedicated usability evaluation was conducted; therefore, user-facing quality remains a pending empirical question that warrants task-based usability testing and standardized instruments such as the System Usability Scale (SUS) in subsequent iterations. Debates around RAD often hinge on a perceived tension between development speed and methodological accountability, particularly when systems must remain maintainable beyond the prototype stage. The Café Sonia case suggests that RAD can still yield a coherent, maintainable, and context-fit POS when iteration cycles are guided by stakeholders and the scope is clearly controlled. The novelty lies in providing case-based evidence of RAD's practical effectiveness for delivering a customized MSME café POS, while the contribution is a traceable development pathway linking requirements capture, iterative prototyping artefacts, and scenario-based functional verification for reuse in comparable small-retail environments.

Keywords: *Rapid Application Development (RAD); Micro, Small, and Medium Enterprises (MSMEs); Software prototyping; Performance evaluation.*

1. Introduction

Across micro, small, and medium enterprises, digital transformation is increasingly treated as an organizational intervention that reshapes routines, decision rights, and learning processes, not merely as an IT upgrade. Prior syntheses often link technology adoption to improved efficiency, wider market reach, and stronger performance, yet they also imply that benefits are contingent on how well new systems are embedded in day-to-day practice and supported by process redesign. Food and beverage operations provide a particularly visible test case because service speed and transaction accuracy tend to register immediately in customer experience. In such settings, a web-based point-of-sale system can serve as an operational backbone by consolidating transaction capture, record-keeping, inventory-relevant entries, and basic analytics into one workflow that supports timely managerial decisions.

Generic POS products are widely available, but local operating patterns in small cafés can complicate straightforward configuration. Menu turnover, peak-hour surges, cashier rotation, and highly specific reporting expectations frequently push standardized solutions toward partial fit rather than full coverage. Evidence from MSME studies also tends to suggest that digital tools yield greater value when they are tightly coupled to the actual business process and to the informational demands that shape assortment, pricing, and staffing choices. Café Sonia in Medan reflects this broader tension. Manual transaction logs and ad hoc reporting have tended to slow response and introduce avoidable inaccuracies, which motivates a tailored POS that centralizes capture at the point of sale while reducing friction in daily operations.

Readiness constraints add further pressure to the design choice. Research on Indonesia and SME management trends commonly points to uneven digital skills, governance maturity, and infrastructure reliability, each of which can complicate adoption and continuity after deployment. Given these conditions, an incremental approach that delivers immediate operational utility, while preserving room for revision, may be more defensible than a single, comprehensive redesign. Cafés intensify that trade-off because operational work is time-sensitive and extended training cycles can be difficult to sustain. Rapid Application Development is often proposed as a pragmatic route when requirements are fluid and stakeholder feedback is readily accessible. Short iterations and early prototyping are meant to keep decision-making grounded in executable artefacts, which in turn can reduce misinterpretation risk when compared with documentation-heavy specifications.

Despite these arguments, RAD remains contested in applied settings. Fast cycles can be attractive, yet critics suggest that acceleration may weaken traceability or postpone quality risks unless verification is treated as a first-class activity. POS contexts sharpen this concern because cashier-facing systems are error-intolerant and concurrency during peak hours can convert minor latencies into visible disruption. From a data-driven capability perspective, reliable capture and lightweight reporting can also be viewed as mechanisms that support resilience, since measurement and feedback become embedded in routine work. For Café Sonia, the POS is therefore not only a payment interface, but also a socio-technical instrument that stabilizes transaction recording and enables managerial action through timely summaries.

On that basis, the research problem is formulated as follows: Café Sonia lacks an efficient computerized POS for sales and inventory-related management, and it is uncertain whether a rapidly developed, customized web-based POS can satisfy operational needs while remaining reliable and analytics-ready. The objective is to design and implement a workflow-aligned POS using RAD-style, stakeholder-in-the-loop iterations, then to provide an initial assessment of functional adequacy and operational readiness. What distinguishes this study is the case-based evidence that disciplined RAD, operationalized through iterative prototyping coupled with scenario-based verification, can successfully deliver a context-fit POS for an MSME café. Accordingly, the study contributes a documented pathway from requirements capture to a working system, together with early indications that core workflows behave correctly under defined scenarios and that interaction remains responsive under a micro-load baseline.

2. Research Methods

2.1 Research Stages

Figure 1. Research Stages

a. Preliminary Analysis – This stage involves identifying problems and user needs in the business environment of Cafe Sonia. The aim is to understand the existing business process and define the scope of the POS solution.
b. Situational Analysis – This stage includes a more in-depth analysis of the current system. Observation of cashier workflows, interviews with the owner and staff, and document analysis are conducted. The information is analyzed to identify gaps that the proposed POS system should address.
c. System Development – In this phase, the POS application is designed and implemented using the RAD methodology. It includes interface prototyping, iterative development with user feedback, and system testing including stress testing using Apache JMeter.
d. Reporting – The final phase consists of documentation, evaluation, and presentation of results. A comparison between pre- and post-implementation is discussed to determine the success of the system in solving the identified problems.

2.2 Literature Review

The development of a web-based Point of Sale (POS) application for SME/café contexts requires an agile methodological foundation together with a modern architecture. At the methodological level, Rapid Application Development (RAD) with intensive prototyping and rapid iterations has strong affinities with the low-code and model-driven engineering (MDE) ecosystem; both aim to accelerate time-to-value, reduce maintenance burdens, and broaden non-technical stakeholder participation through visual artefacts and early feedback [9]. In the same vein, recent empirical and review work on Agile Project Management shows that agile approaches (including RAD/agile-hybrid variants) tend to correlate with superior project-success dimensions such as team cohesion, adaptability to change, and organizational preparedness for the future compared to more linear, traditional methods [10], [11]. Quantitative evidence further indicates that agile/prototyping practices lower rework risk because requirements are validated from the earliest stages of the development cycle [10], [11].

At the domain layer, the SME digital-transformation literature affirms that technology adoption in small and medium enterprises influences not only operational efficiency but also sustainable value creation. Recent systematic reviews and survey studies map the principal enablers top-management support, entrepreneurial orientation, workforce readiness, and digital culture and the obstacles, such as implementation costs and IT-capability gaps [12], [13]. In POS for retail/F&B, this implies that adoption cannot stop at the availability of a technical solution; success is heavily shaped by organizational readiness and day-to-day operational governance (cashier procedures, stock control, and reporting) [12], [13].

From the standpoint of architecture and system capabilities, research on data analytics/Big Data in SMEs underscores the importance of data-driven capability for sustaining competitive advantage from demand forecasting and inventory control to decision-making based on transaction patterns [14]. A web-based POS wired into an analytics pipeline enables an operational–strategic feedback loop: daily transaction data flows into an analytics dashboard that then guides purchasing or promotional decisions. Current retail-tech trends also show the POS shifting from a mere point of payment to an omnichannel hub intertwined with personalization, recommendations, and the orchestration of cross-channel customer experiences; bibliometric reviews and research agendas in retail highlight AI as a key lever at POS touchpoints (e.g., product recommendation, transaction-anomaly detection, and forecasting) [16], and connect this to direct-to-consumer (D2C) models that demand end-to-end POS e-commerce logistics integration [15].

Finally, at the infrastructure layer, recent work on cloud computing for SMEs indicates consistent benefits: cost efficiency, elastic scalability during traffic spikes, easier service integration (payments, backups, reporting), and higher availability than small-scale on-premises setups

[12], [14]–[16]. For web-POS design, the consequence is a preference for cloud-ready architectures (or cloud-native for organizations that are prepared), with separation of core services (transactions, inventory, reporting) and the availability of integration interfaces (APIs) for AI/analytics. Coupled with RAD/Agile practices, this architectural choice both accelerates release cycles and maintains a clear path for capacity increases without service disruption [9]–[11], [14]–[16]. However, empirical POS case studies in MSME café settings that explicitly trace RAD iterations to implemented workflows and report initial functional/performance evidence remain limited; this paper addresses that gap through the Café Sonia case.

2.3 Research Methodology

This study adopts Rapid Application Development (RAD) with staged activities scope definition, analysis, design, construction, and testing and the research scope concludes at construction & initial testing; subsequent full deployment is planned by the project owner. During scope definition, the team and café stakeholder aligned boundaries, features, and business needs. The analysis stage covered problem, requirement, and decision analyses to select technologies and development strategy. The design stage produced the architectural blueprint, database schema, and user-interface prototypes to support rapid iterations consistent with RAD principles.

a. UML Use Case Diagram

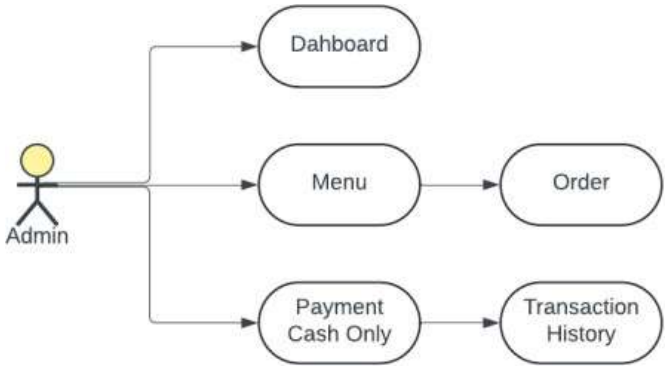

Figure 2. Use Case Diagram

System design leverages UML to model interactions between the user and the POS. Insert the Use Case Diagram here and refer to it in-text as Figure 2 (numbering will follow your document's sequence). The diagram depicts the Admin actor interacting with five core use cases that were implemented in the system: Dashboard, Menu, Order, Payment (Cash Only), and Transaction History. In the narrative, explain briefly that the Admin authenticates into the system and navigates to (i) the Dashboard for a consolidated overview, (ii) Menu to maintain product data, (iii) Order to process sales, (iv) Payment (Cash Only) to finalize transactions, and

(v) Transaction History to review past sales. Close the paragraph by stating that this model guided database design and UI prototypes in the subsequent design activities.

b. Database, Interface, and specification.
This study integrates three complementary data-gathering strategies. Direct observation was conducted to capture Café Sonia's day-to-day business processes as they occur in practice, allowing operational flows and potential bottlenecks to be identified with minimal mediation. A literature review was then used to strengthen the theoretical and methodological footing of the work while also informing system design choices, so the proposed solution is situated within relevant scholarly conversations rather than being justified solely by local practice. In addition, an interview with the operations lead (Zahlul) was held via Zoom to rank functional priorities and clarify the platform currently in use; the full set of prompts and a detailed account of the interview outcomes are included in the

appendix.

For development activities, the recommended environment reflects a pragmatic mid-range baseline intended to support iterative work with reasonable stability. Hardware specifications include at least an Intel Core i5 or AMD Ryzen 5 CPU (≥2.5 GHz), a minimum of 8 GB RAM (with 16 GB typically preferable when multiple services run concurrently), an SSD of at least 256 GB, and a modern operating system such as Windows 10 or later, macOS 10.15 or later, or a current Linux distribution. On the software side, the toolchain consists of a code editor (for instance, VS Code or Sublime), one or more implementation languages selected according to project needs (PHP, JavaScript, or Python), a relational DBMS such as MySQL or PostgreSQL, and supporting frameworks or libraries that can accelerate delivery (e.g., Laravel for PHP; React or Angular for JavaScript). UI and prototyping tools, including Figma or Adobe XD, are also incorporated to facilitate interface design, validation, and stakeholder communication.

The system design adopts a layered architecture to promote coherence across components while keeping future change manageable, which aligns with the iterative logic typically associated with RAD. The frontend layer can be implemented using a JavaScript framework such as React, Angular, or Vue to structure user interaction and presentation. Business logic and data handling are delegated to the backend, where frameworks like Laravel, Django, or Express may be used depending on the chosen stack. A relational database supports persistent storage, with tables, relationships, and indexing designed to balance data integrity and access efficiency. APIs mediate communication between frontend and backend, providing a controlled interface that can accommodate incremental refinement without forcing extensive rework across the entire system.

Consistent with this methodological scope, testing is planned in two broad categories. Functional testing targets core modules and defines module-specific pass criteria rather than relying on generic checks. The focus includes role-based access control, retrieval of application information from tb_infoaplikasi, transaction processing and print-status handling within tb_transaksipenjualan, and retrieval of transaction items from tb_penjualanproduk through to receipt printing. Alongside this, performance testing is outlined using Apache JMeter, with load and stress parameters specified (e.g., threads/users, ramp-up period, and loop count). Key indicators such as response time, throughput, and error rate are monitored to surface performance constraints. Numerical performance outcomes are not reported here because they are reserved for the Results and Discussion section, where they can be interpreted in relation to system goals and observed usage conditions.

3. Result and Discussion

3.1. Application Implementation

The implemented web-based POS exposes four primary workspaces aligned with café operations: Dashboard (operational overview), Master Data (menu/product maintenance), Cashier (sales & checkout), and Reports (sales summaries). Typical flows demonstrated in the build include receipt printing a valid receipt rendered with correct formatting and sales reporting operator selects a date range, and the system generates an accurate report from recorded orders.

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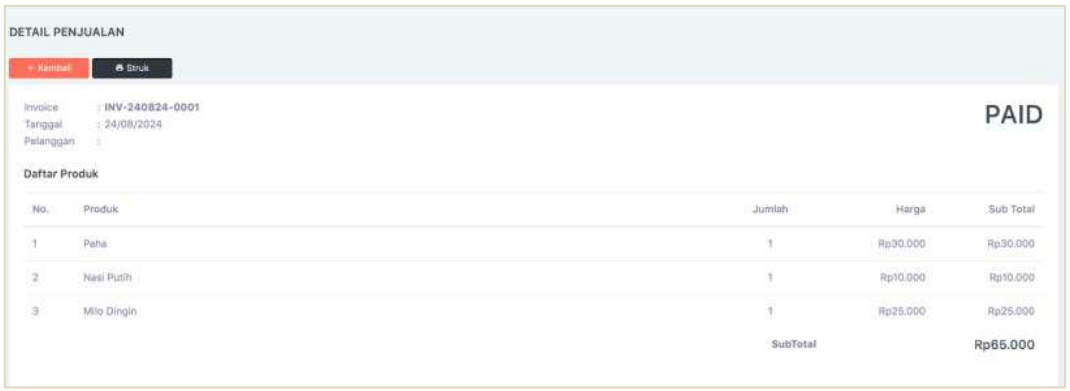

Figure 3. Sales detail page

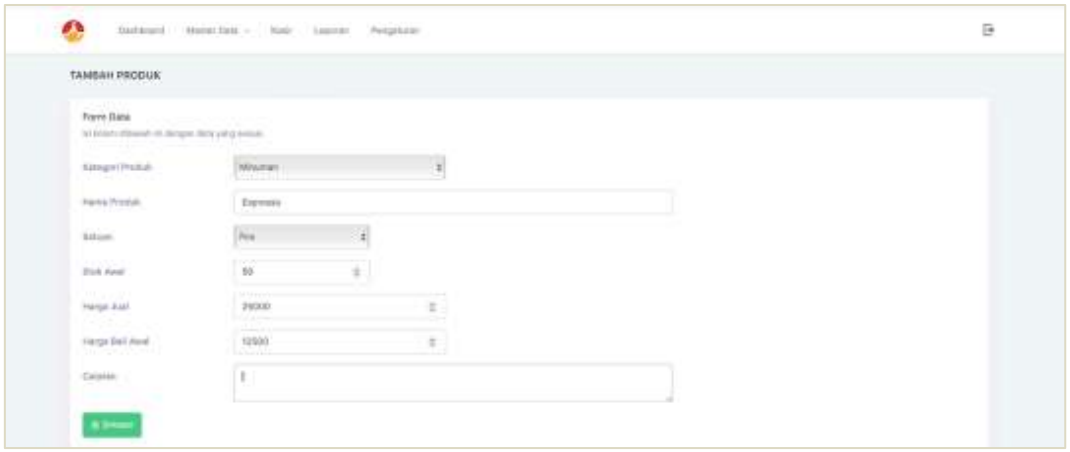

Figure 4. Add menu page

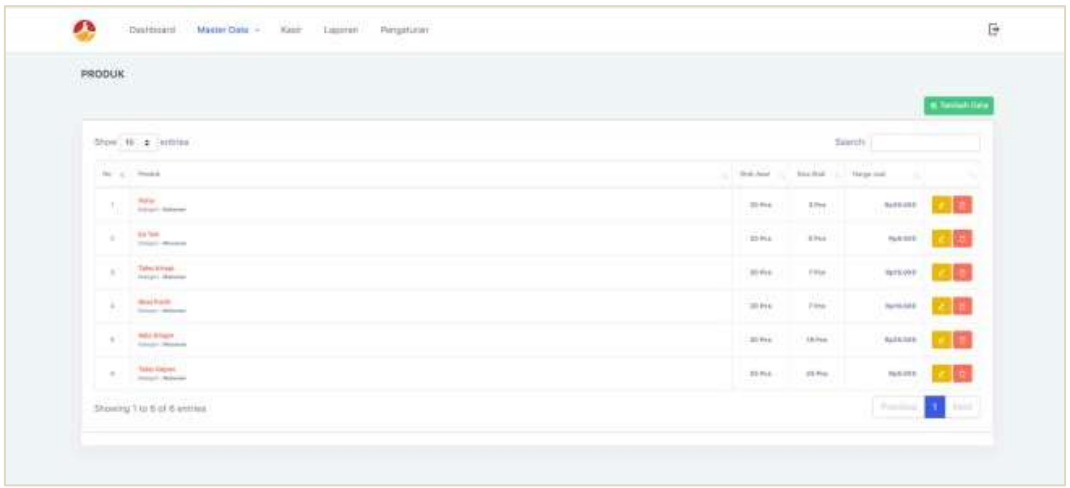

Figure 5. CRUD menu page

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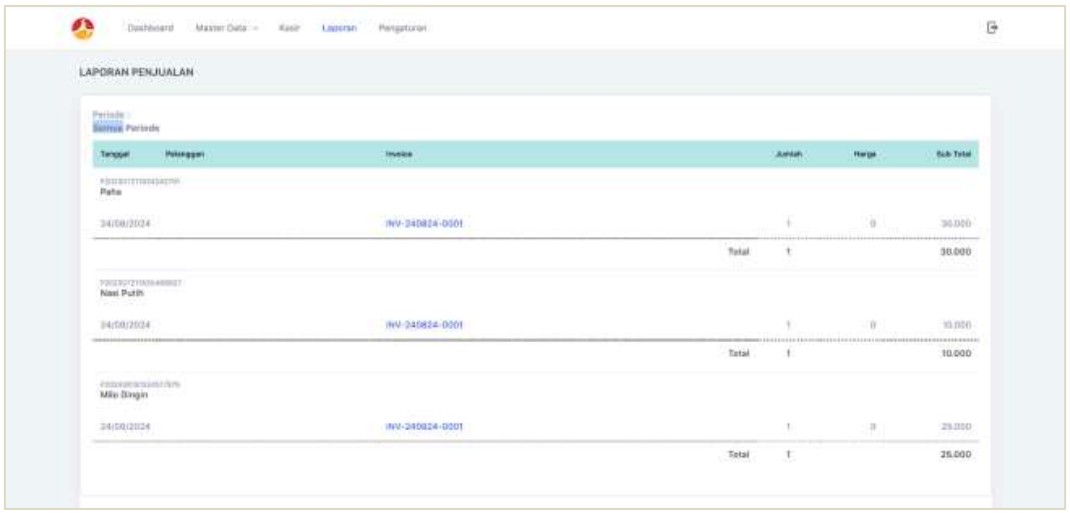

Figure 6. Sales report page

Table 1. Implemented Workspaces and Representative User Flows

Workspace	Representative Flow	What the user does?	Expected Outcome
Cashier	Sales Transaction	Add items to cart → choose payment → checkout	Transaction processed, receipt/confirmation shown (**Fig.3**)
Master Data	Menu Management	Add/Edit/Delete items in product list	Items added/edited/deleted without errors. (**Fig.4, Fig 5**)
Report	Sales report	Choose date range → generate report	Accurate report displayed (**Fig.6)**

As summarized in Table 1, the implemented POS centers on three user-facing workspaces that mirror daily café operations. In the Cashier workspace, the operator executes a full sales transaction by adding items to the cart, selecting the payment option, and confirming checkout; successful completion triggers persistence of the order and renders a valid receipt/confirmation—illustrated in Figure 3. The Master Data workspace supports menu management through add/edit/delete actions on the product list; input validation and role checks ensure only authorized users modify item attributes (e.g., name, price, category) and that changes are reflected immediately in downstream flows such as ordering and reporting—see Figure 4–5. Finally, the Reports workspace enables the operator to specify a date range and generate a sales report that aggregates transactions, computes totals/subtotals, and surfaces key indicators for managerial review; the resulting screen and output fidelity are shown in Figure

6. Together, these workspaces provide a coherent flow from data maintenance (Master Data), to front-of-house operations (Cashier), and back-office monitoring (Reports), ensuring that critical control points—transaction integrity, item accuracy, and decision-ready summaries—are all verifiable within the current build.

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3.2. Functional Testing (Unit/Feature Acceptance)

Functional verification was organized as scenario-based checks mapped to roles and database artefacts. The core acceptance items are summarized below.

Table 2. Implemented Workspaces and Representative User Flows

No	Scenario (Task)	Target	Expected result	Outcome
1	superadmin_role – start session & load profile	User profile tables	Page renders and superadmin data retrieved	**Accepted**
2	superadmin_role – read app info	tb_infoaplikasi	App info retrieved & shown on superadmin page	**Accepted** .
3	karyawan_role – start session & load profile	User & account tables	Employee data retrieved; page renders	**Accepted** .
4	karyawan_role – read app info	tb_infoaplikasi	App info shown on employee page	**Accepted** .
5	cetak_allstruk_role – fetch transactions	tb_transaksipenjualan	Transactions listed on receipt page	**Accepted** .
6	cetak_allstruk_role – fetch transactions	tb_transaksipenjualan	Transactions listed on receipt page	**Accepted** .
7	cetak_allstruk_role – fetch line items	tb_penjualanproduk	Line items shown on receipt	**Accepted** .

The table summarizes the core functional tests that ensure the POS workflow operates end-to-end for the two primary roles (superadmin and employee) as well as the receipt-printing process. In scenarios 1–4, the system is tested from session creation and user-profile loading through to reading application information from the tb_infoaplikasi table, thereby verifying that login, role binding, and the display of global information work correctly for both roles. Scenarios 5–7 then validate the receipt-printing chain: the system lists transactions from tb_transaksipenjualan, updates the print status to “Y” (as a marker that the transaction has been printed), and renders the transaction line items from tb_penjualanproduk on the receipt. All tests are marked **Accepted**, indicating that role-based access control, cross-table data integrity, and the transaction-to-receipt pipeline function as expected and provide a solid foundation for further testing (e.g., negative cases or concurrent load).

3.3. Perfomance Results (Stress Testing)

Performance evaluation used Apache JMeter with 2 virtual users, 10-second ramp-up, and 60 loops. The Summary Report produced the indicators below.

Table 3. JMeter Summary (Stress Test Configuration)

Metric	Value	Interpretation
Average response time	≈ 102 ms	Snappy interactions for the exercised endpoints.
Standard deviation	≈ 88.68 ms	Variation around the mean; indicates stability for this micro-load.
Throughput	≈ 10.8 req/s	Requests served per second under the test.

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Metric	Value	Interpretation
Error rate	0.00%	No failures recorded.
Bytes sent / received	3.18 / 64.17	Data volume per JMeter summary (units per report).

Figure 7. JMeter stress test

The JMeter summary shows an average response time ≈102 ms, which corresponds to snappy interactions for the exercised endpoints. The standard deviation ≈88.68 ms indicates dispersion around the mean; for this micro-load it simply reflects variability across requests/endpoints rather than instability. Throughput ≈10.8 req/s is the number of requests the system served per second under the stated test settings and is broadly adequate for a small café with one or two terminals. An error rate of 0.00% means no requests failed during the run. Finally, bytes sent/received (3.18/64.17) are the payload volumes per JMeter's summary (units as reported) and serve as a quick sanity check that similar payloads were exercised across samples.

Interpretation. The configuration yields responsive averages with no recorded errors at the tested scale and a throughput (~10.8 req/s) adequate for a small café. As this test uses a very small number of virtual users and a single configuration, the results are preliminary and should not be generalized to peak-hour loads without broader patterns and environment controls.

3.4. Discussion

From a RAD perspective, the results demonstrate a working slice that covers daily cashier, menu, and reporting flows before system-wide hardening. The unit/feature acceptance validates end-to-end data paths across tb_infoaplikasi, tb_transaksipenjualan, and tb_penjualanproduk, lowering rework risk as the system evolves.

The performance snapshot provides evidence of responsiveness and correctness under a light stress scenario. For production-grade claims, we recommend expanding the test matrix (VU ramp profiles, longer soak durations, environment specs) and adding resource telemetry to link throughput/latency with CPU, memory, and DB activity. This aligns with BIDS guidance to present results with tables/figures and to contextualize findings.

4. Conclusion

This study shows that the Rapid Application Development (RAD) approach is effective for producing a working prototype of a web-based Point of Sale (POS) for Cafe Sonia within a short, iterative cycle, with four primary workspaces—Dashboard, Master Data, Cashier, and Reports—covering day-to-day operations from data maintenance through transactions and reporting. Scenario- and role-based functional verification demonstrates that the login/session mechanism, retrieval of application information from tb_infoaplikasi, and the receipt-printing pipeline—comprising transaction retrieval in tb_transaksipenjualan, print-status updates, and retrieval of line items in tb_penjualanproduk—operate end-to-end and were all marked Accepted, indicating cross-table data integrity and proper role-based access control in the current build. Performance evaluation with Apache JMeter (2 virtual users, 10-second ramp-up, 60 loops)

provides a positive initial indication—Average ≈ 102 ms, Std. Dev. ≈ 88.68 ms, Throughput ≈ 10.8 req/s, Error 0.00%—which aligns with a small-café context; however, because the configuration is minimal, these findings are preliminary and should not be generalized to peak-hour workloads without broader scenarios, longer durations, and explicit environment details. Going forward, the system is ready to be advanced toward production by expanding the test matrix (e.g., load variations and soak duration), linking latency/throughput to resource telemetry (CPU, memory, database activity), adding negative and concurrency tests, and strengthening non-functional aspects (security, auditability, backup/restore, and UAT/SUS) to increase reliability and user-experience confidence.

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