BEACONHOUSE NATIONAL UNIVERSITY

Wasail

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REQUIREMENT ANALYSIS DOCUMENT

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Introduction

Inefficiencies, wastage and imprecise demand forecasting due to traditional inventory management processes have been an emerging challenge in the landscape of the food industry, specifically the supply chain system. There is a dire need for digitisation and automation within the industry, as evident by businesses' inability to streamline processes, predict demand accurately, and optimise resource usage. This deficiency hinders the possibility of an agile and responsive supply chain that is essential for navigation in today's data-driven decision making.

In response to the aforementioned issue, our proposed solution aims to address current vulnerabilities in the supply chain i.e. grocery and vendor retail domain by providing a technological solution. The solution comprises a platform that seeks to integrate grocery store owners with vendors, initiating a collaboration. Both parties are to undergo a registration procedure coupled with firm authentication measures to ensure interaction safety within the platform and foster a secure and trustworthy environment. An intuitive design of the platform for sales and purchase of goods would reduce physical visits by vendors and enhance operational efficiency through a tracking feature for grocery store owners. Novice grocery store owners would be assisted in searching for specific products from reliable registered vendors.

The highlight of this platform is the incorporation of a demand-forecasting system aided by machine learning (ML), imploring a shift towards modernization and automation. Advanced data analytics with ML are to create a transformed order management and distribution system through accurately predicted customer demand. As efficiency and accuracy arise in the inventory management, the precision by ML will allow stores to order optimal quantities, mitigating risks of overstocking and understocking. The platform would utilise weather conditions, traffic variations, holidays and variables alike in demand forecasting.

This approach aims to redefine forecasting, curb waste, and optimise operational efficiency for grocery stores and vendors. Ultimately, the solution would strive to augment overall profitability in the food industry and create a smarter supply chain system.

Existing Systems

In the current supply chain scenario in Pakistan, the movement of products relies heavily on outdated and paperwork-intensive processes. This traditional approach poses significant challenges, including vulnerability to disruptions, limited visibility due to infrastructure constraints, and communication hurdles. Retailers face stockouts, unpredictable supply arrivals, and a slow replenishment process, leading to operational inefficiencies and working capital restrictions. The conventional procurement structure demands substantial time investment, with retailers spending an average of 25 hours per week navigating wholesale markets.

A notable player addressing these challenges is ‘Tajir’, a platform revolutionising inventory management for mom-and-pop stores in Pakistan. Tajir acts as a vendor, offering a seamless solution for purchasing inventory. It enables retailers to order at their convenience, receive on-demand deliveries, access transparent pricing, and choose from an extensive product selection. Inspired by successes like Tajir, our proposed software solution aims to complement and enhance the existing landscape by providing unique features tailored to the specific needs of small and medium retailers in Pakistan.

Adding to this is ‘Jugnu’, a Business to Business (B2B) e-commerce platform founded in 2020. Jugnu strives for social and economic empowerment by connecting large suppliers to small and medium enterprises, driving growth in local economies. The platform operates across major cities in Pakistan, offering a user-friendly platform for ordering and receiving deliveries within a 24-hour window.

Next is ‘Bazaar’ which contributes to digitising and growing businesses in Pakistan through its mobile app, providing small business owners access to a wide assortment of goods with free next-day delivery. Retailo, another B2B marketplace, allows retailers to restock their shops conveniently with features like instant price comparisons and next-day delivery, eliminating the need for multiple distributors and weekly restocking hassles.

‘Dastgyr’, another B2B marketplace, addresses the pain points of small retailers by connecting them with manufacturers and suppliers. It offers a one-stop solution for inventory needs, allowing retailers to place orders in seconds and receive on-demand delivery. Additionally, retailers working with Dastgyr for three months become eligible for credit purchases, addressing the challenge of limited access to external capital for growth.

Additionally, we also explored ‘Candela RMS’, an enterprise retail software solution focusing on inventory management and POS for all kinds of retail. Candela RMS offers features like ‘*Manage Inventory Shrinkage*’ which is essentially a reorder level feature that sends an alert when an item in the inventory reaches a lower limit and ‘*Edibles Expiry Management’* another feature which allows the entry of expiration dates during stock entry and subsequently printing the expiry date along with the barcode. While this feature aids in managing the expiration of products, it doesn't directly address the nuanced challenge of demand forecasting.

As we undertake this software solution project, we draw insights from the successes of these platforms, aiming to contribute to the modernization and resilience of the supply chain ecosystem in Pakistan. Our market survey and research findings indicate a gap in the current solutions, with a need for a system that not only helps manage inventory but also accurately predicts demand and facilitates smooth communication between grocery stores and vendors. By incorporating elements from these innovative solutions, we seek to offer a comprehensive and effective software

solution tailored to the specific challenges faced by small and medium grocery store retailers in the country.

Literature Survey

In addressing the multifaceted challenges of the food industry, recent studies have illuminated innovative solutions, offering insights that span crucial domains. One study explored the effectiveness of high-tech inventory management within supermarkets, attributing a significant 56.7% of their performance to automation [1]. Another research framework proposed the strategic implementation of AI and robotics to combat food loss during the pandemic, emphasising sensory enhancement and collaborative automation [2].

Recent advancements in deep learning, as highlighted in various studies, signal a transformative shift in the landscape of demand forecasting. Techniques such as multi-modal sales forecasting networks and the application of LSTM demonstrate superior accuracy and effectiveness [3, 4]. The debate between traditional and machine learning forecasting emerges, with a study showcasing the promise of a support vector machine in handling multiple demand series [5].

A groundbreaking study utilised low-cost sensors and machine learning to achieve a remarkable 92.65% accuracy in predicting for preventing food wastage, addressing a critical concern in the industry [6]. Global food supply chains are explored in another study, emphasising the importance of efficiency and behaviour change, particularly in affluent economies, to combat waste [7]. Strategies for proactive food waste reduction in the grocery sector are elucidated in a study that carefully balances customer satisfaction and inventory management [8].

The evolving role of e-grocery as an alternative to traditional retailing is highlighted, emphasising in-stock availability in customer decisions [9]. Generalised Additive Models for Location, Scale, and Shape (GAMLSS) are recommended in another exploration, specifically focusing on demand distribution tails in e-grocery [10]. A simulation model dissects the benefits and drawbacks of Vendor-Managed Inventory (VMI) in the grocery supply chain, revealing that manufacturers reap more significant benefits from VMI adoption [11].

The chocolate industry is subject to a study employing machine learning for refined predictions based on regular and promotional sales data [12]. Retail firms, including Walmart, Costco, and Kroger, are analysed as economic indicators through statistical regression and machine learning, exposing operational inefficiencies [13]. The study on 'Corporacion Favorita,' a major grocery chain in Ecuador, offers insights into optimising predictions and mitigating stock-out and over-stocking issues [14].

In addition, abroad there are platforms like Shelf Engine and Guac, both leveraging machine learning for demand forecasting and order optimization in the grocery retail

sector. The major difference lies in their approach; Guac provides recommendations, leaving the final order decision to stores, while Shelf Engine actively decides orders and assists in placing them with vendors. Drawing inspiration from global industry trends, our proposed system aligns with the approach of Guac, aiming to leverage technology, embrace automation, and address current vulnerabilities in our supply chain. Despite notable progress in these studies and platforms, challenges such as training set size, overfitting, and model complexity persist, necessitating further exploration for the development of a responsive and sustainable food system.

Requirement Gathering and Fact Finding

Data Collection Technique: Interviews & Observation

- Conducted structured and unstructured interviews with grocery store owners.
- Walked around the store with owners, explaining concepts like shelf placement for better marketing and promotion.

Reasoning: Interviews provide a strategic and adaptable approach, capturing detailed, context-specific information essential for understanding the challenges faced by grocery store owners in the supply chain.

Issues identified: Outdated Ordering System

- Effects observed include discounts on products close to expiration, product monopolisation, and limited sources for new products.
- The in-person interviews highlighted these issues and their impact on the supply chain.

Interview Insights:

1. Ordering Process:
    - Manual observation of daily sales to determine the quantity for the next order.
    - Budget constraints leading to a significant decrease in stock purchasing.
    - Some products are restricted by vendors.
2. Software Issues:
    - Dependency on electricity for software usage.
    - Lack of backup in case of power outages.
    - Manual data entry during power disruptions.

Areas for Improvement: Digitisation Opportunities

- Potential for digitising manual processes, especially during power outages.
- Consideration for backup solutions to address electricity dependency.
- Streamlining data entry processes for efficiency.

Conclusion: The insights gathered through interviews with grocery store owners highlight critical issues in the current supply chain, forming a crucial foundation for the development of our software solution. The experiences shared by Z Mart, Express Store, and My Store underscore the necessity for a digital solution to tackle challenges related to order management, inventory control, and system reliability. Furthermore, the additional research reveals significant gaps in the existing mechanisms, including the absence of a formal communication channel with vendors, authentication issues, and a reliance on vendors as the sole source for new products.

Software Requirement Specification (SRS)

User Roles

The grocery store app has the following user roles:

- Grocery Store Owner: A user who is looking for a product for their store.
- Vendor: A user who is selling the products to the grocery stores.

User Stories

User Story: Registration on the App

As a new user, I want to be able to register for the “Wasail” app.

Acceptance Criteria:

- When I open the app for the first time, I should be presented with a registration screen.
- I can choose my user role, either "Grocery Store Owner" or "Vendor," during the registration process.
- The registration screen should prompt me to enter the following information:
    - Phone number
- After entering the required information, I can submit my registration request by clicking on the "Register" button.
- After clicking on the "Register" button, the app should display a confirmation pop up.
- Upon successful registration, I should receive a one time password (OTP) on the phone number that I have given for account confirmation.
- I should be able to enter that OTP in the specified place on the app.
- After my account has been confirmed, the app should automatically navigate to the page where I can input my personal information.

User Story: Authentication

As a grocery store owner, I want to be able to authenticate my identity to access the platform's features effectively.

Acceptance Criteria:

- When I open my app, the app should display a pop-up prompting me to verify my account.
- I can click on the 'Get Verified' button and the app should take me to the verification screen.
- After I am on the verification screen, I should be able to upload pictures of my identification card so that they can verify my details.

User Story: Searching for a Product

As a grocery store owner, I would like to find a product easily, which I can display in my store, so that I do not have to go through the hassle of going to wholesale markets myself to find those products.

Acceptance Criteria:

- When I log into the app, I should see a search bar on the main screen along with popular categories.
- I can search the product by either the name of the product (for e.g Milkpak) or the category of the product (for e.g milk).
- After pressing the 'Search' button, the app should present a list of vendors offering the product I need, taking into account their ability to deliver to my store's location. (along with the products)
- The vendors on my connection list who fulfil the aforementioned criteria should be displayed at the top, and the rest of the vendors should be displayed after them.
- I can click on the vendor's profile to view more details.

User Story: Connecting with a Vendor

As a grocery owner, I would want to connect with the vendors so that I can place orders.

Acceptance Criteria:

- Once I click on the vendor's profile, the option to connect with the vendor should be displayed to me.
- I can click on the 'Connect' button so that I can form a link with that vendor and start placing orders to that vendor.
- The app would display the vendor in my connection list as well.

User Story: Ordering the Product

As a grocery store owner, I would want to place an order for the product that I've searched for.

Acceptance Criteria:

- Once I have clicked on the vendor's profile, the app should display the vendor's details which should include the contact information, the areas in which they deliver, the product listings and an option to connect.
- While I'm on the vendor's profile, the app is displaying the product that I have searched for under the "Searched Product" section, and the other products the vendors sell under the "Other Products" section.
- I can click on the product I want to order, and the app would take me to another screen where I would be able to select the quantity of the product.
- A recommended section would also be displayed along with the quantity of the product that would suggest the amount to order.
- Once I have filled out the aforementioned criteria, I would select the "Place Order" button and my order would be placed.

User Story: Tracking the Order

As a grocery store owner, I would like to keep a track of the orders that I have placed, so I would know when they are arriving.

Acceptance Criteria:

- Once I open the app, it should show a section of 'My Orders' at the bottom app bar.
- I can click on the 'My Orders' button and it should open the My Order section that should display all the orders that I have placed to different vendors.
- I can click on a specific order to see what stage it is at in the delivery process, so that I know when to expect its arrival.

Functional Requirements

User Role Management:

- **FR1: User Registration**
    - **Description:** The system should allow users to register with the app, specifying their user role as either "Grocery Store Owner" or "Vendor."
    - **Actor:** New User
    - **Precondition:** User is not registered.
    - **Postcondition:** User's registration information is saved, and they are assigned the selected user role.
    - **Details:**

    i. Users must provide essential information such as name, email, and password during registration.
    ii. User roles are selected during registration and cannot be changed later.

- **FR2: User Login**
    - **Description:** The system should allow registered users to log in with their credentials.
    - **Actor:** Registered User
    - **Precondition:** User is not logged in.
    - **Postcondition:** User gains access to their role-specific features.
    - **Details:**
        i. Users must enter their phone number to log in.
        ii. Successful login grants access to the app's features based on the user's role.

Searching for a Product:

- **FR3: Product Search**
    - **Description:** The system should provide a search feature for grocery store owners to find products easily.
    - **Actor:** Grocery Store Owner
    - **Precondition:** User is logged in as a grocery store owner.
    - **Postcondition:** A list of products and vendors matching the search criteria is displayed.
    - **Details:**
        i. The search can be performed based on product name or category.
        ii. The search results should prioritise vendors that can deliver to the store's location.
        iii. The search results should display product details and vendor information.

Connecting with a Vendor:

- **FR4: Connect with Vendor**
    - **Description:** The system should allow grocery store owners to connect with vendors for placing orders.
    - Actor: Grocery Store Owner
    - **Precondition:** User is logged in as a grocery store owner and has selected a vendor from the search results.
    - **Postcondition:** The connection between the grocery store owner and the vendor is established, and the vendor is added to the grocery store owner's connection list.
    - **Details:**

    i. After connecting with a vendor, the vendor's contact information and delivery areas are made accessible to the grocery store owner.
    ii. The vendor is added to the grocery store owner's connection list for easy access.

Ordering the Product:

- **FR5: Product Ordering**
    - **Description:** The system should enable grocery store owners to place orders for products.
    - **Actor:** Grocery Store Owner
    - **Precondition:** User is connected with a vendor and is ready to place an order.
    - **Postcondition:** The order is placed successfully.
    - **Details:**
        i. Grocery store owners can select products to order from the vendor's profile.
        ii. They can specify the quantity of the selected product.
        iii. The system should provide recommendations for the order quantity based on historical data.
        iv. The placed order is confirmed, and a notification is sent to the vendor.

Tracking the Order:

- **FR6: Order Tracking**
    - **Description:** The system should allow grocery store owners to track the status of their orders.
    - **Actor:** Grocery Store Owner
    - **Precondition:** User has placed orders.
    - **Postcondition:** User can view the status and expected delivery time of their orders.
    - **Details:**
        i. The "My Orders" section should display a list of orders placed with different vendors.
        ii. Grocery store owners can select a specific order to view its delivery status, including estimated delivery time and real-time tracking information if available.

Authentication:

- **FR7: User Authentication**
    - **Description:** The system should enable grocery store owners to authenticate their identity and gain access to the platform's features. This process involves user verification through document submission.

- **Actor:** Grocery Store Owner
- **Precondition:** User has registered for the app and is attempting to access their account.
- **Postcondition:** User is granted access to the platform after successful verification.
- **Details:**
    i. Upon app launch, a verification pop-up should appear.
    ii. A "Get Verified" button should be present in the pop-up.
    iii. Clicking "Get Verified" should take the user to the verification screen.
    iv. On the verification screen, the user can upload images of their identification card.
    v. The system should provide clear guidelines on accepted document types and image quality.
    vi. After document submission, the system processes and verifies the information.
    vii. Proper error handling is in place for unclear or insufficient document images.
    viii. Successful verification marks the user's account as verified, granting access to the platform.

Non-Functional Requirements

1. **Security Requirements:**
    - **Authentication:** The system must implement a secure authentication mechanism to ensure that only authorised users can access the application. Two-factor authentication (2FA) should be supported.
    - **Data Encryption:** All sensitive user data, including login credentials, payment information, and personal details, must be encrypted during transmission and storage using industry-standard encryption algorithms (e.g., SSL/TLS). Encryption should also extend to data at rest within the database.
    - **Authorization:** The system should implement fine-grained role-based access control to restrict users' access to specific features and data based on their roles. Access permissions should be configurable and manageable by system administrators.
    - **Audit Trail:** The system must maintain detailed audit logs of user activities, including login attempts, data access, and transactions, for security and compliance purposes. Logs should be secure, tamper-evident, and readily accessible for auditing.
    - **Data Backup and Recovery:** Regular automated backups of the application's data and configuration settings must be performed. A well-defined data recovery plan should be in place to ensure data availability and integrity. Data backup should be performed at least

daily, and the recovery plan should include clear procedures for data restoration in case of data loss or system failure.

2. **Performance Requirements:**
    - **Response Time:** The system should be responsive, with a maximum acceptable response time of two seconds for standard operations, such as product searches, order placements, and order tracking.
    - **Scalability:** The system should be designed to handle an increasing number of users and data without significant performance degradation. It should be able to scale horizontally to accommodate increased user loads.
    - **Resource Utilisation:** The system should be optimised for efficient use of server resources, such as CPU and memory, to ensure smooth operation even during peak usage.

3. **Availability and Reliability:**
    - **Uptime:** The system should strive for high availability, with at least 99.9% uptime. Downtime for maintenance and updates should be scheduled during off-peak hours and should be communicated to users in advance.
    - **Redundancy:** Redundancy measures, such as failover servers and load balancing, should be in place to ensure system reliability and minimise downtime in case of server failures.

4. **User Experience:**
    - **Usability:** The user interface should be intuitive and user-friendly, with consistent navigation and clear instructions. It should be designed to minimise user errors.
    - **Accessibility:** The application should be accessible to users with disabilities.

5. **Data Privacy and Compliance:**
    - **Data Privacy:** The system must comply with data privacy regulations and ensure the protection of user data. Personal and sensitive information should be handled and stored securely.
    - **Compliance:** The system should adhere to relevant industry standards and legal requirements, including but not limited to data protection laws and regulations. Compliance with any specific industry standards related to grocery stores and vendors should also be maintained.

6. **Mobile Responsiveness:**
    - **Mobile Compatibility:** The app should be responsive and compatible with a range of mobile devices and screen sizes to provide a consistent user experience on smartphones and tablets.

7. **Load Testing:**
    - **Load Testing:** The system should undergo load testing to determine its capacity and performance under various load conditions. Testing should be conducted to assess the system's behaviour during peak usage.

8. **Localisation:**
    - **Localisation:** The application should support multiple languages and regions to cater to a diverse user base.

9. **System Logging and Monitoring:**
    - **Logging and Monitoring:** Comprehensive system logging and monitoring tools should be in place to detect and address issues proactively. System administrators should be alerted to critical events or potential security breaches.

10. **Third-Party Integrations:**
    - **Third-Party Integrations:** The system should be able to seamlessly integrate with third-party services, such as payment gateways and location services, as necessary.

Test Cases

Test Case 1: User Registration

- **Test Scenario:** A new user registers for the "Wasail" app.
- **Preconditions:** User is not registered.
- **Test Steps:**
    1. Launch the app.
    2. Choose to register as a "Grocery Store Owner" or a "Vendor."
    3. Provide the required registration information (phone number).
    4. Complete the registration process by clicking the "Register" button.
- **Expected Result:** User is successfully registered, and their selected user role is saved. The user is redirected to the app's main screen.

Test Case 2: User Login

- **Test Scenario:** A registered user logs into the "Wasail" app.
- **Preconditions:** User is not logged in.
- **Test Steps:**
    1. Launch the app.
    2. Select the "Log In" option.
    3. Enter the user's registered phone number.
    4. Click the "Login" button.

- **Expected Result:** User's credentials are verified, and the app grants access to role-specific features based on the user's role.

Test Case 3: Product Search

- **Test Scenario:** A grocery store owner searches for products using the app.
- **Preconditions:** User is logged in as a grocery store owner.
- **Test Steps:**
    1. Access the app's main screen.
    2. Use the search bar to enter a product name or category.
    3. Click the "Search" button.
- **Expected Result:** The app displays a list of products and vendors matching the search criteria. Results prioritise vendors who can deliver to the store's location, and product details along with vendor information are shown.

Test Case 4: Connect with Vendor

- **Test Scenario:** A grocery store owner connects with a vendor to place orders.
- **Preconditions:** User is logged in as a grocery store owner and has selected a vendor from the search results.
- **Test Steps:**
    1. Click on the selected vendor's profile.
    2. Initiate the connection by clicking the "Connect" button.
- **Expected Result:** The connection between the grocery store owner and the vendor is successfully established, and the vendor is added to the connection list for future orders.

Test Case 5: Product Ordering

- **Test Scenario:** A grocery store owner places an order for a product.
- **Preconditions:** User is connected with a vendor and is ready to place an order.
- **Test Steps:**
    1. Access the vendor's profile.
    2. Select the product to order.
    3. Specify the quantity of the selected product.
    4. Follow any recommended order quantity.
    5. Click the "Place Order" button.
- **Expected Result:** The order is successfully placed, and a notification is sent to the vendor.

Test Case 6: Order Tracking

- **Test Scenario:** A grocery store owner tracks the status of an order.
- **Preconditions:** User has placed orders.
- **Test Steps:**
    1. Access the "My Orders" section in the app.
    2. Select a specific order.
    3. View the order's delivery status and estimated delivery time.

- **Expected Result:** The app displays the order's current status, and the user can see the expected delivery time.

Test Case 7: User Authentication

- **Test Scenario:** A grocery store owner initiates the user authentication and verification process.
- **Preconditions:** User has registered for the app and is attempting to access their account.
- **Test Steps:**
    1. Upon app launch, a verification pop-up should appear.
    2. Click on the "Get Verified" button.
    3. Access the verification screen.
    4. Upload images of the identification card.
- **Expected Result:** After document submission, the system processes and verifies the information, and upon successful verification, the user gains access to the platform.

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