BEACONHOUSE NATIONAL UNIVERSITY

Wasail

PRJ-F23/333

PROJECT PROPOSAL REPORT

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Problem Statement

In the current landscape of the food industry, a factor significantly contributing to inefficiencies, wastage, and inadequate demand forecasting are traditional manual processes for inventory management which underscore the need for digitalization and automation within the food industry. Businesses presently have not streamlined their processes up to their potential, be able to predict demand precisely, or optimise resource allocation. This implores a more agile and responsive supply chain and in the era where data-driven decision-making has become paramount, digitalization and automation empower businesses to make informed choices swiftly, fostering a resilient and future-ready food ecosystem. Furthermore, a seamless integration of technologies is needed to improve communication between vendors and grocery store retailers to allow a collaborative and synchronised network that could prove to be essential for the industry's growth and sustainability.

Existing System

In Pakistan, products move from suppliers to stores in an outdated manner, relying heavily on paperwork. Unfortunately, this system faces significant challenges due to its outdated nature and dependence on manual processes. This traditional approach makes the supply chain vulnerable to disruptions, worsened by limited visibility caused by infrastructure and technological constraints. Communication is also a hurdle, as less developed infrastructure leads to delays and potential misunderstandings. Retailers struggle with stock outs because they can't predict when supplies will arrive, and the slow replenishment process hampers their operations. The conventional procurement structure demands a significant time investment, with retailers spending an average of 25 hours per week navigating wholesale markets and dealing with distributors. This not only affects operational efficiency but also imposes working capital restrictions. Consequently, retailers are forced to invest more capital in their stores, resulting in a limited range of product categories due to constraints in expanding their offerings range. Wholesalers and distributors face challenges as well, including a small customer base, limited reach, and information gaps, relying heavily on manual efforts, which makes order generation a labour-intensive process. Given these challenges, there's an urgent need for the supply chain in Pakistan to transition towards more modern and technology-driven practices. This shift is particularly crucial in the current business landscape, where rapid changes are the norm. Embracing modern solutions can enhance efficiency, reduce delays, and create a more resilient supply chain ecosystem.

In this landscape, one platform that is working towards automating the management of inventory in Pakistan is Tajir. Tajir is making strides in revolutionising the supply chain by helping mom-and-pop stores manage their inventory more efficiently. Acting as their vendors, Tajir provides a seamless solution for purchasing inventory. Through Tajir,

retailers can overcome the challenges of traditional procurement, gaining the ability to order at their convenience, receive on-demand deliveries, access transparent pricing, and choose from an extensive selection of products. Tajir's approach significantly reduces the time investment required for procurement, offering a transformative shift from the conventional 25 hours per week spent in wholesale markets.

As we propose our software solution, we draw inspiration from the successes of platforms like Tajir. While Tajir is making remarkable strides, our tailored system aims to complement and enhance the existing landscape by providing a unique set of features to address the specific needs of mom-and-pop stores in Pakistan. Together with innovative solutions like Tajir, we aspire to contribute to the modernization and resilience of the supply chain ecosystem in Pakistan.

Literature Survey

In addressing the multifaceted challenges of the food industry, recent studies have illuminated innovative solutions, offering insights that span across crucial domains.

One study delves into the effectiveness of high-tech inventory management within supermarkets, attributing a significant 56.7% of their performance to automation [1]. Another research framework proposes 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, 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 utilises 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].

Despite the notable progress in these studies, challenges such as training set size, overfitting, and model complexity persist, necessitating further exploration for the development of a responsive and sustainable food system.

Additional Research

The additional research included conducting interviews with different grocery store owners in order to understand the on ground issues that are being faced by them. The findings of these interviews included discovering the fact that they do not have a proper mechanism to contact their vendors, there is no formal way of checking if the vendor is authentic or a ‘mobiler’, a term used within the vendor community for a person who acts as a real vendor and sells fake goods. They also mentioned that they have to manually check how much of the items are left for them to order more and when asked about how they decide which new item to place they mentioned that their only source to new products is only through vendors.

Proposed Solution

In the domain of grocery retail, a persistent challenge has been food wastage which demands an approach beginning with the seamless integration of grocery store owners with vendors. The process would be initiated by a registration system for grocery store owners and vendors, followed by rigorous user authentication for safety against unauthorised personnel e.g. ‘mobilers’. Additionally, the legitimacy of grocery store owners would be verified meticulously in order to foster a secure collaborative environment. Collaborators connected through the platform will be facilitated by an intuitive navigation system for product sales and purchase. The platform will not only help reduce the number of physical visits to the grocery stores by the vendors but also provide a tracking feature for grocery store owners, enhancing operational efficiency. Novice grocery store owners would be aided through the platform's assistance in vendor search for specific products.

In this collaborative platform, the integration of a demand-forecasting system will be

supported by machine learning (ML), implying the necessity for embracing modernization and automation. To achieve this, a sophisticated system which harnesses advanced data analytics and machine learning, becomes imperative for accurately predicting customer demand for grocery products. The platform will serve as a hub for managing orders, streamlining all aforementioned processes up until distribution. Automating this process ensures efficiency and accuracy in the inventory management and the precision, owed to ML, will empower stores to order optimal quantities, mitigating the risks of overstocking or understocking. Furthermore, the development of pricing algorithms, factoring in demand trends, and other pertinent variables such as weather, traffic and specific holidays can maximise sales of grocery items before they approach their expiration dates.

This holistic approach strives to redefine the landscape of forecasting, effectively curb waste, and optimise the operational efficiency of grocery stores and vendors, ultimately resulting in an augmentation of overall profitability.

Deliverables

- App
- Website
- ML Model
- REST API
- Database

Technologies

Programming Languages:

- Python
- Java
- JavaScript
- Dart

Data Storage:

- MySQL
- MongoDB

Machine Learning:

- TensorFlow
- PyTorch
- Scikit-Learn

Cloud Services:

- Google Cloud
- Amazon Web Services

Web Development:

- Front-End
    - HTML
    - CSS
    - React
    - Bootstrap
- Back-End
    - Spring Boot
    - Node.js

Mobile Development:

- Flutter

REST API:

- Spring Boot
- Node.js

Analytics and Visualisation:

- Tableau
- Grafana
- Custom Dashboard

Version Control:

- GitHub

Project Management:

- Jira

Collaboration:

- Discord

Business Model

Product Promotion:

- Description:
    - Allow vendors to showcase their products prominently on your platform.
    - Feature products in dedicated sections, banners, or listings to grab the attention of users.
    - Offer vendors the opportunity to have sponsored product listings.
    - Provide banner spaces on the platform for increased visibility.
- Monetization:
    - Charge vendors for premium product placements and visibility.
    - Charge vendors based on a pay-per-click (PPC) or pay-per-impression (PPI) model for sponsored listings and banners.

Performance Analytics:

- Description:
    - Provide vendors with detailed analytics on the performance of their promotions.
    - Include metrics such as click-through rates, conversion rates, and customer engagement.
- Monetization:
    - Charge vendors for access to advanced analytics and insights.

Project Methodology

The project will follow an iterative approach, with planned iterations every six weeks. Feedback from end-users, monitoring tools, and emerging trends will drive continuous improvements in features, performance, and user experience.

Project Initiation (Week 1-5)

- Define the project scope, objectives, and requirements.
- Create a project team with assigned roles and responsibilities.
- Set up project communication channels and tools.
- Conduct an initial market research to understand the grocery industry in Pakistan.

Requirement Gathering (Week 6-9)

- Conduct interviews and surveys with potential users (grocery store owners, vendors, and customers) to gather detailed requirements.

- Identify key features and functionalities for the mobile app, website, API, and ML model.
- Create a comprehensive requirements document.

System Design (Week 9-12)

- Design the architecture for the mobile app, website, and backend system.
- Create wireframes and prototypes for the user interfaces.
- Define the database schema for customer and vendor data.
- Plan the integration of the ML model for demand forecasting.

Development (Week 13-36)

- Database (Week 13-14)
    - Design and create the MySQL database schema
- Machine Learning (Week 14-30)
    - Data Acquisition
    - Data Cleaning
    - Integration of additional factors
    - Feature Engineering
    - Development of ML Models
    - Accuracy Improvement through various techniques
- Application (Week 14-30)
    - Build user interface in Flutter
    - Add Functionality
    - Database and ML Model Integration
- REST API (Week 14-24)
    - REST API design and database integration with Spring Boot.
    - Build the API endpoints for data retrieval
    - Develop APIs frontend and backend communication, including ML model integration
- Website (Week 30-36)
    - Learning JavaScript and React
    - User Interface
    - Admin Portal features
    - User authentication and admin functionalities

Testing and Quality Assurance (Week 15-36)

- Conduct unit testing and integration testing testing for all components.
- Identify and resolve any bugs or issues
- Ensure data security and privacy compliance

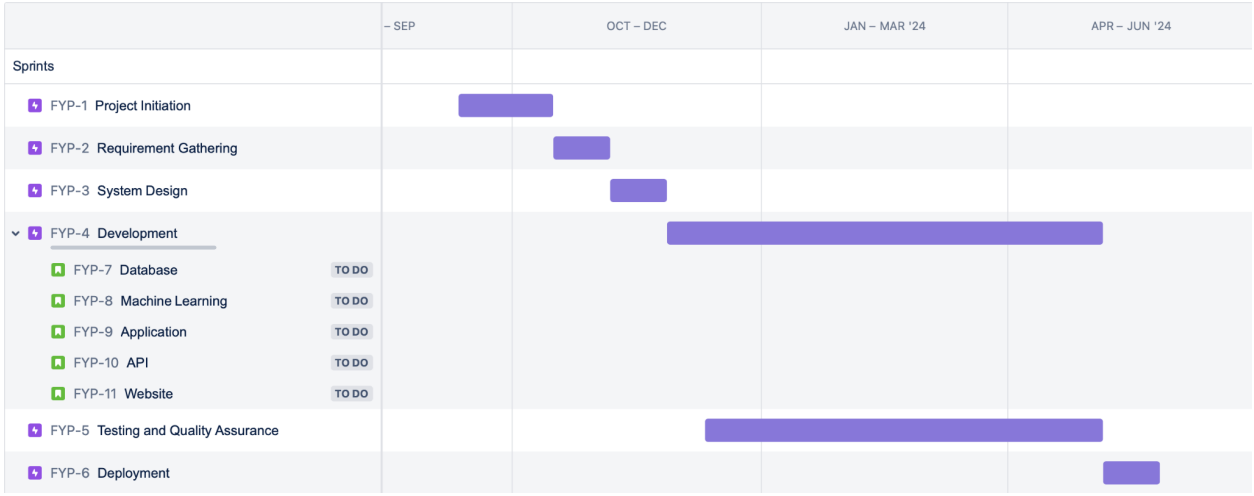
Deployment (Week 36-38)

- Deploy the mobile app to app stores
- Host the website on a web server
- Deploy the backend API on a cloud or dedicated server
- Populate the initial data in the database
- Ensure scalability and performance of the system

Maintenance (Ongoing)

- Provide ongoing maintenance, updates, and support to ensure the platform's stability and functionality.
- Continuously improve the ML model's accuracy based on real-world data.

Timeline



Expertise

Machine Learning

- Ms. Huda Sarfraz
- Dr. Adnan Rashid

Data Storage

- Ms. Amna Humayun
- Dr. Natash Ali

Web Development

- Mr. Nauman Ali

App Development

- Mr. Asim Irshad

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