Second Review Document

Start-Up Web Application

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Abstract:

In the present scenario of e-globalization and economic liberalization, small-scale startups/industries occupies a place of strategic role in employment of manpower and productivity, distribution of income across the regions through increased investments and profits. However, such industries find themselves in an intensely competitive environment because of giant enterprise occupying most of the market segments. This paper identifies problems of small scale startups and after completely analysis, provides answers for upgrading and modernizing their technologies and suggest measures for facilitating procedures for accessibility of finance, requirements of improvements in skills, education and training. Through our paper, we have proposed a stage to remove a wide range of barriers for reception of improved technologies, which is essential for growth of small scale startups. We have likewise provided strong and feasible techniques for business analysis and growth in the provided stage. The use of our foundation encourages technological upgrade and in-house technological innovations and advancement of inter-firm linkages. In our paper we are likewise exploring other aspects of strategy development like human resource, vendor development, association culture, etc.

Keywords: E-globalization, Small-scale industries, Technological improvement, Investment

1Introduction:

1.1Theoretical Background

As accessibility to e-commerce and technology has become a need for industries, large-scale industries are moving towards these markets. However small-scale industries are not able to compete with these industries as they do not have the capital or the technological no-how of how to start and run a successful e-commerce. Here, we are creating a platform where small-scale industries can market their products to the public. They can also access various information, training material and practical seminars for better understanding and improvement of their business. This platform also acts as a platform to showcase and improve their business. This allows investors to broaden their vision to small-scale industries and find small effective investments. Even the consumers will be able to get better products at cheaper rate as the small-scale industries generally have products which are locally sourced and cost less.

1.2Motivation

We have seen many small business sufferings as the pandemic raged, most were finding it hard to find customers, leading to business shutting down. Market all over the world had faced severe damage. Especially in India, where 45%-50% of exports are handled by small scale business, the damage dealt with the economy was immense. During this pandemic raged period, one of the many reasons why small-scale vendors were not able to continue and face a total shutdown was business not being conducted digitally.

1.3Objectives

- Provide analytical tools
- Provide inventory management tools
- Provide learning materials for startups
- Provide a platform for investors to invest in startups
- Digitize the market for small business

2Literature Survey

In India 50% of GDP is contributed by Small-scale industries. These do not have access to modern technological advancements. Many suffered huge losses especially due to pandemic. This showed us the need for introducing new technologies to this sector of industry.[1] Currently these small scale industries are not able to compete with large scale industries, basically due to the lack of

capital. They lack the new technologies like e-commerce to market their product to the current market. They are facing constraints in competitive priorities, investment and performance optimization.[2] Despite the government level knowledge that small scale industries are not able to cope with e-commerce system of large industries, there have been no involvement to uplift small scale industries. Slow pace of ecommerce diffusion in small-scale industries have been studied and found that investment and marketing have been the most important in the slow integration with e-commerce.[4] Currently large Ecommerce giants(large-scale industries) have utilized and structured their marketing around social media. However, the small-scale industries do not have nor the capital nor the technological know-how for this level of marketing.[3] Many studies have shown that e-commerce is especially good for developing countries. As it expands the market and availability to boarder market. [5]

3Overview of Proposed System

3.1Introduction

Nevertheless, a simple e-commerce platform is useless for people who have no knowledge of how the sales work in the market. Therefore, we are adopting various business intelligence techniques like Product Recommendation, Profit forecast, Cost Benefit Analysis, etc. to ease the use of our system. Also, the web application is built with responsive design and has adopted various methods.

3.2Frameworks and Architecture

3.2.1MERN Stack Architecture

We are using MERN stack to built the web application. It is a full-stack solution following the 3-tier architecture: MongoDB as database, ReactJS as frontend and NodeJS as backend.

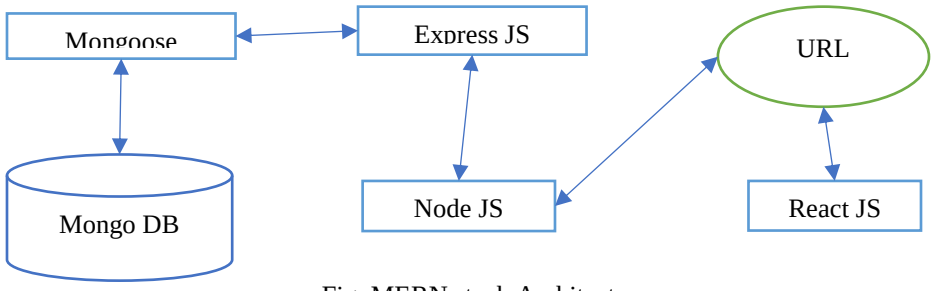

Fig: MERN stack Architecture

MongoDB is designed to store JSON data natively making it scalable. It is built on JSON and JavaScript. Express.js handles server-side applications like HTTP requests and responses, also

makes it easy to map URLs to server side functions. React.js allows building interactive user interfaces and communication with remote server making it an easy to use and deploy.

3.2.2Model-View-Controller Design Pattern:

We have adopted MVC (Model-View-Controller) design pattern for coding. This pattern is used to separate application's concerns. The Model View Controller (MVC) design pattern specifies that an application consist of a data model, presentation information, and control information. The pattern requires that each of these be separated into different objects.

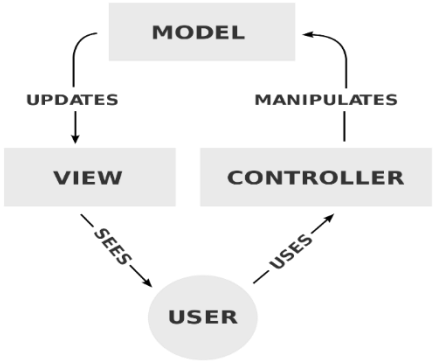

Fig: Model-View-Controller

- The **Model** contains only the pure application data, it contains no logic describing how to present the data to a user.
- The **View** presents the model's data to the user. The view knows how to access the model's data, but it does not know what this data means or what the user can do to manipulate it.
- The **Controller** exists between the view and the model. It listens to events triggered by the view (or another external source) and executes the appropriate reaction to these events. In most cases, the reaction is to call a method on the model. Since the view and the model are connected through a notification mechanism, the result of this action is then automatically reflected in the view.

3.3.3Microservice Architecture

Microservices - also known as the microservice architecture - is an architectural style that structures an application as a collection of services that are

- Highly maintainable and testable
- Loosely coupled
- Independently deployable
- Organized around business capabilities
- Owned by a small team

The microservice architecture enables the rapid, frequent and reliable delivery of large, complex applications. It also enables an organization to evolve its technology stack.

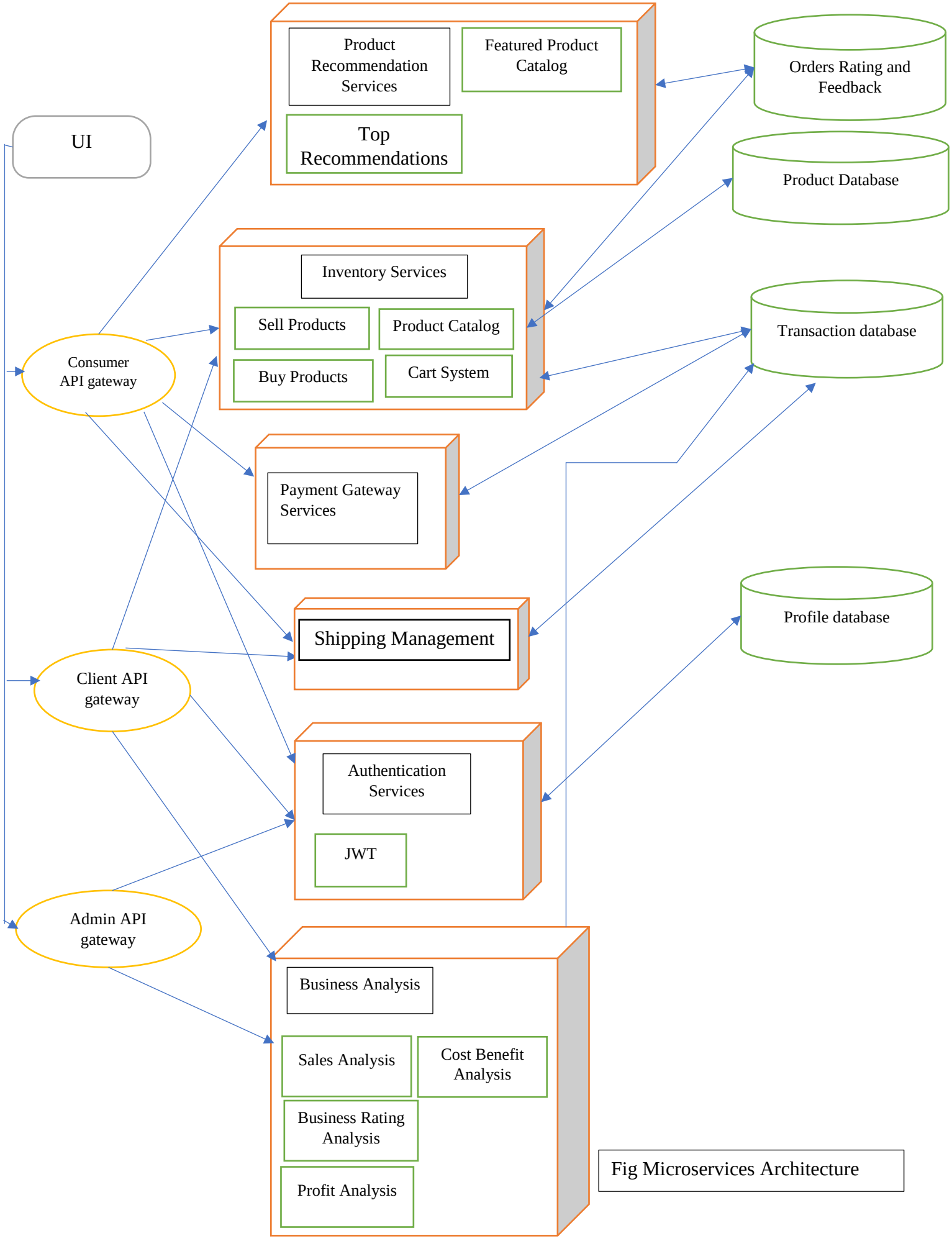

Fig Microservices Architecture

A) Product Recommendation Service:

Recommender system makes prediction based on users' historical behaviors. This service allows consumers to get recommendation for buying new products based on their pervious data. The system will intake the rating of consumers and find the similarity between users. Based on this similarity we assume that if user A has given good ratings to item X and user A and user B have high similarity then user B might b interested in buying item X.

After much analysis, we decided that **user-based Collaborative Filtering** with **explicit ratings** of items would be a better approach to our product recommendation service. After applying PCA (Principal Component Analysis) to reduce dimension and remove noise data, we have generate an n × m matrix of ratings, with user u_i, i = 1, ...n and item p_j, j=1, …m. Now we predict the rating r_{ij} if target user i did not watch/rate an item j. The process is to calculate the similarities between target user i and all other users, select the top X similar users, and take the weighted average of ratings from these X users with similarities as weights using equation 1.

$$r_{ij} = \frac{\sum_k Similaries(u_i, u_k) r_{kj}}{number\ of\ ratings}$$

Equation 1: Collaborative Filtering

$$r_{ij} = \bar{r}_i + \frac{\sum_k Similaries(u_i, u_k)(r_{kj} - \bar{r}_k)}{number\ of\ ratings}$$

Equation 2: Collaborative Filtering (Weighted Average rating)

While different people may have different baselines when giving ratings, some people tend to give high scores generally, some are pretty strict even though they are satisfied with items. To avoid this bias, we have subtracted each user's average rating of all items when computing weighted average, and add it back for target user, shown as above in equation 2.

To calculate the similarity, we can use Pearson's Correlation or Cosine Similarity. Since Pearson's Correlation works better with large data set and our data set is small for now, we have used Cosine Similarity to find Similarities between users.

$$Cosine\ Similarity: Sim(u_i, u_k) = \frac{r_i \cdot r_k}{|r_i||r_k|} = \frac{\sum_{j=1}^{m} r_{ij} r_{kj}}{\sqrt{\sum_{j=1}^{m} r_{ij}^2 \sum_{j=1}^{m} r_{kj}^2}}$$

Equation 3: Cosine Similarity

To handle sparsity issues in the dataset, we have created temporary predicted rating. In this, wherever user has not rated an item, we have assigned weighted mean average rating of that item in the place. We have user temporary predicted ratings whenever we encounter an item not rated. This helps to handle the issue of calculating similarity between users.

We are also using Apriori Algorithm to recommend user to buy a product based on what products they have bought previously. We are using products bought together dataset to determine the frequent items set and their support. For our system we have determined length of frequent items set as 2 and support value as minimum 4.

B) Payment gateway Services

We are using 3rd party payment gateway. This service is in developer mode in our prototype system.

C) Authentication Services

This service is using JWT security for authentication. JSON Web Token (JWT) is an open standard (RFC 7519) that defines a compact and self-contained way for securely transmitting information between parties as a JSON object. For the Reactjs JWT Authentication, we used Backend Service (using Nodejs Express) provides secured RestAPIs with JWT token. – Reactjs project will request RestAPIs from Backend system with the JWT Token Authentication implementation.

1. **User Registration Phase**: – User uses a React.js register form to post user's info (name, username, email, role, password) to Backend API /api/auth/signup. – Backend will check the existing users in database and save user's signup info to database. Finally, It will return a message (successfully or fail) to
2. **User Login Phase**: – User posts user/password to signin to Backend RestAPI /api/auth/signin. – Backend will check the username/password, if it is right, Backend will create and JWT string with secret then return it to Reactjs client.

After signin, user can request secured resources from backend server by adding the JWT token in Authorization Header. For each request, backend will check the JWT signature and then returns back the resources based on user's registered authorities.

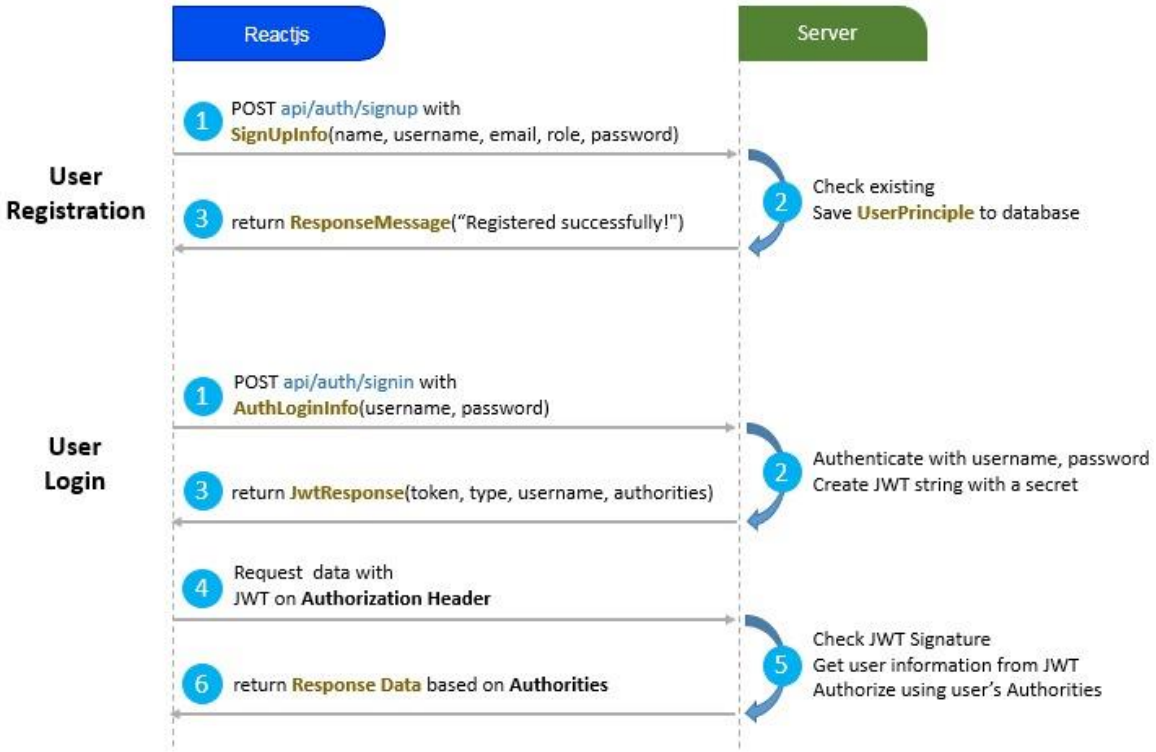

Fig: Sequence Diagram for JWT Authentication

Reactjs JWT Authentication would be built with 5 main kind blocks:

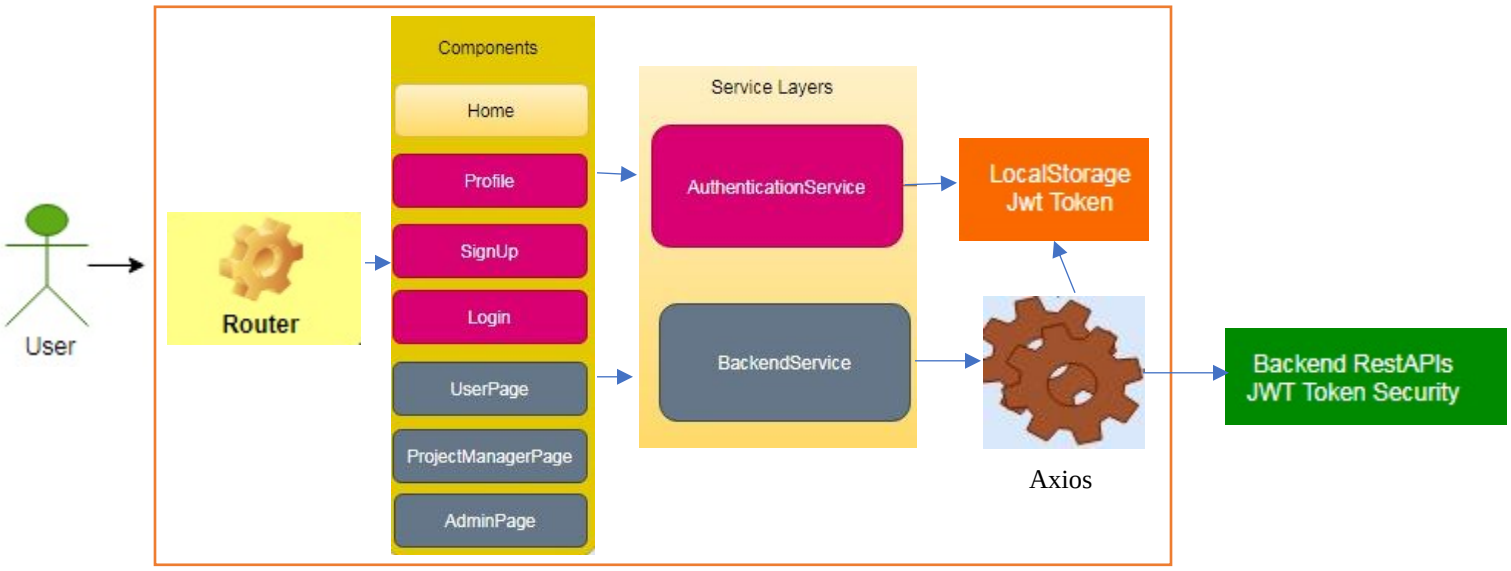

Fig: ReactJS JWT Token Application

- **Reactjs Router** is a standard library for routing in React. It enables the navigation among views of various components in a React Application, allows changing the browser URL, and keeps the UI in sync with the URL.
- **Reactjs Components** split the UI into independent, reusable pieces, and think about each piece in isolation.
- **Reactjs Service** is a bridge between Reactjs Component and Backend Server, it is used to do technical logic with Backend Server (using Ajax Engine to fetch data from Backend, or using Local Storage to save user login data) and returned a response data to React.js Components
- **Local Storage** allow to save key/value pairs in a web browser. It is a place to save the login user's info.
- **Axios** – (an Ajax Engine) is a promise-based HTTP client for the browser and Node. js. Axios makes it easy to send asynchronous HTTP requests to REST endpoints and perform CRUD operations.

D) Business Analysis Services

Business Forecasting Service is using time series analysis and auto regression forecasting. We are extracting data of profits earned & date of Clients, no of goods sold & date of Clients and weighted mean average of rating of sold items & date. With these data, we are first smoothing the data (removing noise) in period of 4. Then we are applying chain of functions of **Moving Average** and **Linear Weighted Moving Average** with period 5 and period 2 respectively. Then after analyzing the data using sliding regression forecasting we find which forecasting is optimal **Auto Regression using Least Square Method** or **Auto Regression using Max Entropy**. We also find the sample size and degree for forecasting.

$$SMA = \frac{A_1 + A_2 + \ldots + A_n}{n}$$

Equation: Simple Moving Average

$$\mathrm{LWMA} = \frac{(P_n * W_1) + (P_{n-1} * W_2) + (P_{n-2} * W_3) \ldots}{\sum W}$$

Equation: Linear Weighted Moving Average

Also we can use cost benefit analysis to predict if the current business need to expand or not.

$$\text{Net Present Value (NPV)} = \sum \text{Present Value of Future Benefits} - \sum \text{Present Value of Future Costs}$$

$$\text{Benefit-Cost Ratio} = \frac{\sum \text{Present Value of Future Benefits}}{\sum \text{Present Value of Future Costs}}$$

Equation: Cost Benefit Analysis

E) Shipping Management Service

As all e-commerce platform, there should be shipping service available. In our case we are using geo-location API service to exactly pin point longitude and latitude of the consumer. This helps to reduce all kinds of error for the location for the consumer. We also have a variable product weight to determine the weight of the order placed. The 3rd party courier service then can be appointed to make the delivery.

Furthermore, for client(seller) has option to accept or reject any order made for product. The orders page in client helps client to track the orders that are not completed and helps focus on that.

3.3Proposed System Model

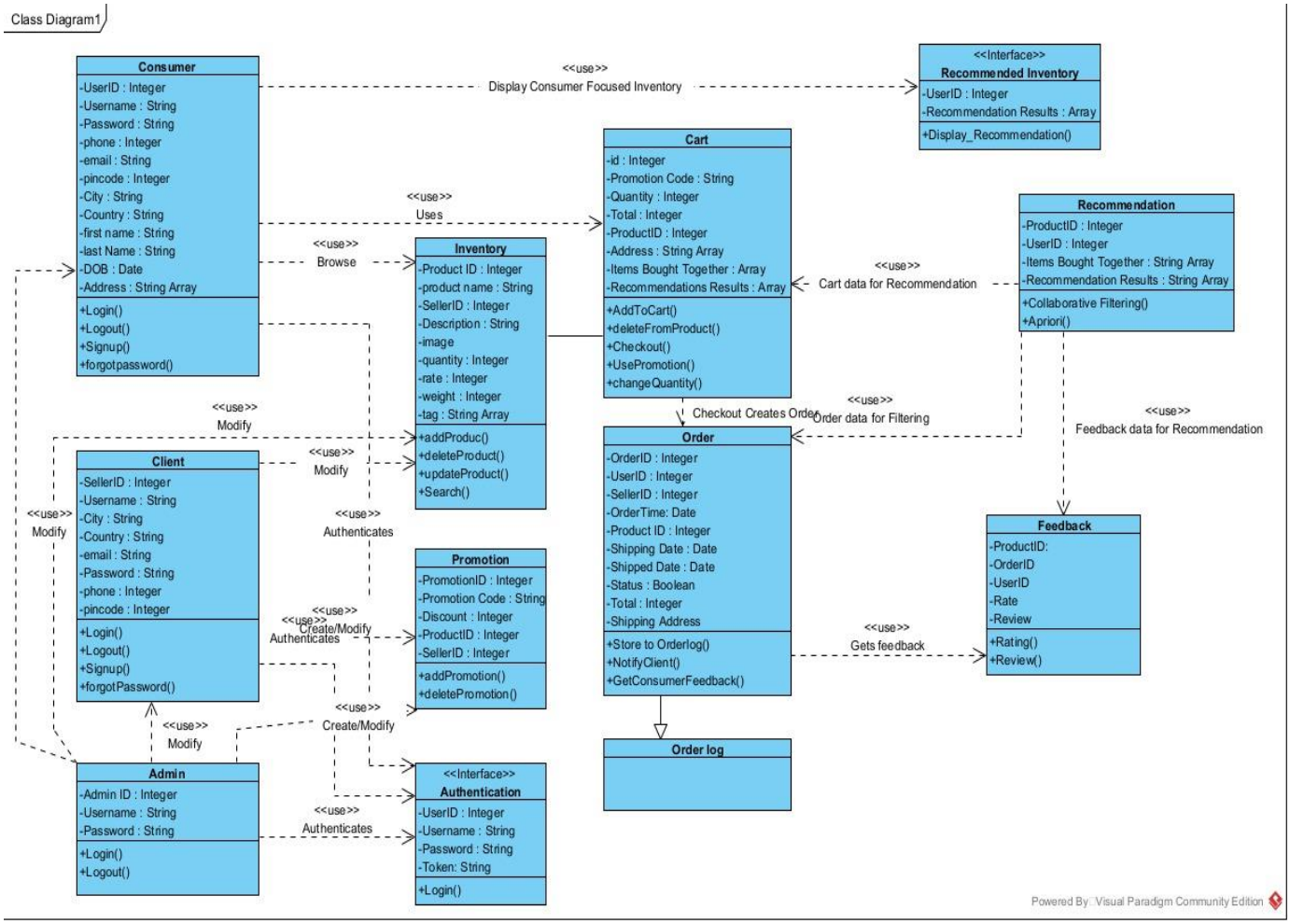

Fig: UML diagram

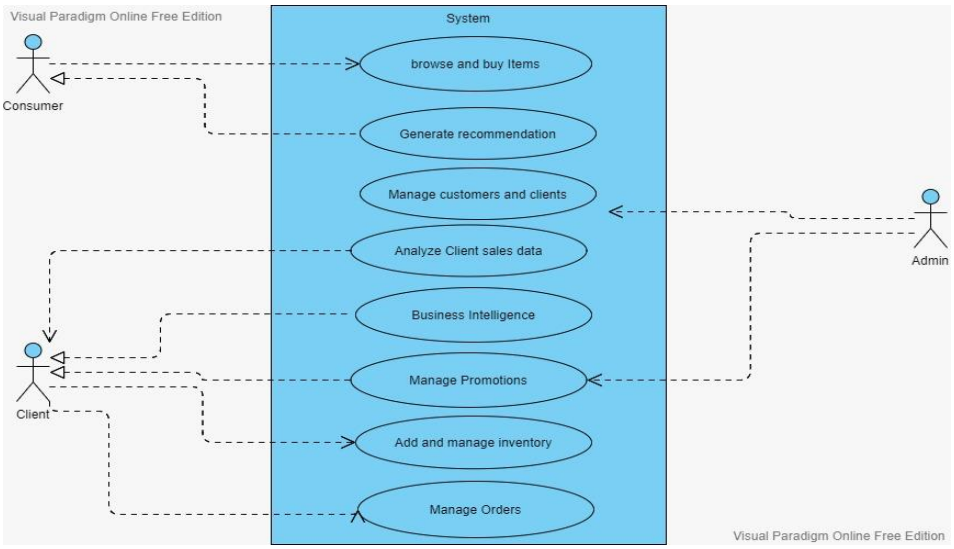

Fig: Usecase Diagram

4Proposed System Analysis and Design

4.1Introduction

When it comes to websites targeting buyers and sellers, it is very important to think of a sustainable platform with easy and secure access to services. Our application focus on core functional requirements and non-functional requirements for a basic e-commerce platform

4.2Requirement Analysis

4.2.1Functional Requirements

The major functional requirements for the applications are:

1. *Minimum steps to make a purchase for consumers*: Making sure that the checkout process is as quick as possible
2. *Mobile-friendliness*: A responsive web application suitable for both small screens and big screens.
3. Unique, recognizable design: The application has a theme of its own but still has to use common recognizable symbols for ease use.
4. *Rating and Feedbacks*: The application has rating and feedback system for each orders it has done.
5. *Product Recommendation*: The application recommends the products based on user's history activities.

6. *Business Forecasting*: The application can predict the sales for the upcoming month.
7. *Enhanced Shopping Cart*: Shopping cart properly describes transaction: discount amount, VAT amount, total, number of quantity, product details added, option to remove them, etc

4.2.2Non-functional Requirements

1. *Scalability*: The application ensures that the system can scale to meet traffic and order volume at normal and peak times
2. *Security*: The application provides JWT authentication security for the users.
3. *Accessibility*: The accessibilities of the services are well defined in the application.
4. *Extensibility*: The application is built in such a way that it is feasible to make future developments.
5. *Data integrity and retention*: Data from the application is stored forever, and integrity of data stored is maintained by using a unique key to distinguish each piece of data.

5Result and Discussion

5.1Recommendation System:

5.1.1User based Collaborative Filtering

From the product database we formulated a nxm matrix of all users and product. Then we applied PCA dimension reduction. Then we found similarity for all user with each other's rating values. This gave the predicted rating valued for non-rated items. After sorting then for each user, we recommend that product to the user.

[{"productId":5,"productName":"product5","image":"img1.jpg","desp":"description of product","price":300,"sellerName":"seller1","sellerId":"1","sellerContact":"9841023456","stock":100,"rating":5,"reviews":[{"reviewid":1,"userid":6,"username":"user","userimg":"img1.jpg","rating":3,"reviewDesp":"something something","reviewDate":"11/12/2021"},
{"reviewid":2,"userid":5,"username":"user2","userimg":"img1.jpg","rating":4,"reviewDesp":"something something","reviewDate":"11/12/2021"},
{"reviewid":3,"userid":3,"username":"user2","userimg":"img1.jpg","rating":5,"reviewDesp":"something something","reviewDate":"11/12/2021"}],"offers":[{"offerid":1,"offerDetails":"discount on this product now","expDate":"11/12/2025"},{"offerid":2,"offerDetails":"this service available","expDate":"11/12/2025"}]},
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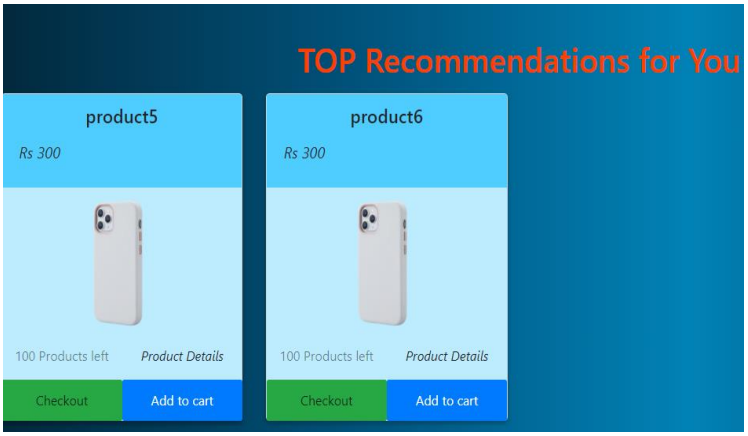

5.1.2Aprior Algorithm

We are using aprior algorithm to calculate the items user might buy based on user's own history of orders. Here we are maintaining a set of orders being bought together. From this we find frequent item dataset and their support value. We have put a threshold value for support as 4.

Any frequent item set with support greater than 3, we are using them to find if user has bought any of the item from the set. If has bought then, we recommend other items in the set


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[{"productId":2,"productName":"product2","image":"img1.jpg","desp":"description of
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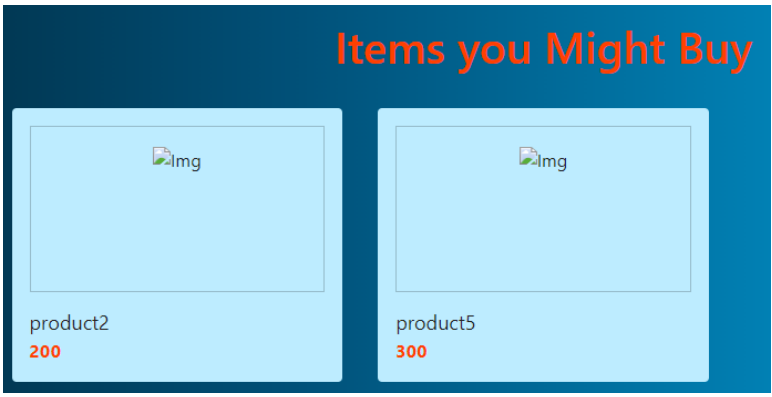
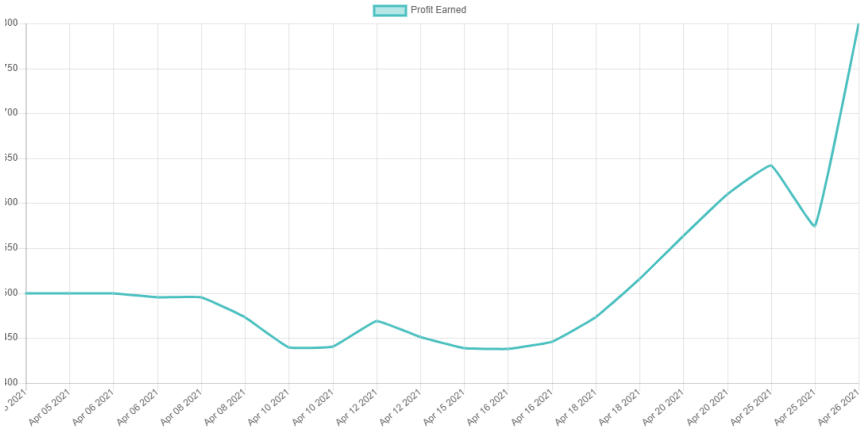
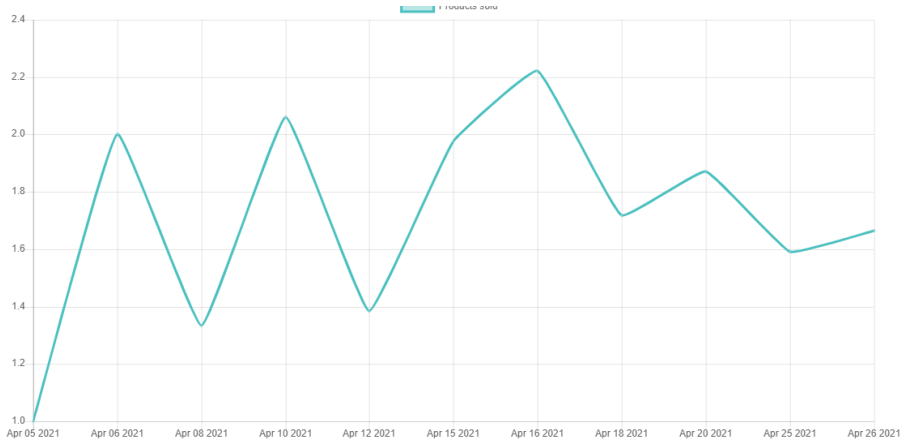


5.2Time Series Analysis

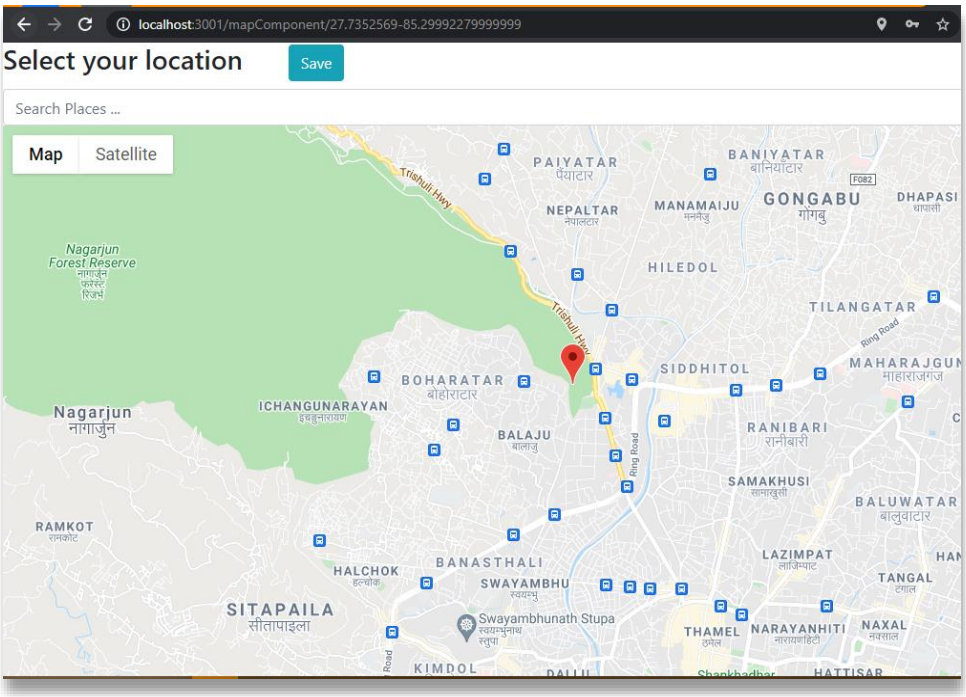
5.2.1Time series Analysis of Profit



5.2.2Time series Analysis of Goods sold



5.3Google Maps API used for Shipping



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