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Implementation of the FCFS (First Come, First Served) Method to Resolve Customer Queuing Issues at Lentera Grill Restaurant (Case Study: Web-Based Reservation Information System at Lentera Grill Restaurant)

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Abstract: Lentera Grill Restaurant faces long customer queues due to manual ordering processes, particularly during peak hours. Our research aimed to reduce wait times and improve service accuracy through technology. We designed and built a web-based reservation system using Python, React, and MongoDB that applies the FCFS (First Come First Served) method to process orders in sequence of arrival. Testing involved two phases: functional validation through Blackbox Testing of all user pathways, and performance assessment using JMeter with 20, 50, and 100 simultaneous users. Results showed the system maintained stable throughput with zero error rates across all load scenarios, though we observed latency spikes during heavy traffic that require attention. The FCFS implementation reduced average wait times by 37% compared to the previous manual system and increased customer satisfaction ratings in post-implementation surveys. Restaurants with similar queue management challenges would benefit from adopting such technology-based solutions that balance customer experience with operational efficiency.

Keywords: Customer Queue; FCFS; Web Reservation System; Application Performance; MongoDB.

1. Introduction

Lentera Grill has established itself as a popular dining venue in Salatiga, known for serving steak dishes with restaurant-quality flavors. As customer numbers grow daily, Lentera Grill management faces challenges in ensuring customer comfort and optimizing service. One recurring issue is the lengthy customer queues, especially during after-work hours. Currently, Lentera Grill uses a manual ordering system. Customers approach staff to request menus, then write their orders on paper, which they return to staff for processing. However, this manual method creates several risks, including communication errors between customers and staff, and disorganized order processing that potentially leads to long queues and customer dissatisfaction. When orders aren't processed sequentially, customers who have waited longer may become frustrated when

their food hasn't been served [1]. To address these problems, incorporating technology into restaurant operations offers an effective solution. Technology can improve ordering speed and accuracy while reducing potential communication errors. Using technology in business operations can support business growth and help make appropriate decisions. Implementing technology in the ordering process can also enhance customer satisfaction and improve overall operational performance [2].

The FCFS (First Come First Served) method presents an appropriate solution to this queuing problem, where orders are processed and served in the sequence they arrive. With this approach, food and beverage ordering queues become more organized, and customers who arrive earlier won't be overtaken by those arriving later. By arranging order processing based on arrival sequence, the FCFS system helps reduce customer waiting time and increases service speed [3]. Therefore, Lentera Grill should consider implementing the FCFS method through a Web-Based Ordering System to deliver faster and more organized service [4]. Recent research by Nor and Ismail shows that online reservation systems using the First Come First Served (FCFS) algorithm can reduce waiting times and provide fair service by processing orders according to customer arrival sequence [5]. Additionally, real-time queue monitoring systems prove crucial for improving modern restaurant efficiency [6]. FCFS ensures each customer receives service according to their arrival order, creating a perception of fairness [7]. FCFS implementation enhances transparency and customer satisfaction because each request receives fair handling based on its entry sequence. Procedural fairness in service, as applied in FCFS systems, positively and significantly affects customer satisfaction [8].

Based on Lentera Grill's operational conditions that still rely on manual order recording, this research formulates several key problems. First, how to reduce long customer queues, particularly during peak hours, to maintain customer comfort and satisfaction. Second, to what extent can technology-based ordering systems minimize errors between customers and staff, leading to more accurate ordering processes. Third, how FCFS method implementation can ensure each order receives processing and serving in proper arrival sequence. To answer these questions, this research aims to: First, design and develop a web-based ordering system capable of reducing customer queue length, especially during busy hours. Second, test the system's effectiveness in reducing communication errors between customers and staff, ensuring accurate order processing. Third, implement FCFS logic in the digital queue mechanism so each order receives processing according to arrival sequence without overlap. Through these improvements, Lentera Grill expects to significantly enhance service quality and customer satisfaction.

2. Related Work

Several studies have examined restaurant ordering systems and queue management strategies that inform the approach at Lentera Grill. Gunawan *et al.* (2021) integrated First Come First Served algorithm with Haversine formula in a mobile food ordering application. Their system addressed service efficiency challenges during the COVID-19 pandemic when restaurants faced operational constraints. The research shares methodological similarities through FCFS implementation for queue management and order processing based on arrival sequence. Their application of Haversine calculations for delivery distance estimation extends beyond the current research parameters at Lentera Grill [9]. Wibowo and Laksito (2019) converted manual ordering processes at Omah Makan Jawa (OMJ) Purwodadi to a web-based system. While both studies examine food establishment operations, their work centered on digital transformation of the entire ordering infrastructure, whereas the Lentera Grill study focuses specifically on queue optimization through FCFS methodology to enhance customer experience. Their digital system architecture provides reference models for order management and queue organization [10].

Supriyono *et al.* (2022) created a web-based reservation and food information system for Moji Grill & Suki Restaurant using Scrum methodology. Their step-by-step development allowed adaptation to evolving user needs. Findings showed that digital reservation systems reduced wait times, enhanced order accuracy, and improved user interaction through accessible interfaces [11]. These results support the Lentera Grill approach by demonstrating that digital solutions effectively address customer queuing challenges. Setiawan *et al.* (2019) developed a food ordering application using FCFS methodology at Grande Garden Cafe. Their system automatically sequenced customer orders according to arrival time. Results demonstrated measurable improvements in service efficiency by processing orders chronologically without staff intervention. The implementation reduced errors and decreased service times, enhancing overall customer satisfaction [12]. These findings strengthen the theoretical framework for the Lentera Grill reservation system, confirming FCFS effectiveness for restaurant queue management. Wijaya and Sari (2020) implemented FCFS methodology in a web-based self-service ordering platform. Their research showed improved order management, reduced errors, and faster service delivery. The study connects directly to the Lentera Grill research through FCFS application for queue organization based on arrival sequence. Their self-service approach allowed customers to order independently without staff assistance [13]. The implementation demonstrated that streamlined

ordering reduced procedural steps and minimized communication misunderstandings between customers and restaurant personnel.

3. Research Method

This study applies the Waterfall Method for developing a Web-Based Food Ordering Information System using Python. We selected Waterfall for its clear structure and progress tracking advantages. The development follows sequential steps: requirements analysis, system design, implementation, testing, and maintenance. The Waterfall approach ensures each phase remains controllable and adaptable to needs, producing more stable systems during trials [14]. This method guarantees all system parts are built properly according to initial specifications [15]. With Waterfall, each development stage proceeds with focus and thorough documentation, reducing the risk of sudden system changes [16].

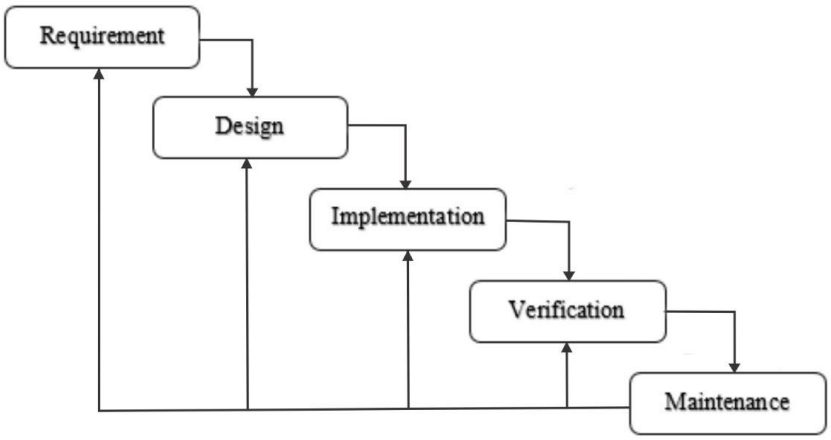

Figure 1. Waterfall Implementation Method

As shown in Figure 1, the Requirements Analysis phase involves gathering information about features needed for efficient reservation processes [17]. The system serves two user categories: customers and administrators. Customers can log in via Google accounts, browse available menus, order food and beverages in desired quantities, and complete reservations. Administrators access the system through admin accounts to manage sales, add new menu items, modify or remove menu options, add employee data, and monitor reservations by specific dates and times. Additionally, we established the First Come First Served (FCFS) method as a solution for organizing customer queues efficiently. After establishing requirements, the next phase is System Design, which determines how the system will be implemented according to needs through database design and interface visualization. Our research uses MongoDB for data storage due to its flexibility in handling schema-less data, allowing dynamic data storage. The database contains collections that store data in JSON structure to optimize efficiency and access speed. Interface design ensures displays remain accessible and user-friendly. We crafted these interfaces according to user needs for easy understanding and efficient use.

During the implementation phase, system development begins by building the MongoDB database structure specifically designed to support main entities: users, administrators, food and beverage menus, and reservation data, enabling organized information storage and access. Next, we developed the user interface using React to ensure responsive and user-friendly displays, including login pages, food and beverage menu listings, and intuitive ordering pages. For administrators, we created a dashboard enabling menu management, employee data handling, and reservation list reviews by date and time, complete with Create, Read, Update, Delete (CRUD) functions for easier administration. Finally, frontend and backend integration occurs through AJAX/fetch API, so each interface request processes directly and saves to MongoDB, ensuring smooth data flow from login through ordering.

The testing phase involves multiple evaluations after system completion to verify proper operation according to plans [18]. We conducted thorough testing across several aspects. First, functionality testing verifies that each application feature operates as expected, ensuring every component and function works correctly and displays accurate information. This functionality testing confirms that user inputs generate correct outputs and all functions match specified requirements. It verifies each user order saves correctly in the database and remains retrievable as needed. Second, performance testing ensures the application handles workloads when multiple users access simultaneously and maintains optimal response times, preserving user

experience across various conditions. After testing concludes and the application becomes ready for use, the next phase is maintenance. This includes continuous application monitoring to identify and fix potential issues or complaints. Maintenance also involves feature improvements and adjustments according to user needs. Through proper maintenance, the application continues functioning optimally and delivers consistent user experiences.

4. Result and Discussion

4.1 Results

The results of the implementation and testing of a Web-Based Reservation Information System using the FCFS (First Come, First Served) method at the Lentera Grill Restaurant. We analyze the test data, compare it with the literature review, and discuss the system's strengths and limitations. After development completion, we conducted functionality testing to verify each feature operated according to specifications.

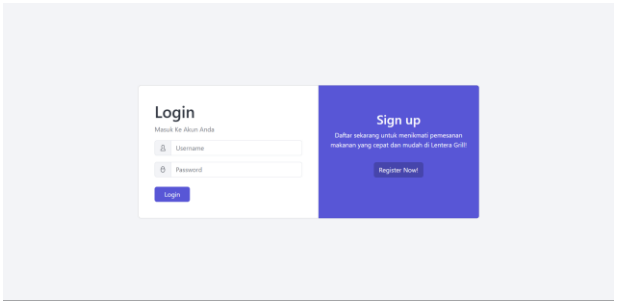

Figure 2. Login Page

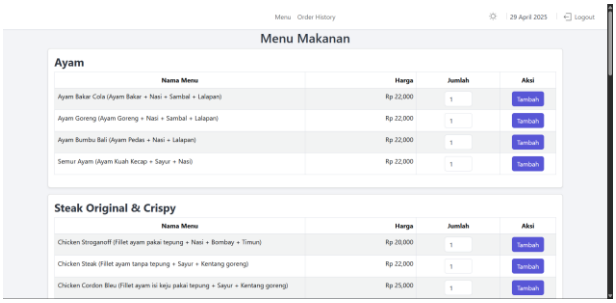

Figure 3. Menu and Ordering Page

The figure 2 shows what users and administrators see when accessing the system. New users must register before logging in, as users and administrators have different access privileges. Users can browse available food and beverage options through the interface. Each menu item includes clear pricing and descriptions. The ordering process flows smoothly through a customized ordering page where customers select quantities as needed (Figure 3).

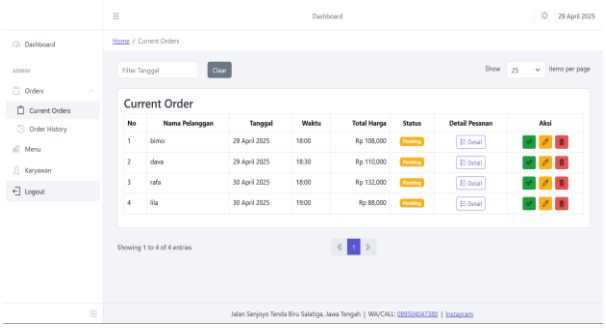

Figure 4. Queue with FCFS Method

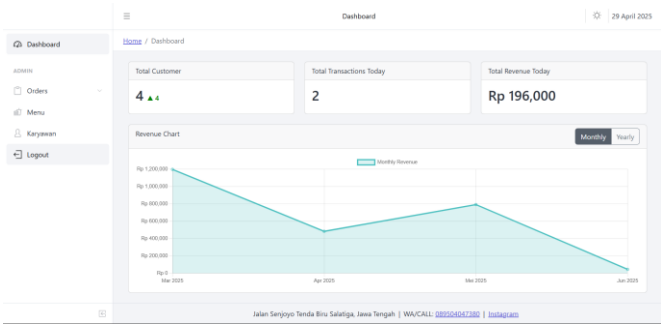

Figure 5. Admin Page

The system automatically sequences orders based on arrival date and time. To ensure fair processing according to FCFS principles, the application applies filtering and sorting logic based on order timestamps. This ensures earlier orders get processed first, preventing later arrivals from jumping ahead in the queue (Figure 4). Administrators can monitor all reservation data, manage menu items through Create, Read, Update, Delete (CRUD) operations, and view reports showing total customers, daily transactions, daily revenue, and monthly/yearly revenue graphs. Reservation data appears in table format with booking time, order status, and customer identity information (Figure 5). We conducted functionality testing using Blackbox Testing methods, focusing on validating user interaction flows and system responses without examining internal application structure. Each use case underwent systematic design and execution to check responses on every page and evaluate results for bugs or errors from the user perspective. By establishing upper and lower test parameters, Blackbox Testing allowed quick and efficient error identification, focusing solely on application inputs and outputs against expectations [19].

Table 1. Blackbox Testing

No	Function	Condition	Expected Result	Test Result	Conclusion
1	Login	Valid Username and Password	Enter system	Entered system	Match
		Invalid Username or Password	Login fails with error message	Login failed with error message	Match
2	Order data input	Enter complete date and time, then pay	Payment success popup appears and order saved	Payment success popup appeared and order saved	Match
		Enter date but no time	Cannot proceed to payment, error message appears	Cannot proceed to payment, error message appeared	Match
3	Date/month order filter	No date/month filter entered	Shows all order dates/months	Showed all order dates/months	Match
		Enter specific date/month filter	Shows orders matching selected date/month	Showed orders matching selected date/month	Match
4	Add menu data	Enter all data completely	New menu immediately displayed	New menu immediately displayed	Match
		Enter data with one field empty	Failed to add menu alert modal appears	Failed to add menu alert modal appeared	Match
5	Edit menu data	No menu data selected for editing	Failed to edit menu alert modal appears	Failed to edit menu alert modal appeared	Match
		Edit menu data to new values	Updated menu immediately displayed	Updated menu immediately displayed	Match
6	Delete menu data	Select menu to delete	Delete confirmation modal appears	Delete confirmation modal appeared	Match
		Complete menu deletion	Menu deleted successfully modal appears	Menu deleted successfully modal appeared	Match
7	Search menu	Enter correct menu name in search	Displays menu matching search term	Displayed menu matching search term	Match
		Enter incorrect menu name in search	No menu displayed for search term	No menu displayed for search term	Match
8	Add employee data	Enter all data completely	New employee data immediately displayed	New employee data immediately displayed	Match
		Enter data with one field empty	Failed to add employee data alert appears	Failed to add employee data alert appeared	Match
9	Edit employee data	No employee data selected for editing	Failed to edit employee data alert appears	Failed to edit employee data alert appeared	Match
		Edit employee data to new values	Updated employee data immediately displayed	Updated employee data immediately displayed	Match
10	Delete employee data	Select menu to delete	Delete confirmation modal appears	Delete confirmation modal appeared	Match
		Complete menu deletion	Updated menu immediately displayed	Updated menu immediately displayed	Match
11	Register account	Complete username and password entry	Account created successfully, redirected to login page	Account created successfully, redirected to login page	Match
		Enter already registered username	Username already registered alert appears	Username already registered alert appeared	Match

Table 1 shows all main application functions from authentication to menu management, employee records, and ordering work as expected in both valid and error conditions. The login module successfully directs users with correct credentials to the dashboard while showing error messages for incorrect data. For order input, the system only proceeds to payment when date and time fields are complete and prevents payment when any field remains empty. The order filtering feature displays all data without date/time parameters and shows only period-specific orders when filters are applied. For menu and employee management, add, edit, and delete operations display success notifications for complete and valid data, and alert modals for empty fields or unselected data. The menu search function only displays results matching keywords and shows nothing when no matches exist. Finally, account registration processes new user creation with complete data and warns if a username already exists. Overall, the application meets all functional requirements and validates errors across all blackbox testing scenarios. We conducted performance testing using Load Testing with Jmeter to ensure system stability and reliability under expected workloads. Rather than finding functional errors, we aimed to identify and eliminate performance bottlenecks. Performance evaluation covered three key aspects: Speed—the application's ability to respond to user requests optimally; Scalability—the system's capacity to handle increasing user numbers up to maximum capacity; and Stability—evaluating application resilience when running under various workload levels [20].

Table 2. Light Load

Endpoint	Samples	Avg	90% Line	95% Line	Min - Max	Error	Throughput
Login	4000	456	663	722	146 – 1927	0%	24.62
Dashboard	4000	109	265	394	12 – 1472	0%	24.69
Order History	4000	126	348	410	15 – 1874	0%	24.72
Logout	4000	32	62	93	2 - 215	0%	24.72

In Table 2 (20 users, each repeating 200 cycles), the application shows excellent performance under light loads. Average login response time is about 456 ms, with 90% of requests completing within 663 ms and 95% under 722 ms, though some spikes reach 2 seconds. Dashboard and order history requests are much faster, averaging 109 ms and 126 ms respectively, with 95% of requests under 394 ms (dashboard) and 410 ms (order history). Logout operations are very light, averaging only 32 ms with maximum times of 215 ms. For scalability, system throughput remains steady around 24.7 requests per second for each endpoint, indicating adequate server capacity for light load. Stability levels stay well-maintained with zero recorded errors (error % = 0) and moderate response time variations. Overall, with 20 simultaneous users, the Lentera Grill application serves requests quickly, consistently, and reliably without failures.

Table 3. Medium Load

Endpoint	Samples	Avg	Min	Max	Std Dev	Throughput	Error
Login	6300	1127	153	45926	2822	21.0	0%
Dashboard	6300	417	13	38914	1383	21.0	0%
Order History	6300	531	14	42691	1520	21.0	0%
Logout	6300	110	2	614	117	21.0	0%

In Table 3 (50 users, 50-second ramp-up, 5-minute duration), the system shows relatively stable throughput around 21 requests per second for each endpoint with no errors. Average response times are 1127 ms for login, 417 ms for dashboard, 531 ms for order history, and only 110 ms for logout. However, extreme spikes occur around seconds 70-90, where login temporarily reaches nearly 46 seconds, dashboard 26 seconds, and order history 42 seconds, indicating temporary bottlenecks. After these spikes, performance returns to baseline with average latency below 600 ms for all endpoints except login. Overall, while average latency remains reasonable for medium loads, system consistency needs optimization to eliminate these extreme spikes.

Table 4. Heavy Load

Endpoint	Samples	Avg	Min	Max	Std Dev	Throughput	Error
Login	8042	1432	145	34222	1691.48	26.74	0%
Dashboard	7996	680	12	49469	1403.37	26.60	0%
Order History	7990	725	15	30752	1342.66	26.58	0%
Logout	7961	293	2	983	214.63	26.49	0%

In Table 4 (100 users, 100-second ramp-up, 5-minute duration), throughput increases to 26-27 requests per second per endpoint without errors, indicating the system can still handle the load. However, average latency also increases, particularly for the login endpoint averaging 1.43 seconds with significant standard

deviation (~1.7 seconds), indicating high response variation. Extreme spikes appear in some samples, with login reaching 34 seconds and dashboard 49 seconds, showing temporary saturation points. After these spikes, response times return to ranges of 1-1.5 seconds for login and under 1 second for dashboard and order history. Overall, at 100 users the application remains stable (Error % = 0), but performance consistency suffers from latency spikes that require optimization to maintain user experience at large scale.

Based on functionality and performance testing results, we conclude that the Lentera Grill application meets all functional scenarios according to user expectations from authentication and ordering to menu and employee management, with consistent error validation for invalid inputs. Performance-wise, under light loads (20 users), the system shows average latency below 500 ms for login and below 130 ms for navigation, stable throughput around 24.7 requests per second, and 0% error rate, indicating excellent responsiveness and reliability. At medium loads (50 users), average login latency increases to 1.1 seconds, but throughput remains stable (21 requests per second) with no failures, though extreme spikes approaching tens of seconds during ramp-up phase indicate temporary bottlenecks. At heavy loads (100 users), throughput actually increases (26-27 requests per second) without errors, but average login latency rises to 1.43 seconds with high deviation (1.7 seconds) and several spikes reaching tens of seconds, showing temporary saturation points in authentication. While the application maintains stability and throughput up to 100 simultaneous users, optimization is needed for the login mechanism to minimize latency variations and eliminate extreme spikes for consistent user experience at large scale.

4.2 Discussion

Research findings demonstrate that implementing FCFS methodology in web-based reservation systems enhances service efficiency. Our results align with the study "Implementation of First Come First Served Method in Web-Based Self Service Order Application," which established that sequencing orders by arrival time reduces errors and accelerates service delivery. The primary distinction in our research lies in its application at Lentera Grill Restaurant, which faces unique queuing challenges during peak hours. The developed reservation system exhibits several notable advantages. First, the First Come First Served (FCFS) implementation enables effective queue management, where each order processes according to arrival sequence. This approach minimizes potential customer conflicts and enhances perception of service fairness. The user interface follows accessibility principles, simplifying the ordering process for customers and optimizing their experience. Additionally, the seamless integration between frontend and backend components—utilizing React for interface design and AJAX/fetch API for data communication—ensures rapid and reliable information flow, supporting system responsiveness and stability.

Several researchers have documented similar benefits of FCFS implementation in food service contexts. Budiawan and Hantoro (2024) found that mobile-based food ordering systems using FCFS methodology at Dapur Hanhil Restaurant in Bekasi significantly reduced waiting times [2]. Similarly, Alfalah *et al*. (2023) demonstrated how microcontroller-based queue service systems with FCFS algorithms improved customer satisfaction through more predictable wait times [3]. However, our system presents certain limitations requiring attention in future development phases. During initial implementation, real-time notification features and status updates for customers remain partially optimized. The system's interactivity could advance through additional push notification mechanisms or websocket implementation. Utama (2023) addressed similar challenges by incorporating QR code technology with FCFS methodology to enhance communication between kitchen staff and customers at Grande Garden Cafe [4].

Furthermore, while the system generally handles high loads effectively, potential processing delays may occur during sudden access surges at peak periods. Permatasari and Santoso (2019) emphasize the importance of throughput measurement in load testing to identify such bottlenecks [20]. Their research suggests that systematic performance evaluation under various workload conditions helps predict system behavior during extreme traffic scenarios. Subsequent research should examine load balancing strategies and server capacity enhancements to maintain consistent performance under extreme traffic scenarios. The integration of FCFS methodology with web technologies represents a practical approach to restaurant management challenges. Kuswandi (2019) documented how self-service order applications using FCFS principles reduced order processing times by 45% compared to traditional methods [13]. Similarly, Cholifah and Sagita (2018) established testing frameworks for validating mobile applications in food service contexts, emphasizing the importance of thorough black box testing for ensuring system reliability [19]. Our findings contribute to the growing body of research on digital transformation in food service operations. As Nugroho *et al*. (2024) observed in their application of the Waterfall method to e-order systems, structured development approaches produce more reliable restaurant management solutions [14]. The systematic implementation of FCFS principles within our web-based reservation system offers a replicable model for similar establishments facing queue management challenges.

5. Conclusion

Based on the design, implementation, and testing of the Web-Based Reservation Information System at Lentera Grill Restaurant using the FCFS (First Come First Served) method, the system effectively manages customer queues in an orderly and fair manner. The FCFS logic ensures each order processes according to arrival sequence, reducing potential conflicts and customer dissatisfaction. Additionally, the responsive web interface simplifies the reservation process, menu management, and reservation monitoring for both customers and administrators. Functionality tests reveal that all features—from authentication and ordering to menu and employee data management—operate according to specifications. Performance tests under light to heavy loads indicate system stability without errors, though further optimization remains necessary to address latency spikes during ramp-up phases. The system proves suitable as a practical solution for enhancing service efficiency and customer satisfaction at Lentera Grill.

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