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CAFETERIA SYSTEM: USING CAPTCHA AUTHENTICATION AND SHA-256 ENCRYPTION

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Article Info

Abstract

The cafeteria system at UiTM Melaka Jasin Campus was developed to improve the efficiency of food ordering and purchasing by integrating digital solutions. The main challenges addressed were inefficient cafeteria operations and lack of security features. To address these issues, the system introduced an online platform that allows students to place orders in advance, reducing waiting times and improving security. Key security measures, such as CAPTCHA-based authentication and SHA-256 encryption, were implemented to protect user data, including passwords. Functional testing by two lecturers confirmed that all 19 system modules operated as expected, ensuring a smooth and user-friendly experience. The system allowed students to easily browse the menu, place secure orders and make payments, while vendors benefited from streamlined and efficient order management. In addition, security tests using Hashcat and John the Ripper showed strong performance in SHA-256 encryption, ensuring that user data remained protected from cyber threats. In conclusion, the cafeteria system successfully improved food ordering efficiency, strengthened security, and optimized vendor operations. The integration of CAPTCHA and SHA-256 encryption further strengthens the system's reliability, making it a secure and effective solution for cafeteria management.

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INTRODUCTION

A cafeteria is a self-service restaurant where customers take food from a counter and bring it to their table (*Dictionary*, 2024). Found in a variety of locations, cafeterias provide food and drinks at posted prices. Many offer a varied menu, including main courses, snacks, traditional dishes and drinks. These busy spaces attract people of all ages and remain active until the stalls sell their offerings. Many cafeterias still rely on traditional methods, requiring customers to queue, pay with cash, and wait for long queue for food to be served, causing inconvenience for both consumers and vendors. Long waits can lead to frustration, order cancellations, and congestion, especially at popular stalls (Wavetec, 2024). Some customers also have to queue for long periods of time for their desired dishes, which may seem excessive. (Cake, 2021).

Despite this, cafeterias remain busy hubs, and vendors also need time to rest after serving people continuously. This system simplifies the purchasing process with a user-friendly design that ensures smooth operation. According to Christian Gronroos, in order to provide service as an aid that can be expected this needs to work well for customer satisfaction (Grönroos, 2023). It includes essential features for convenience and integrates security measures, especially for transactions.

LITERATURE REVIEW

Cafeterias are familiar to Malaysian society and exist in various locations around the world. Research shows that the food court industry remains a part of everyday (Zulhanif & Ferdian, 2019). Cafeterias can offer convenience to customers, but excessive crowding can cause inconvenience. Long queues at the food counter and cashier are often unavoidable (Zulhanif & Ferdian, 2019).

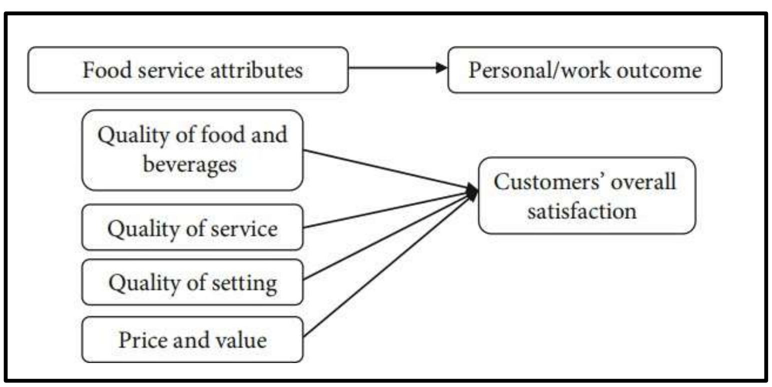

Figure 1: Food service Attributes and Customer Satisfaction

Authentication and CAPTCHA

Authentication ensures the authenticity of a user or system by verifying credentials against authorized databases, improving security and preventing unauthorized access (Barney, 2024). Various authentication methods, including passwords, two-factor authentication, and CAPTCHA, are widely used to protect systems. CAPTCHA, or the Completely Automated Public Turing test to tell Computers and Humans Apart, was introduced in 1997 to prevent automated URL submissions that manipulate search engine rankings algorithms (Hanna & Rosencrance, 2024). It includes text, audio, and image-based authentication methods to distinguish humans from bots, improving security and accessibility (*CAPTCHA Authentification*, 2023).

Encryption and SHA-256

Encryption protects data by converting plaintext into unreadable ciphertext using cryptographic algorithms (TechTarget, 2023). SHA-256, part of the SHA-2 family, improves data security by generating a 256-bit hash that is resistant to cyberthreats, ensuring data integrity and preventing unauthorized modification (Landge, 2024). This cryptographic method cannot be changed, making it very secure for protecting sensitive (Baivab Kumar Jena, 2023).

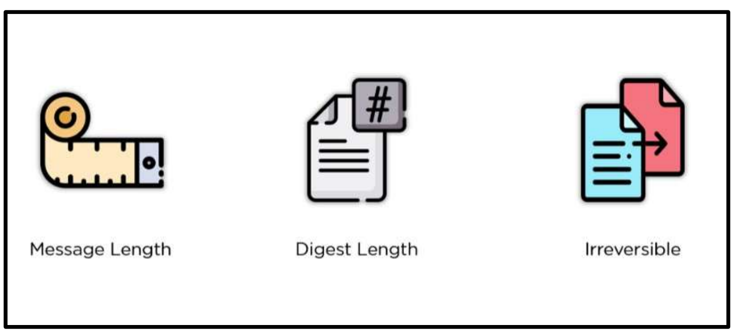

Figure 2: Characteristic of SHA-256

Comparison Between Related Work

Previous research on online food ordering systems provided valuable insights and served as a reference for this project, contributing to a better understanding of system development. Various studies highlighted different methodologies, advantages, and limitations.

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Table 1: Comparison of the Food Ordering System

Title	Methodology	Advantage	Disadvantage
Smart Food Fare Canteen: Automation of bills and serving (Mothukuri et al., 2021).	In this system, there is the help of codes such as QR used as an automatic billing system.	The manual billing system is reduced and not used. The customer's order will be displayed on the screen	In this system is no online transaction
Food Chain Based Canteen Automation System (Paul et al., 2021).	This system has been implemented with the help of cloud computing. All data can be stored in the cloud for use and save existing records	Have relevant data security features. Admin can get and access easily the data that has been recorded	No Online transactions
Canteen Management Android Application Using E-Wallet (Fegade et al., 2019).	The food ordering system is automated, which is used in the college canteen.	This proposed system can reduce paperwork for some tasks. Row Name Here This is the standard font	For payment only available E-wallet and pay on delivery which is cash
Canteen Management System Using the E-Wallet (Katkar et al., 2018).	Customers can order their food at the counter and pay online. The encryption scheme used for secure transactions.	- Secure online transactions. No need for physical payment	Customers can only order food at the counter. Customers have to line up at the counter to place an order

METHODOLOGY

The "Waterfall" approach is named for its sequential flow, where each phase flows smoothly into the next, resembling a waterfall. This method was chosen as a guideline for clarity, simplicity, and smooth integration of phases, ensuring consistency throughout project development. The cafeteria system at UiTM Jasin serves two users: students and vendors. Vendors register, log in, manage menus, and process orders based on payment status. They receive notifications, update order status, and can mark items as out of stock. Students also register and log in, place orders from a single vendor per transaction, and pay via cash or online banking. They track order status and collect food upon completion, with access to order history for reference.

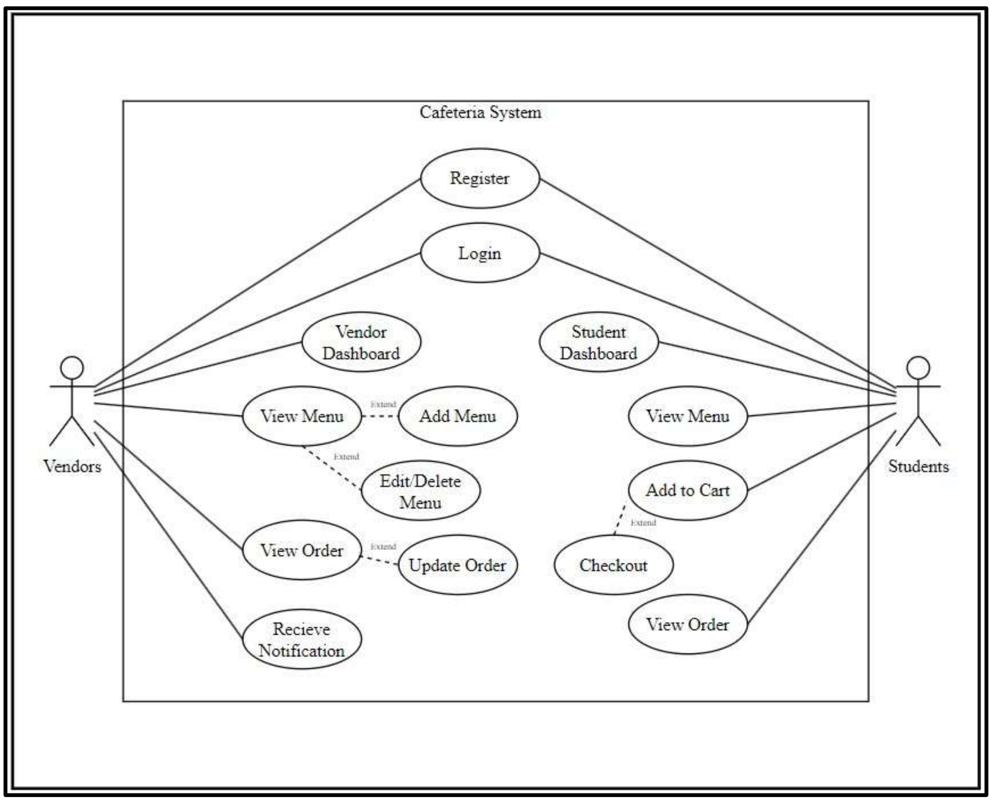

Figure 3: Use Case Diagram

System Design

The system design phase follows the requirements analysis, outlining the system structure and flow to create the overall architecture. This stage is important to gain a clear understanding and perspective of the cafeteria system development. The flowchart visually represents the process, highlighting the key steps and overall structure. The system has three main modules: login, vendor and student. Users first open the application and either log in or register if they are new. After successfully logging in, they are directed to their respective home pages based on their role. If the login fails, they must try again until it succeeds.

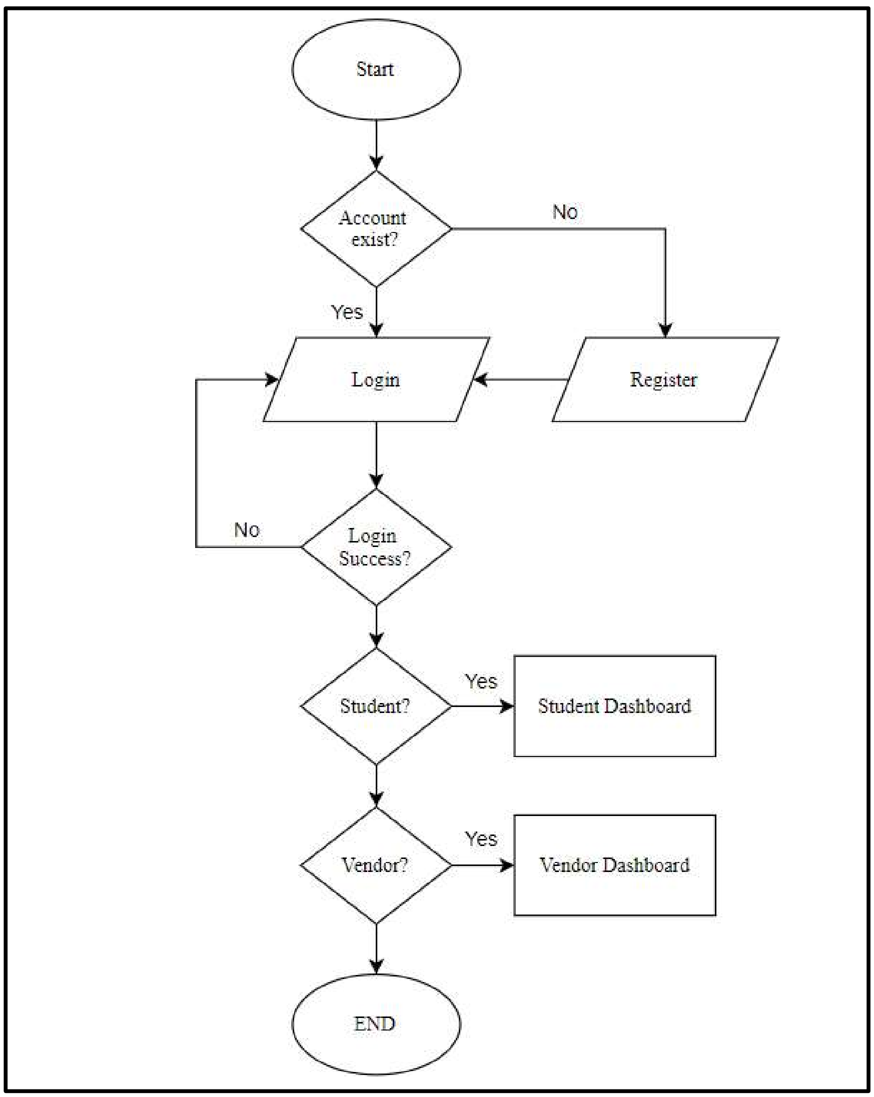

Figure 4: Flowchart of the Cafeteria System

The Entity Relationship Diagram (ERD) outlines seven system tables: users, carts, cart items, menus, order items, orders, and payments. The users table stores student and vendor details, while vendors manage menus and students add items to carts before checking out. Orders link users to selected menu items, with order items tracking quantities and prices. Payments are recorded with transaction details to ensure secure processing.

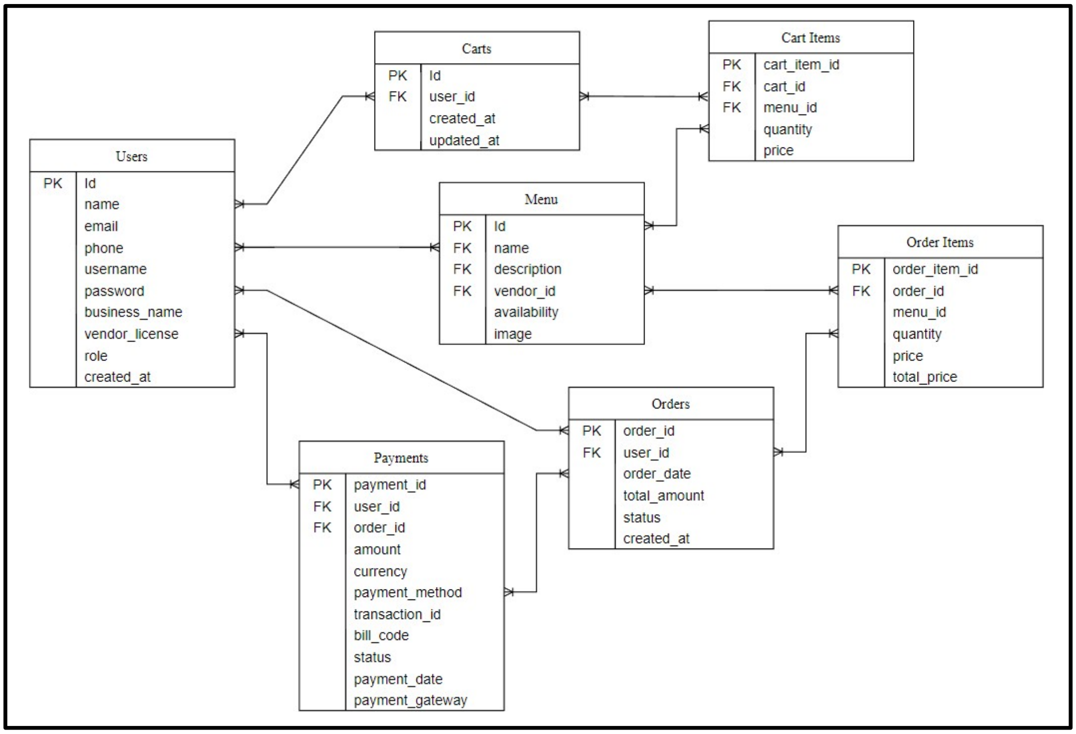

Figure 5: The Entity Relationship Diagram (ERD)

The cafeteria system operates online, allowing users at UiTM Jasin to place orders without queuing. With an internet connection, users can access the system via their phone or laptop. Security measures such as authentication and encryption are implemented to protect user accounts from intrusion and threats.

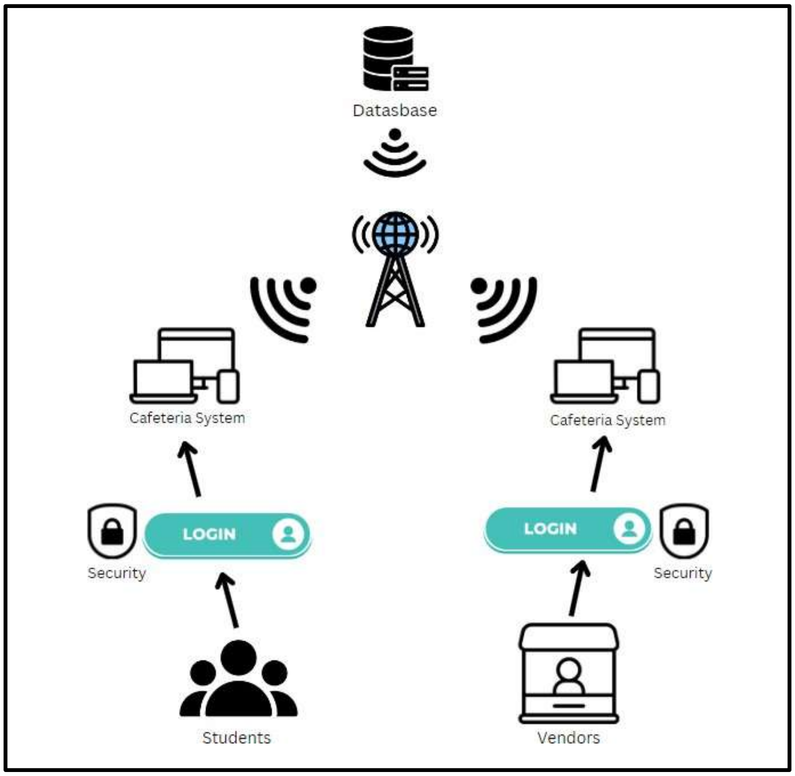

Figure 6: Logical diagram for the cafeteria

RESULT AND DISCUSSION

The development of the web-based cafeteria system is complete, with all interfaces designs fully implemented. The system consists of three main modules: Login, Vendor and Student.

Functionality Testing Results

All tables below the functional test results confirmed that all modules of the UiTM Jasin cafeteria system were operating successfully and in line with the project objectives. The system efficiently supports students and vendors with seamless login and registration, robust security features, menu management, payment processing and real-time order notifications. Successful testing by two lecturers as evaluators further confirmed the reliability and usability of the system, ensuring that it was ready for implementation.

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Table 2: Login Functionality test

Module	Expected Output	Result
Login01	Student and vendor can log in using a username and password.	Pass
Login02	New student and new vendor can register.	Pass
Security01	CAPTCHA (Score based) appears on the login page.	Pass

Table 3: Buyer Functionality test

Module	Expected Output	Result
Buyer01	Shows the student dashboard.	Pass
Buyer02	Student can view or update new profiles.	Pass
Buyer03	Student can change a new password.	Pass
Buyer04	Student can view menus from all vendors	Pass
Buyer05	Student can add menus to the cart and view menu from cart.	Pass
Buyer06	Student can proceed with payment.	Pass
Buyer07	Student can view order status.	Pass
Buyer08	Student can logout of the system.	Pass

Table 3: Vendor Functionality test

Module	Expected Output	Result
Vendor01	Appears on the Vendor dashboard.	Pass
Vendor02	Vendor can view or update new profiles.	Pass
Vendor03	Vendor can change a new password.	Pass
Vendor04	Vendor can view, add, delete and edit menus	Pass
Vendor05	Vendor can view a list of available orders.	Pass
Vendor06	Vendor can change order status (pending, processing, rejected and completed)	Pass
Vendor07	Vendor will get notifications about new orders by email.	Pass
Vendor08	Vendor can logout of the system.	Pass

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Security Testing Results

CAPTCHA validation in the cafeteria system is categorized into three levels, each represented by a different color. The blue "No CAPTCHA" level means that the user does not need to complete the image validation. The green "Pass" level indicates that the user successfully validated the CAPTCHA by selecting the correct image as instructed. The red "Failed" level appears when the user selects the wrong image, such as selecting a pedestrian instead of a bridge when prompted to select a bridge. During the use of the system, 86 validations were recorded. On 19 December 2024, the most important data was collected, showing that 19 validations were bypassed because the system considered them valid. In addition, 41 validations required user interaction, while 7 failed, although failure does not necessarily indicate that the user did not complete the challenge.

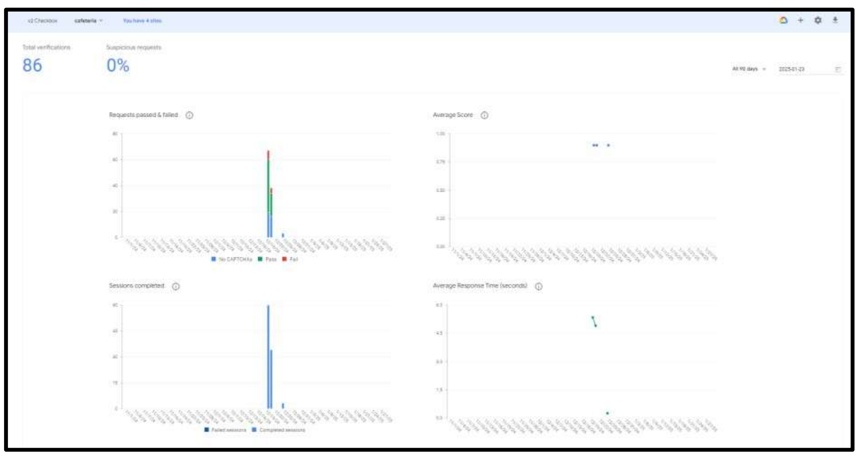

Figure 7: The Data from CAPTCHA

In conclusion, CAPTCHA has proven effective in preventing automated bots from accessing the system, ensuring security by distinguishing human users from bots, and reducing the risk of brute force attacks and spam.

The figure 8 below, shows that the Hashcat session expired, meaning that all possible passwords from the RockYou wordlist were tried but none of the hashes were repeated. This could be because the target password was not in the wordlist or was too complex. In such cases, a hybrid or brute force attack may be needed to increase the chances of success. In conclusion, this test resulted in a failure, demonstrating the effectiveness of SHA-256 encryption in protecting users' personal information in the cafeteria system.

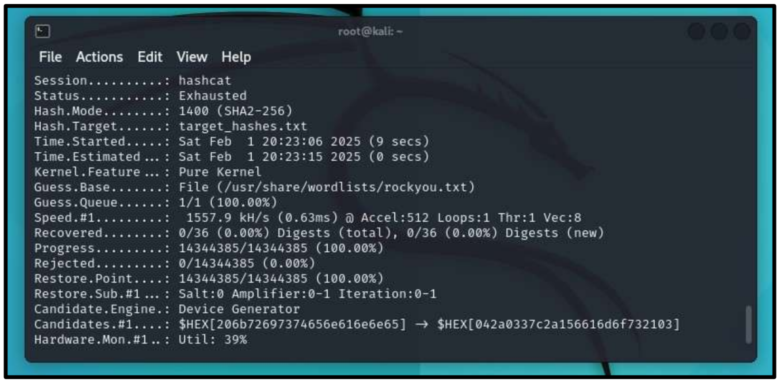

Figure 8: Hashcat Status Complete

The figure 9 below shows the commands executed with John the Ripper to crack SHA-256 hashes stored in "hashes.txt" using the RockYou wordlist. The tool successfully loaded 36 password hashes, but none were cracked, as shown in the figure. In conclusion, despite running a penetration test with John the Ripper, the test was unsuccessful. This result highlights the effectiveness of SHA-256 encryption in securing the cafeteria system.

Figure 9: John the Ripper Status Complete

CONCLUSION

Overall, the cafeteria system improves the food ordering process by providing a simple platform that allows users to place orders efficiently. It incorporates two key security features: CAPTCHA authentication to prevent automated bot access and SHA-256 encryption to protect user data, ensuring passwords are secure from unauthorized access. The system successfully achieves its objectives by reducing the time and effort required for users to order food while also benefiting vendors by enabling smoother sales monitoring. The additional security measures further increase user confidence, allowing them to use the system without hesitation.

Limitations

One limitation is related to the CAPTCHA system. While it adds an additional layer of security, users with accessibility issues may struggle to solve the CAPTCHA. Additionally, advanced bots have the potential to bypass this system in the future. However, since Google reCAPTCHA is successfully integrated, this system meets the security requirements. Regarding SHA-256 encryption, while it effectively protects user passwords, more advanced hashing algorithms may offer stronger protection. Another challenge is the performance of security tools such as Hashcat and John the Ripper, which are highly dependent on hardware capabilities. Limited computing power may have affected the efficiency of penetration testing. Scalability is another concern, as increased user traffic from students and vendors can impact system performance.

Recommendations

One major improvement is the implementation of geofencing, which can enhance location-based services. This feature will notify students when they are near a cafeteria or vendor and allow vendors to offer food delivery services more efficiently. Another valuable addition is the integration of e-wallets as an alternative payment method. With the increasing use of digital wallets, supporting platforms such as Grab Pay or Boost will provide students with more flexibility and convenience when making payments. Security can also be strengthened by introducing Multi-Factor Authentication (MFA). While CAPTCHA and SHA-256 encryption offer protection, MFA will add an additional layer of security by requiring users to verify their identity via a one-time code sent to their mobile device.

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