

Track My Shop - A shops, products and services tracking system near specified location



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Session 2019 - 2023

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Assistant Professor

BS(HONS)
IN
COMPUTER SCIENCE

DEPARTMENT OF COMPUTER SCIENCE
GC UNIVERSITY LAHORE

Track My Shop

**Submitted to GC University Lahore in partial fulfillment
of the requirements for the award of degree of**

BS(HONS)

IN

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Declaration

I, Muhammad Zeeshan Yousaf and Fatima Yousaf students of **BS(Hons)** in the subject of **Computer Science** session **2019-2023**, hereby declare that the matter printed in this thesis titled, **Track My Shop** is my own work and has not been printed, published and submitted as research work, thesis or publication in any form in any University, Research Institution etc in Pakistan or abroad.

Date: _____

Signatures of Deponent

Research Completion Certificate

It is certified that the research work contained in this thesis titled **Track My Shop** has been carried out by **Muhammad Zeeshan Yousaf** Roll. No **0259-BSCS-19** and **Fatima Yousaf** Roll. No **0279-r-BSCS-19** under my supervision.

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Dedication

My research work is dedicated to my family and my honorable teacher prof Dr. Muhammad Waqas Anwar who encouraged and helped me to complete my research in the area of formal modeling and formal verification related to computer science.

Abstract

The "Track my Shop" project aims to address a significant issue prevalent in the digital era, where small businesses such as service providers, mini stores, and repair shops struggle to establish an online presence due to cost constraints. In response to this, we propose the development of a Web Application Software that acts as a centralized platform for local businesses to connect with their local customer base. By leveraging this application, shopkeepers can extend their reach and increase their earnings by reaching more customers online. Customers, in turn, can easily access and purchase products or avail services from nearby local shops within their specified geographical proximity. The project integrates an image recognition service, allowing sellers to effortlessly add products or services by simply uploading images. On the customer side, this service facilitates image-based search, enhancing the user experience and streamlining the purchasing process.

Contents

Declaration	i
Research Completion Certificate	ii
Acknowledgements	iii
Dedication	iv
Abstract	v
Contents	vi
List of Tables	x
List of Figures	xi
1 Introduction	1
1.1 Introduction	1
1.2 Project Overview	2
1.3 Problem Statement	2
1.4 Study Limitations	3
1.5 Literature Review	3
2 Requirement Specification	5
2.1 Functional Requirements	5
2.1.1 Affordable Online Presence:	5
2.1.2 Streamlined Product/Service Integration:	5
2.1.3 Enhanced Customer-Shop Connectivity:	6
2.1.4 Geolocation Features:	6
2.1.5 Delivery Request Mechanism:	6
2.1.6 Navigation Assistance:	6
2.1.7 User Experience Optimization:	6

2.1.8	Search History Recording:	7
2.1.9	Comprehensive Search Results:	7
2.1.10	Flexible Result Filtering:	7
2.1.11	Delivery Requests for Products:	7
2.1.12	Navigation to Shops:	7
2.1.13	Category-Based Exploration:	7
2.2	Non-functional Requirements	8
2.2.0.1	Performance	8
2.2.0.2	User Interface (UI) and User Experience (UX)	8
2.2.0.3	Compatibility	8
2.2.0.4	Scalability	8
2.2.0.5	Accessibility	9
2.2.0.6	Image Storage	9
2.2.0.7	Database Management	9
2.2.0.8	Response Time	9
2.2.0.9	Reliability	9
3	Project Design	10
3.1	Methodology	10
3.1.1	Initial Planning	11
3.1.2	Planning	11
3.1.3	Requirements Analysis and Design	11
3.1.4	Implementation and Development	12
3.1.5	Testing	12
3.1.6	Evaluation	12
3.1.7	Summary	12
3.2	Architecture Overview	13
3.2.1	Entity Relationship Diagram (ERD)	13
3.3	Design Description	13
3.2.2	Class Diagram (UML)	14
4	Implementation and Evaluation	15
4.1	Development Stages	15
4.1.1	Strategy Stage	15
4.2	Implementation	15
4.2.1	Tools and Technologies	16
4.3	System Integration	17
4.4	User Interface	17
4.4.1	Login	18
4.4.2	Register	18
4.4.3	Forgot Password	19
4.4.4	Profile	19
4.4.5	Profile Edit	20
4.4.6	Seller Dashboard	20

4.4.7	Seller Shops	21
4.4.8	Seller Shop Create	21
4.4.9	Seller Add Product	22
4.4.10	Seller Add Service	22
4.4.11	Seller Products and Services Listing	23
4.4.12	Customer Home	23
4.4.13	Customer Searching Around	24
4.4.14	Customer Requesting Order	24
4.4.15	Customer Order Requests History	25
4.4.16	Customer Favorites	25
4.4.17	Dark Mode	26
4.5	Hardware Interface	26
4.5.1	Hardware Requirements	26
4.6	Evaluation	27
4.7	Unit Testing	27
4.7.1	Frontend Components	28
4.7.2	Backend API Endpoints	28
4.7.3	Database Interactions	28
4.7.4	Integration Testing	28
4.7.5	Error Handling and Edge Cases	28
4.8	Test Cases	29
4.8.1	Frontend Components	29
4.8.1.1	Test Case 1: User Registration Form Validation . .	29
4.8.1.2	Test Case 2: Product/Service Image Uploading & Recognition	30
4.8.1.3	Test Case 3: Product/Service Component Rendering	31
4.8.1.4	Test Case 4: Order Request with Message	31
4.8.1.5	Test Case 5: Search Box Functionality	32
4.8.2	Backend API Endpoints	32
4.8.2.1	Test Case 6: Response of Product Listing Endpoint	32
4.8.2.2	Test Case 7: Error Handling of Invalid Request .	33
4.8.3	Database Interactions	33
4.8.3.1	Test Case 8: Product Data Retrieval	33
4.8.3.2	Test Case 9: Adding New Product	34
4.8.4	Integration Testing	34
4.8.4.1	Test Case 10: Integration of User Authentication .	34
4.8.4.2	Test Case 11: Integration of Product Listing . .	35
4.8.5	Error Handling and Edge Cases	35
4.8.5.1	Test Case 12: Invalid User Authentication	35
4.8.5.2	Test Case 13: Product Listing Empty	36
4.8.5.3	Test Case 14: Invalid Product Addition	36
4.9	Functional Testing	37
4.9.1	User Authentication and Authorization	37
4.9.2	Product and Service Listings	37

4.9.3	Order Placement and Management	37
4.9.4	Location-Based Features	37
4.9.5	Search and Filtering	38
4.9.6	Error Handling	38
4.9.7	UI/UX Testing	38
4.9.8	Testing Requirements	38
4.9.8.1	User Authentication:	38
4.9.8.2	Product and Service Listings:	39
4.9.8.3	Orders Management:	39
4.9.8.4	Location-Based Features:	39
4.9.8.5	Search and Filtering:	40
4.9.8.6	Error Handling:	40
4.9.8.7	UI/UX Testing:	40
5	Conclusion & Future Work	41
5.1	Conclusion	41
5.2	Future Work	42
5.2.1	Enhanced User Experience:	42
5.2.2	Machine Learning Integration:	42
5.2.3	Facial Recognition	42
5.2.4	Personalized Recommendations:	42
5.2.5	Integration of Payment Gateways:	43
5.2.6	Multi-Language Support:	43
5.2.7	Real-Time Chat and Customer Support:	43
5.2.8	Inventory Management System:	43
5.2.9	Social Media Integration:	43
5.2.10	Third Party Integration for Sign-in:	44
5.2.11	Integration with Other E-commerce Platforms:	44
5.2.12	Customer Analytics Dashboard:	44
5.2.13	Mobile Application Development:	44
5.2.14	Offline Access and Progressive Web App (PWA):	44
5.2.15	Import data from Business Websites:	45
5.2.16	Integration with Local Services:	45
Bibliography		46

List of Tables

4.1	User Registration Form Validation (TC1)	29
4.2	Product Image Uploading (TC2)	30
4.3	Unit Test for Rendering Product/Service Display Component (TC3)	31
4.4	Order Request with Message (TC4)	31
4.5	Search Bar Functionality (TC5)	32
4.6	Test Case for Response of Product Listing Endpoint (TC6)	32
4.7	Test Case for Error Handling of Invalid Request (TC7)	33
4.8	Product Data Retrieval (TC8)	33
4.9	Adding New Product (TC9)	34
4.10	Integration of User Authentication (TC10)	34
4.11	Integration of Product Listing (TC11)	35
4.12	Invalid User Authentication (TC12)	35
4.13	Product Listing Empty (TC13)	36
4.14	Invalid Product Addition (TC14)	36

List of Figures

3.1	Iterative Process Model	10
3.2	Track My Shop - Entity Relationship Diagram	13
3.3	Track My Shop - Class Diagram	14
4.1	Shop Trackee - Login	18
4.2	Shop Trackee - Register	18
4.3	Shop Trackee - Forgot Password	19
4.4	Shop Trackee - Profile	19
4.5	Shop Trackee - Profile Edit	20
4.6	Shop Trackee - Seller Dashboard	20
4.7	Shop Trackee - Seller Shops	21
4.8	Shop Trackee - Shop Create	21
4.9	Shop Trackee - Add Product	22
4.10	Shop Trackee - Add Service	22
4.11	Shop Trackee - Products and Services Listing	23
4.12	Shop Trackee - Customer Home	23
4.13	Shop Trackee - Customer Searching Around	24
4.14	Shop Trackee - Customer Requesting Order	24
4.15	Shop Trackee - Customer Order Requests History	25
4.16	Shop Trackee - Customer Favorites	25
4.17	Shop Trackee - Dark Mode	26

Chapter 1

Introduction

1.1 Introduction

In an era characterized by rapid technological advancements, businesses are constantly seeking efficient, automated, and precise solutions to streamline their operations. This paradigm shift has led to the creation of numerous software programs tailored to meet the diverse needs of different industries, facilities, and various workplaces. Historically, manual methods were employed for data management, but evolving preferences have spurred a transition to digital solutions. Recognizing the digital divide prevalent among small businesses, particularly those serving local communities, this project, "Track My Shop," endeavors to empower these enterprises and enable their seamless integration into the online marketplace.

In today's digital landscape, the majority of businesses across sectors have embraced online platforms to market and sell their products and services, swiftly reaching customers through home deliveries. However, smaller businesses such as service providers, mini stores, repair shops, and local vendors, including cobblers, barbers, milk shops, bakeries, and spare parts shops, often find it financially challenging to establish an online presence. The "Track My Shop" web application sets out to address this disparity by providing local shops a centralized online platform

to connect with their local customer base. Through this application, shopkeepers can significantly broaden their customer reach, attract a larger audience, and consequently, enhance their earnings with minimal effort of input.

The project envisions simplifying and modernizing operations for local businesses by integrating innovative features such as image recognition for effortless addition of products services, and image-based search capabilities for customers.

1.2 Project Overview

The proposed system, "Track My Shop," is a web-based application designed to facilitate the seamless creation of online shops for sellers. Utilizing image recognition technology, sellers can effortlessly add products or services to their online shop by capturing or uploading images. The system automatically identifies and categorizes the items, making them readily accessible to customers in the vicinity of the shop. Conversely, customers can easily browse and search for products or services using images, names, or proximity filters. They can initiate requests for product delivery or obtain directions to the seller's physical shop, enhancing their overall shopping experience.

1.3 Problem Statement

In the contemporary business landscape, small enterprises encounter a significant barrier in establishing an online platform for their operations due to prohibitive costs associated with web development and maintenance. The high financial investment required often restricts their ability to tap into the potential of the digital marketplace, limiting their growth and outreach.

Furthermore, the traditional method of manually inputting products and services into an online platform has become increasingly burdensome and time-consuming. This arduous process not only consumes valuable time but also poses a hindrance

to the efficient management and scaling of businesses, leading to decreased productivity and suboptimal user experiences.

In addition, both customers and local shops face challenges in connecting efficiently. The conventional approach of physically visiting or relying on word-of-mouth recommendations to discover shops or services is cumbersome and time-intensive. This lack of a seamless and convenient means to connect customers with local shops impedes the potential for increased business transactions and growth for these small enterprises. Therefore, an effective solution is imperative to address these pressing issues and bridge the existing gap between small businesses and their online presence while enhancing accessibility and connectivity for both customers and shops.

1.4 Study Limitations

The primary challenges that impeded the advancement of this project were time and financial constraints. The project involved various financial obligations, including expenses for software development, server deployment, image recognition technology, and geolocation features. Additionally, managing fieldwork, development tasks, and adhering to project timelines was demanding. Despite these constraints, we remained committed to ensuring the accuracy and effectiveness of the web application, striving to meet the expectations and needs of both sellers and customers.

1.5 Literature Review

"Track My Shop" embodies the essence of modern business augmentation through technology. In an era where online presence is paramount, this web application offers a cost-effective solution for small and local businesses to establish their digital footprint. By seamlessly integrating products and services using image

recognition and geolocation features, the application enhances accessibility and connectivity between customers and local shops. It paves the way for an intuitive and efficient shopping experience, bridging the gap between traditional brick-and-mortar stores and the vast digital market. The project encapsulates the vision of empowering businesses and customers alike, promoting growth, efficiency, and a seamless convergence of technology and commerce.

Chapter 2

Requirement Specification

2.1 Functional Requirements

Function and features that derives to the end user of the system are following:

2.1.1 Affordable Online Presence:

Develop a cost-effective solution that enables small businesses to establish and maintain an online platform for their products and services without incurring prohibitive expenses, democratizing access to the digital marketplace.

2.1.2 Streamlined Product/Service Integration:

Create an automated system leveraging image recognition technology to simplify and expedite the process of adding products and services to the online platform, reducing manual effort and improving efficiency for business owners.

2.1.3 Enhanced Customer-Shop Connectivity:

Facilitate easy and efficient connection between customers and local shops by providing a user-friendly interface that allows customers to search for products or services based on images, names, or location, thereby fostering a seamless shopping experience.

2.1.4 Geolocation Features:

Implement geolocation features to enable customers to explore nearby shops and their offerings, aiding in quicker decision-making and fostering a stronger connection between customers and local businesses.

2.1.5 Delivery Request Mechanism:

Integrate a system that allows customers to request product delivery from the respective sellers, promoting convenience and encouraging increased sales for the shops while enhancing customer satisfaction.

2.1.6 Navigation Assistance:

Provide navigation features that guide customers to the physical locations of shops, improving accessibility and encouraging more foot traffic to the local businesses, ultimately boosting their visibility and sales.

2.1.7 User Experience Optimization:

Prioritize an intuitive and appealing user interface and experience to ensure that both sellers and customers find the application easy to use and navigate, enhancing overall satisfaction and encouraging continued usage.

2.1.8 Search History Recording:

Record customer searches to provide a history for their convenience and future reference.

2.1.9 Comprehensive Search Results:

Ensure that search results include a wide array of products, services, and corresponding shops for a complete view of available offerings.

2.1.10 Flexible Result Filtering:

Allow customers to filter search results based on various criteria such as price, ratings, shop proximity, or categories, enabling a personalized and efficient shopping experience.

2.1.11 Delivery Requests for Products:

Implement a mechanism for customers to request product delivery, promoting convenience and seamless transactions.

2.1.12 Navigation to Shops:

Enable customers to obtain directions to the physical shops offering the desired product or service, facilitating a smooth transition from online exploration to in-person shopping.

2.1.13 Category-Based Exploration:

Provide an option for customers to explore products and services based on categories, allowing for effortless browsing without initiating a specific search.

2.2 Non-functional Requirements

Here are the non-functional requirements:

2.2.0.1 Performance

- The web application must have rapid response times and load efficiently.
- API calls for data fetching and processing should complete within milliseconds for a seamless user experience.
- The application should maintain high performance even during peak usage.

2.2.0.2 User Interface (UI) and User Experience (UX)

- The UI should be intuitive, aesthetically pleasing, and utilize vibrant colors with smooth animations.
- The design should be consistent and compatible across various screen sizes and devices.
- User interactions and transitions within the application should be smooth and visually appealing.

2.2.0.3 Compatibility

- The web application must be compatible with a wide range of browsers, ensuring consistent functionality and appearance across different platforms.

2.2.0.4 Scalability

- The architecture should allow for seamless scaling to accommodate a growing user base and increased data load.
- The application should be capable of handling increased traffic without compromising performance.

2.2.0.5 Accessibility

- The application should adhere to accessibility standards to ensure usability for individuals with disabilities.
- Content and features should be easily navigable and understandable for users with basic English skills.

2.2.0.6 Image Storage

- Images should be stored securely in AWS S3 buckets, ensuring data integrity and accessibility.
- The image storage system should handle image uploads, retrievals, and deletions in an efficient and organized manner.

2.2.0.7 Database Management

- The database should be maintained automatically, including regular password changes for enhanced security.
- Database operations should be optimized to ensure data retrieval and modification are swift and efficient.

2.2.0.8 Response Time

- The web application should have minimal loading time, providing near-instantaneous responses to user actions.

2.2.0.9 Reliability

- The application should operate consistently without frequent crashes or downtimes, ensuring a reliable user experience by instantly report and monitor any bugs or errors, enhancing application reliability.

Chapter 3

Project Design

3.1 Methodology

The methodology adopted for designing the "Track My Shop" web application is an iterative process. The methodology encompasses various stages from project initiation to implementation, ensuring an organized and systematic approach as each stage is mentioned below:

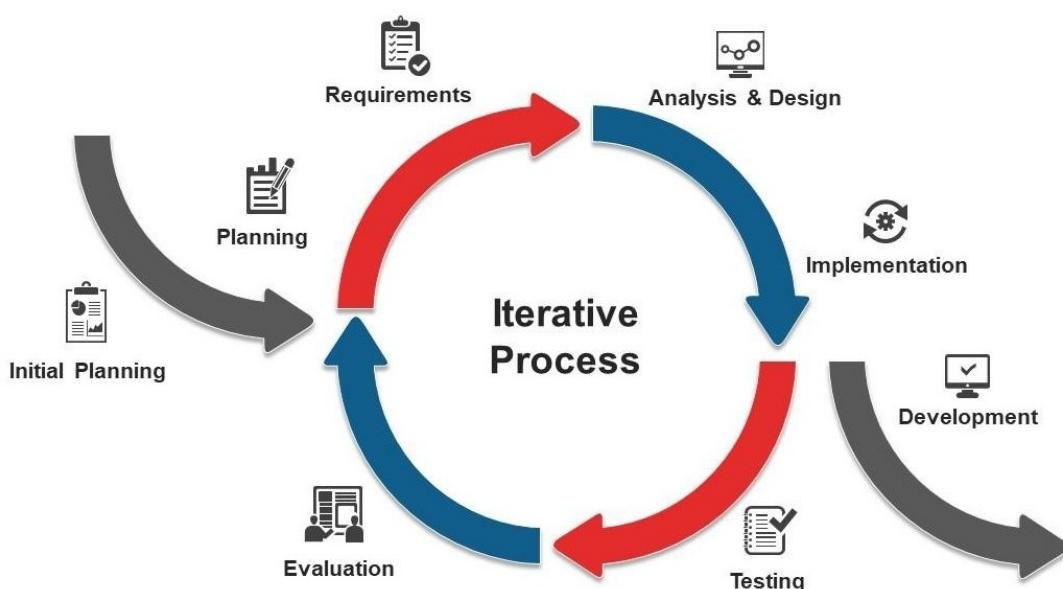


FIGURE 3.1: Iterative Process Model

3.1.1 Initial Planning

In this initial planning stage, the project goals and initial requirements are outlined. Key activities include:

Defining Project Goals: Setting the overall goals and vision for the "Track My Shop" application.

Preliminary Requirement Analysis: Performing an initial analysis of high-level requirements and constraints.

3.1.2 Planning

The planning stage involves planning the upcoming iteration and setting specific goals for it. Key activities include:

Setting Iteration Goals: Defining the objectives and outcomes for the current iteration.

Identifying Resources: Allocating the necessary resources, including manpower, technology, and tools, for the iteration.

3.1.3 Requirements Analysis and Design

In this stage, detailed requirements are gathered and analyzed, and the system's design is conceptualized. Key activities include:

Requirements Refinement: Analyzing and refining requirements based on feedback from previous iterations and stakeholders.

System Design: Conceptualizing the system's design and architecture based on the refined requirements.

3.1.4 Implementation and Development

The implementation stage involves writing code and developing the iteration. Key activities include:

Coding and Development: Writing the code based on the design and architecture defined in the previous stage.

Integration: Integrating the developed components and modules into a cohesive iteration.

3.1.5 Testing

The testing stage involves validating the functionality and performance of the developed iteration. Key activities include:

Functional Testing: Ensuring that the iteration meets the specified functional requirements.

User Acceptance Testing (UAT): Engaging users to validate the iteration against their expectations and requirements.

3.1.6 Evaluation

The evaluation stage involves assessing the outcomes of the iteration. Key activities include:

Evaluation of Goals: Evaluating whether the iteration goals were achieved and identifying areas for improvement.

3.1.7 Summary

The iterative process model is adopted in the development of the "Track My Shop" application, allowing for incremental development, feedback incorporation,

and continuous improvement. Each iteration adds new features, refines existing functionalities, and incorporates feedback for an improved and user-centric product.

3.2 Architecture Overview

3.2.1 Entity Relationship Diagram (ERD)

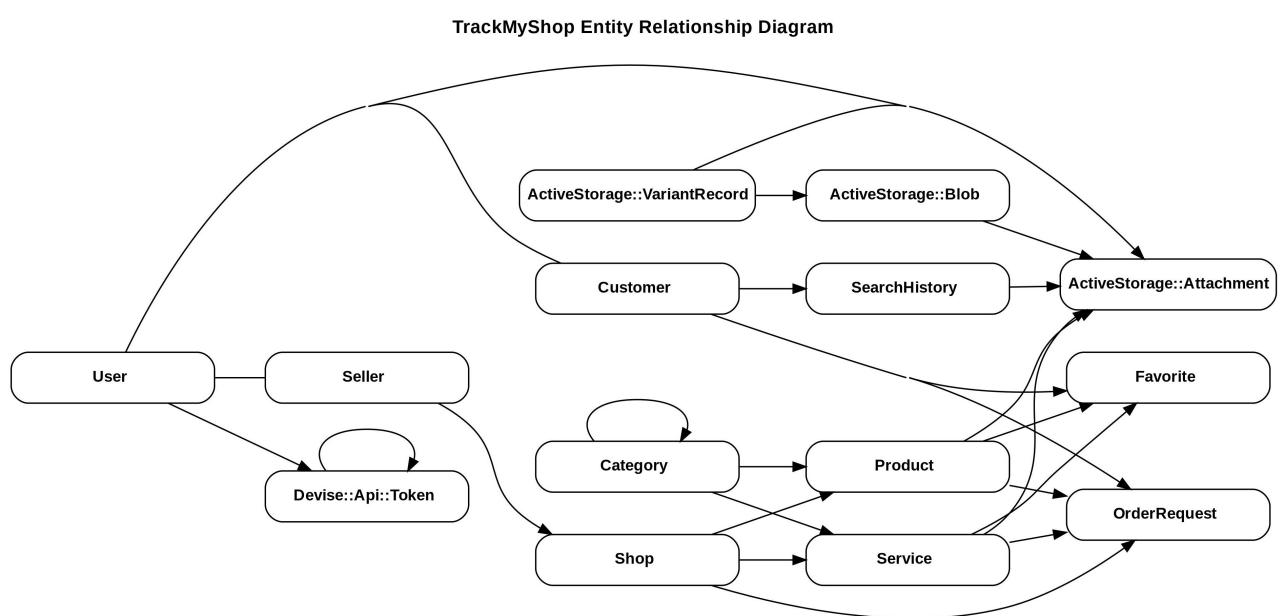


FIGURE 3.2: Track My Shop - Entity Relationship Diagram

3.3 Design Description

3.2.2 Class Diagram (UML)

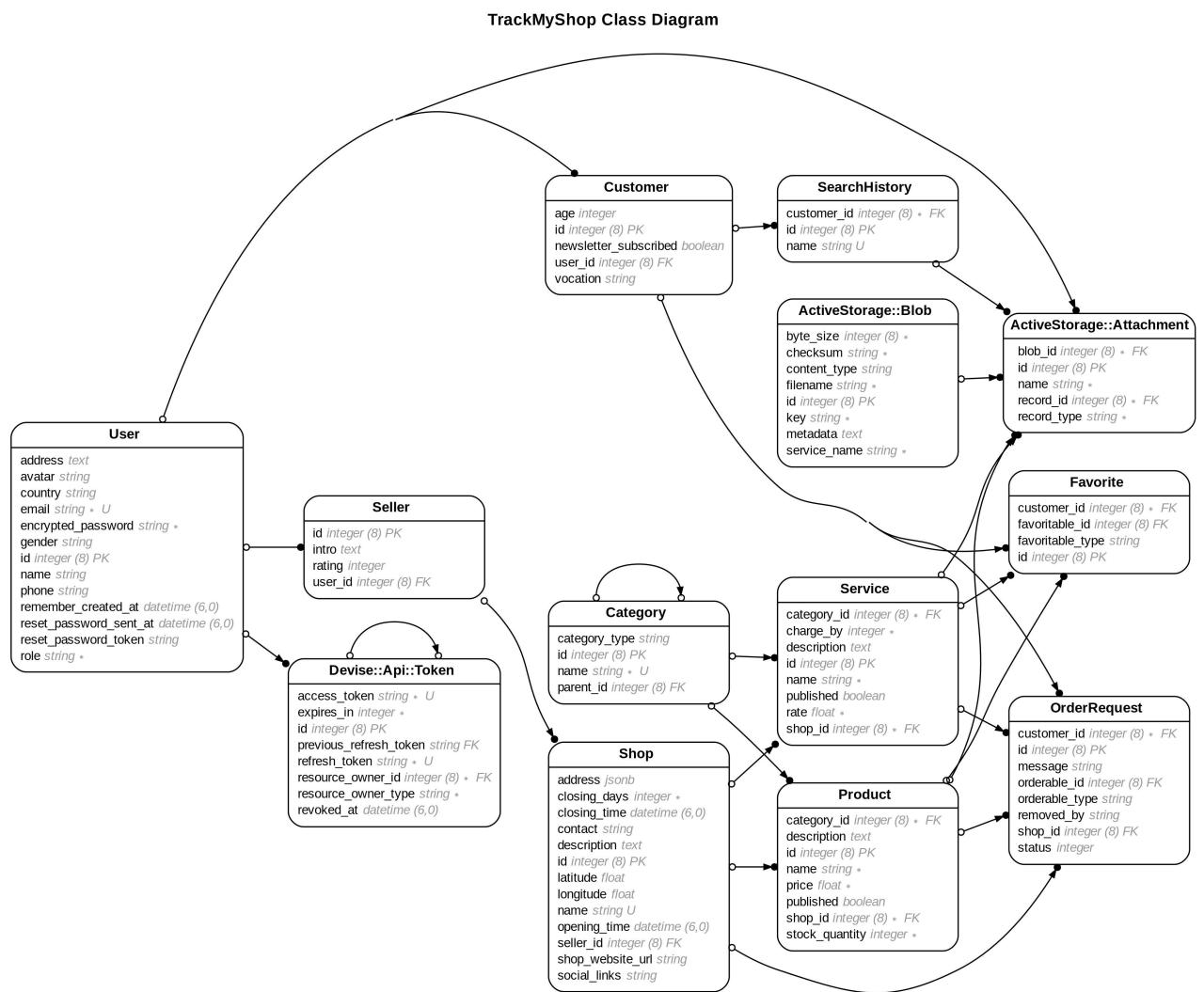


FIGURE 3.3: Track My Shop - Class Diagram

Chapter 4

Implementation and Evaluation

4.1 Development Stages

Following are the stages of development:

4.1.1 Strategy Stage

We designed our web application while keeping in mind the requirements of our end sellers and customers. In order to make it a success we planned each and everything beforehand. We have learned our users demand and then planned our project on it. We have designed it in such a way that it can be easy to use and handle. After jotting down our requirements we made diagrams so that it can give an outlook of our system. After this we worked on our database and later on its implementation. We also wrote the project code, then we integrated and tested our it to verify if its working.

4.2 Implementation

Following is described about the implementation level things:

4.2.1 Tools and Technologies

1. Server-Side API Framework **Ruby on Rails**
2. Front-End Frameworks:
 - **Next.js** (framework built on REACT Js library)
 - **Bootstrap5** (CSS framework)
 - **Google Material UI** (for interactive components)
 - **Google Maps API**
3. DBMS **PostgreSQL**
4. Version Control System (VCS): **Git, Github**
5. Integrated Development Environment (IDE): **RubyMine, VS Code**
6. API and Web testing tool: **Postman**
7. Data Caching server: **Redis**
8. Hosting Service for API: **Heroku**
9. Hosting Service for Front-End App: **Amazon Static Hosting S3**
10. CI — CD tool: **Github Actions**
11. Media Storage Service: **AWS S3**
12. Image Recognition Service: **AWS Rekognition**
13. Domain Name Service: **AWS Route53**
14. Domain Platform: **Namecheap.me**
15. Bug Report Service: **Sentry**
16. Mailer Service: **Mailjet**

4.3 System Integration

System integration in the "Track My Shop" project is a critical process where all the individual components and modules of the system are combined and tested to ensure they function as a unified, cohesive unit. This integration involves merging the backend functionalities, including database management and server operations, with the frontend user interface to create a seamless and functional application. The integration process also incorporates third-party services, such as image recognition, mapping APIs and Deployment on AWS/Heroku, ensuring their proper interaction within the application. Rigorous testing and validation are conducted to confirm that the integrated system operates smoothly, with data flowing seamlessly between various components.

Achieving a successful integration is vital for delivering a reliable, efficient, and feature-rich web application that can be run on any environment and on any web browser, meets the needs and expectations of both sellers and customers.

4.4 User Interface

The user interface (UI) of the "Track My Shop" project is crafted to deliver a seamless and engaging experience for both sellers and customers. Sellers are provided with a comprehensive dashboard offering insights into their shops, order requests, and sales statistics. They can efficiently manage their shop listings, adding new products/services and updating existing ones. On the other hand, customers are greeted with an intuitive interface that allows effortless browsing of nearby shops and their offerings, categorized for easy exploration. The search functionality is versatile, enabling customers to search by text, images, or based on their preferences. Clear product/service details, interactive maps for shop locations, easy order request processes, and a user-friendly profile management system further enhance the overall usability. The UI is designed to be accessible and responsive to various type of devices and user needs, ultimately fostering a positive and satisfying interaction for all users.

4.4.1 Login

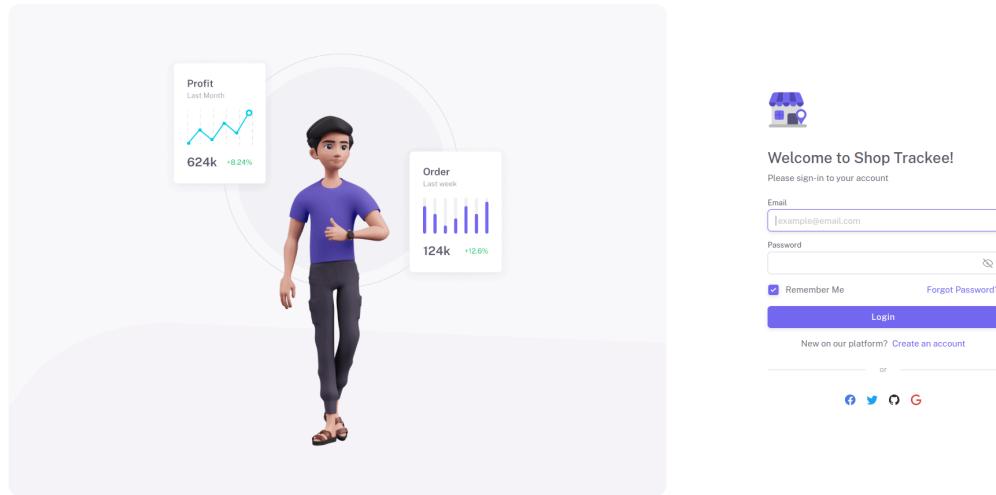


FIGURE 4.1: Shop Trackee - Login

4.4.2 Register

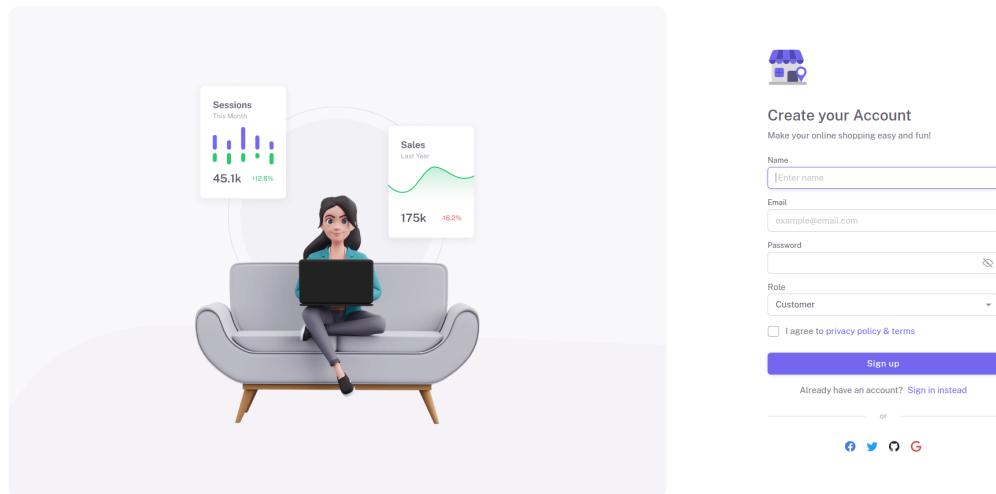


FIGURE 4.2: Shop Trackee - Register

4.4.3 Forgot Password

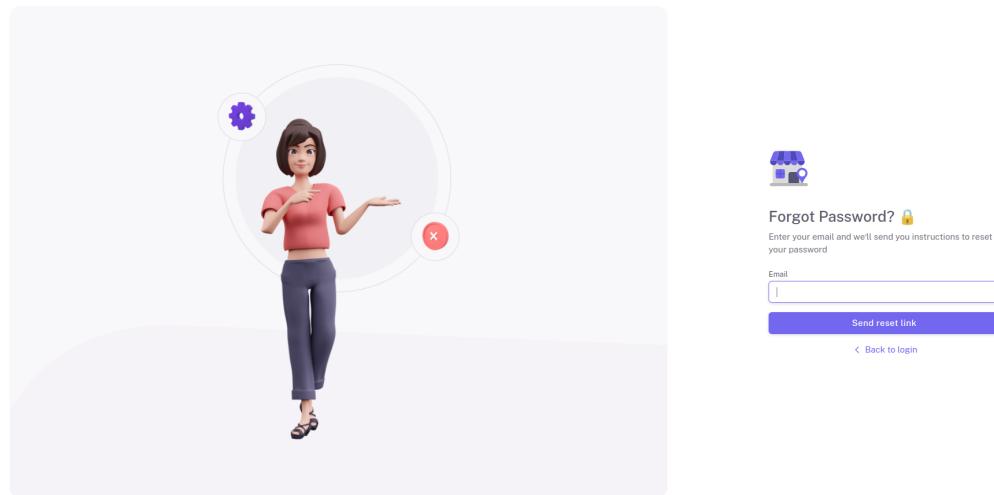


FIGURE 4.3: Shop Trackee - Forgot Password

4.4.4 Profile

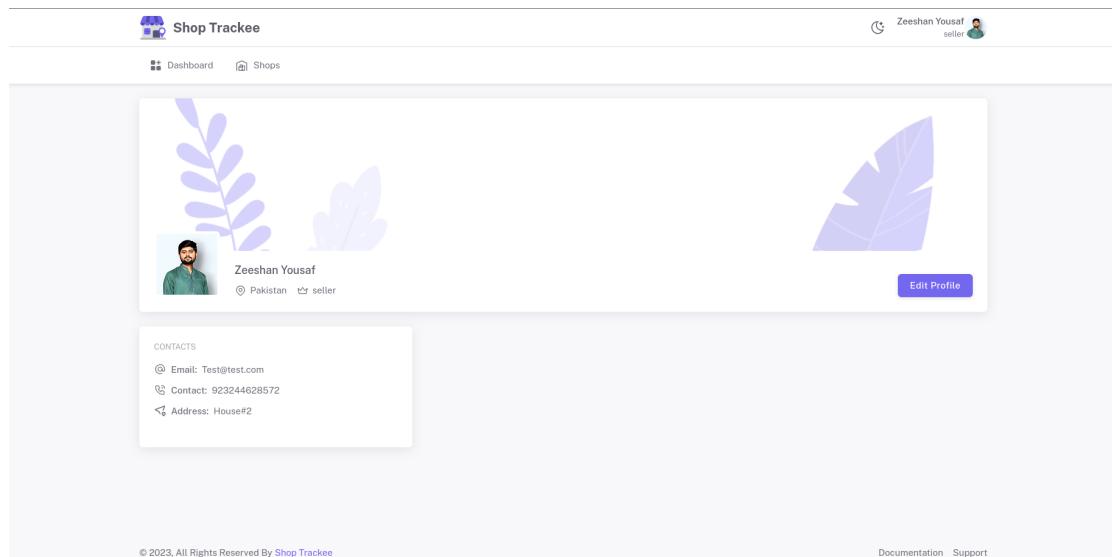


FIGURE 4.4: Shop Trackee - Profile

4.4.5 Profile Edit

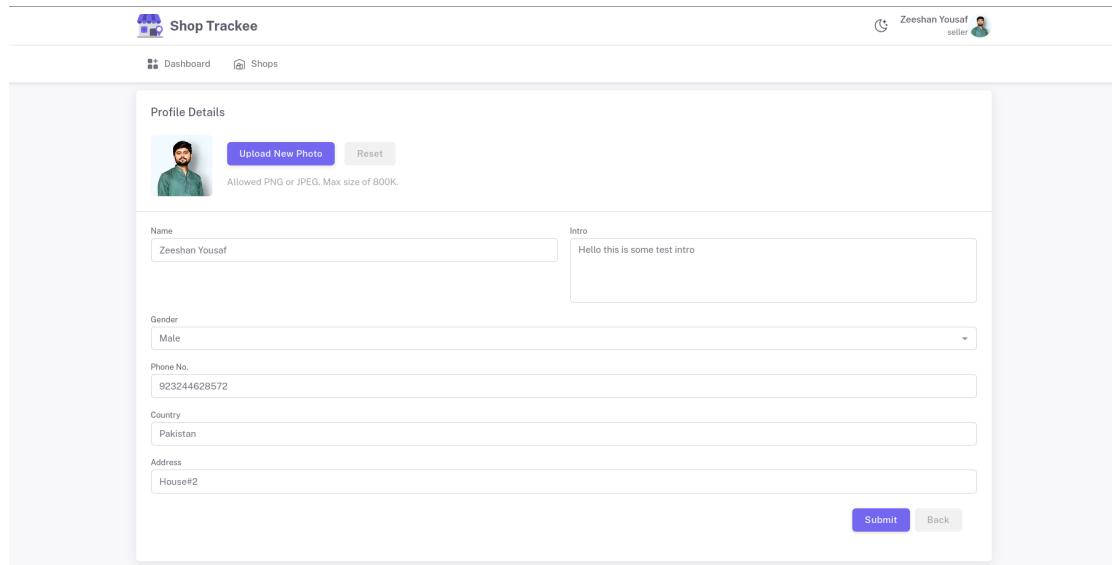


FIGURE 4.5: Shop Trackee - Profile Edit

4.4.6 Seller Dashboard

The screenshot shows the Seller Dashboard. It includes a welcome message 'Welcome Zeeshan Yousaf to Shop Trackee' with a profile picture of the user. Below it is a 'Statistics' section showing 1 Customer, 6 Products, 4 Services, and 1121 Revenue, all updated 1 month ago. The main area is titled 'Order Requests' and contains a table with the following data:

ITEM	SHOP	CUSTOMER	MESSAGE	CREATED AT	LOCATION	STATUS	ACTIONS
Running Shoe Product	Liberty Shop	Fatima	Can Deliver this one pair of Shk	Sun, 08 Oct 2023 7:11	Get Direction	Pending	Accept Reject
Wristwatch Product	Cavalry Shop	Fatima	I need a single wristwatch.	Sun, 08 Oct 2023 7:12	Get Direction	Pending	Accept Reject
Headphone Product	Cavalry Shop	Fatima	Could you deliver me one head	Sun, 08 Oct 2023 7:12	Get Direction	Accepted	Remove

At the bottom, there are pagination controls and a note about rows per page.

FIGURE 4.6: Shop Trackee - Seller Dashboard

4.4.7 Seller Shops

The screenshot shows the 'Shops' section of the Shop Trackee dashboard. It displays three cards for different sellers:

- Meri Dukan**: 03126789012. Status: Ye meri dukan hey aur mein hi isko chlata hun. Hours: 6:00 AM - 9:30 PM. Metrics: 10 Products, 10 Services, 10 Requests, 10 Orders. Buttons: Show, Chat.
- Liberty Shop**: 0324462756. Status: This is shop. Hours: 5:00 AM - 8:00 PM. Metrics: 10 Products, 10 Services, 10 Requests, 10 Orders. Buttons: Show, Chat.
- Cavalry Shop**: 03111222211. Status: This is shop. Hours: 12:00 AM - 6:30 PM. Metrics: 10 Products, 10 Services, 10 Requests, 10 Orders. Buttons: Show, Chat.

At the bottom, there are links for 'Documentation' and 'Support'.

FIGURE 4.7: Shop Trackee - Seller Shops

4.4.8 Seller Shop Create

The screenshot shows the 'Add Shop Details' form for creating a new shop:

- Map**: A map of Lahore, Pakistan, showing various landmarks like Kot Lakhpat, Lahore General Hospital, and Minhas University.
- Address**: Chungi Amar Sadhu, Muff pura Gul Colony, Lahore, Pakistan.
- Name**: Shop Name: 031112345678
- Opening Time**: 6:00 AM
- Closing Time**: 10:00 PM
- Closing Days**: Friday, Sunday
- Social Links**: <https://www.facebook.com/100066264083076>
- Description**: Enter description
- Buttons**: Submit, Back

FIGURE 4.8: Shop Trackee - Shop Create

4.4.9 Seller Add Product

Edit Product

Name Laptop	Price 120000
Category Electronics	Quantity 2
Description It is Electronics, which could be categorized as Technology and Computing.	

Product Images

Choose Files | No file chosen
Capture photo

Recognize Image

Upload More

FIGURE 4.9: Shop Trackee - Add Product

4.4.10 Seller Add Service

Add Service

Name Lighting	Rate 1000
Category Event Planning	Charge by day
Description We offer Lighting on Events, which is Home decor service for your events.	

Service Images

Choose Files | No file chosen
Capture photo

Recognize Image

Upload More

FIGURE 4.10: Shop Trackee - Add Service

4.4.11 Seller Products and Services Listing

The screenshot shows the 'Shops' section of the Shop Trackee seller dashboard. At the top, there are navigation tabs for 'Dashboard' and 'Shops'. A search bar labeled 'Filter By' with the option 'Both' is present. An 'Add' button is located in the top right corner. Below the header, there are four product/service cards arranged in a 2x2 grid:

- Computer Hardware:** An image of a Sony 4K TV. Description: It is Computer Hardware, which represents a Electronics and Hardware , which could be categorized as Technology and Computing. Price: Rs1 Category: Sports and Outdoors. Buttons: Show Details, Edit, Delete.
- Humidification Service:** An image of a Google Home smart speaker. Description: It is Healthcare, which is related to Technology and Healthcare. Category: Healthcare. Charge by: day Rate: 500. Buttons: Edit, Delete.
- Laptop:** An image of a Dell laptop. Description: It is Electronics , which could be categorized as Technology and Computing. Price: Rs12000 Category: Electronics. Buttons: Show Details, Edit, Delete.
- Lighting:** An image of a ceiling light fixture. Description: It is Lighting , which could be categorized as Home and Indoors. Category: Legal Services. Charge by: hour Rate: 4. Buttons: Edit, Delete.

FIGURE 4.11: Shop Trackee - Products and Services Listing

4.4.12 Customer Home

The screenshot shows the customer home page of Shop Trackee. At the top, it displays a welcome message for 'Zeeshan Customer' and various statistics: 268 Searches, 890 Delivered, 62 Pending, and 1.2k Rejected. To the right is a map of a local area with several landmarks labeled, including 'Interchange Park', 'SAMANABAD TOWN', 'Gulshan e Iqbal Park', and 'SAEED COLONY'. Below the map, there are sections for 'Products' and 'Services'.

Products: A grid of three items with 'Request Order' buttons:

- Wristwatch:** An image of a black leather strap watch. Description: It is Wristwatch, which could be categorized as Apparel and Accessories. It is measured as 94 percent wide and 99 percent large inside the image. Price: Rs99.
- Headphone:** An image of a Sony headphones. Description: It is Electronic Headphone, which is categorized as Technology and Computing. Price: Rs1500.
- Running Shoe:** An image of a black and blue running shoe. Description: It is Running Shoe, which represents a Clothing, Footwear, and Shoe. It could be categorized as Apparel and Accessories. It is measured as 79 percent wide and 53 percent large inside the image. Price: Rs2000.

Services: A list of service categories: Consulting, Healthcare, Repair, Beauty, Legal Services, Financial Consulting, Educational Services, Event Planning, Fitness and Wellness, Transportation Services, Cleaning Services. A 'View All' button is also present.

FIGURE 4.12: Shop Trackee - Customer Home

4.4.13 Customer Searching Around

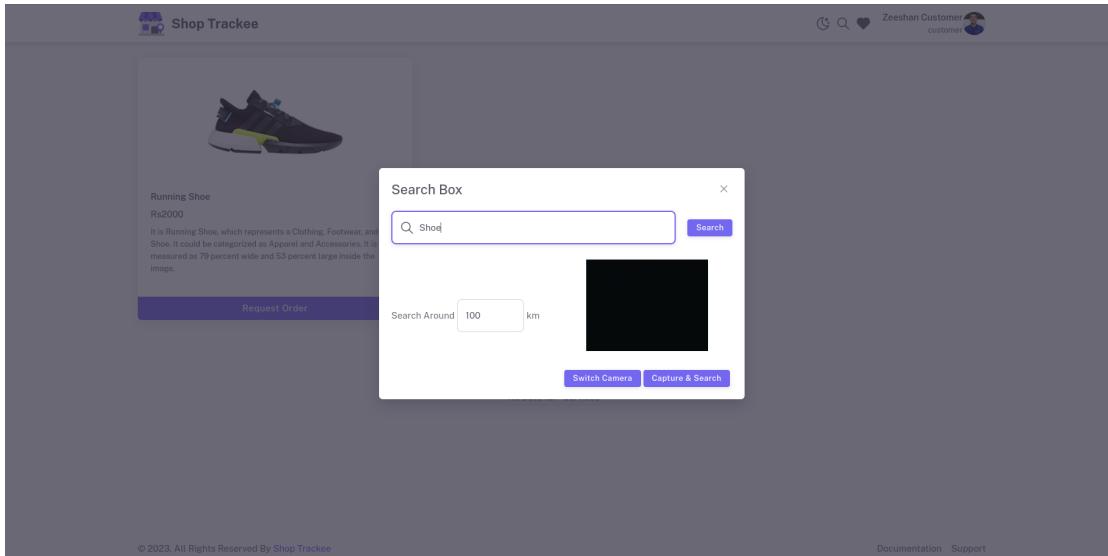


FIGURE 4.13: Shop Trackee - Customer Searching Around

4.4.14 Customer Requesting Order

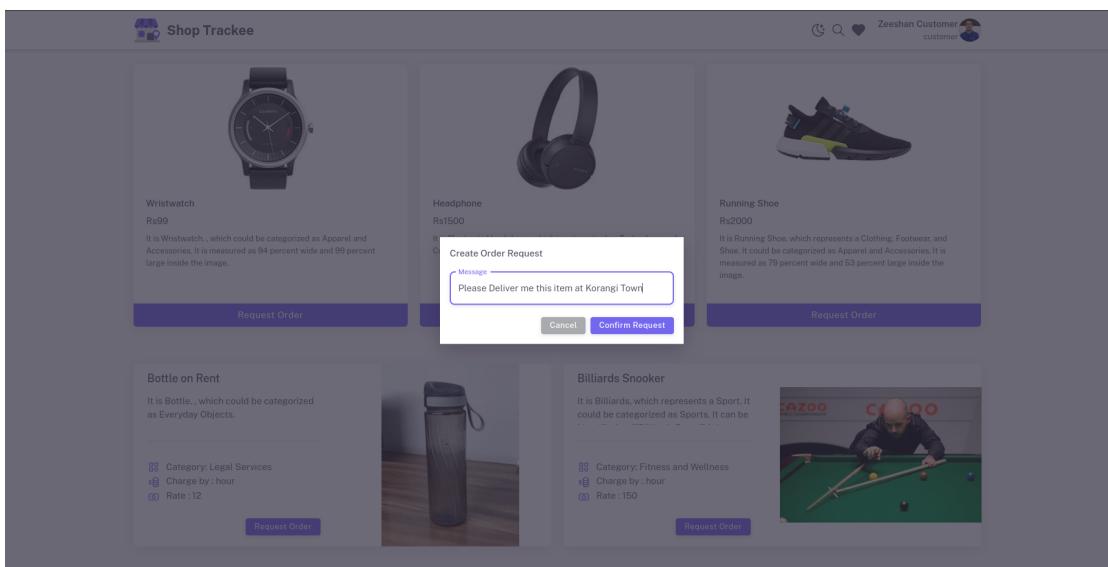


FIGURE 4.14: Shop Trackee - Customer Requesting Order

4.4.15 Customer Order Requests History

Order Requests						
ITEM	SHOP	MESSAGE	CREATED AT	STATUS	ACTIONS	
Wristwatch Product	Cavalry Shop	Please deliver this watch!	Sat, 07 Oct 2023 5:29 PM	Rejected	<button>Remove</button>	
Running Shoe Product	Liberty Shop	My Request for shoes.	Sat, 07 Oct 2023 1:26 PM	Accepted	<button>Remove</button>	
Billiards Snooker Service	Liberty Shop	Service request	Sat, 07 Oct 2023 12:15 AM	Accepted	<button>Remove</button>	
Running Shoe Product	Liberty Shop	Can Deliver this one pair of Shoes to my Locat	Sun, 08 Oct 2023 7:11 PM	Pending	<button>Cancel</button>	
Wristwatch Product	Cavalry Shop	I need a single wristwatch.	Sun, 08 Oct 2023 7:12 PM	Pending	<button>Cancel</button>	
Headphone Product	Cavalry Shop	Could you deliver me one headphone here at T	Sun, 08 Oct 2023 7:12 PM	Accepted	<button>Remove</button>	
Wristwatch Product	Cavalry Shop	Please Deliver me this item at Korangi Town	Sun, 08 Oct 2023 8:36 PM	Pending	<button>Cancel</button>	

Rows per page: 100 | 1-7 of 7

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FIGURE 4.15: Shop Trackee - Customer Order Requests History

4.4.16 Customer Favorites

Furniture
Food and Beverages
Electronics

F
Congratulation Flora! 🎉
Today

New user registered. 5 hours ago Yesterday

New message received 🤝 You have 10 unread messages 11 Aug

Received Payment 25 May

Received Order 📦 New order received from John 19 Mar

[View All](#)

[View All Favorites](#)

FIGURE 4.16: Shop Trackee - Customer Favorites

4.4.17 Dark Mode

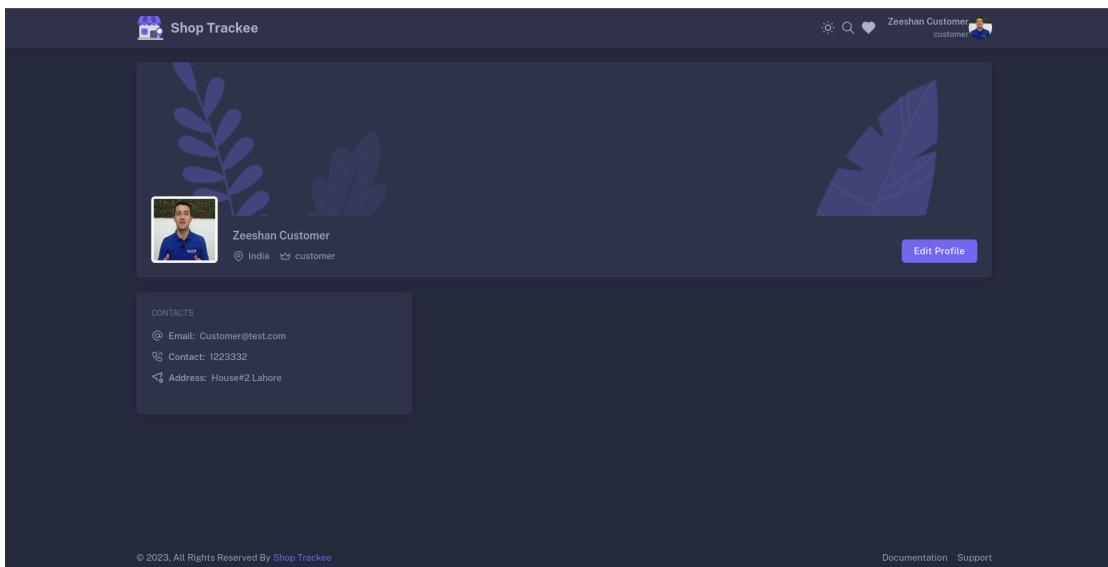


FIGURE 4.17: Shop Trackee - Dark Mode

4.5 Hardware Interface

The "Track My Shop" web application is primarily a software-based system that relies on internet connectivity and web browsers to function. However, there are a few essential hardware components and interfaces that enable its operation:

- Computer Systems (Desktops, Laptops, Tablets)
- Smartphones and Mobile Devices
- Stable Internet Connection
- Cameras (for Image Capture)
- Global Positioning System (GPS) and Location Services
- Input Devices (Keyboards, Mouse, Touchscreens)

4.5.1 Hardware Requirements

Here are some minimal requirements of hardware to run this Web Application:

- Pentium 4 - 1.9Ghz
- RAM 1 GB+
- System Storage (minimum 1 GB)
- Windows, Linux, Mac, Andriod, IOS
- Browsers (Chrome 64+, Edge 79+, Firefox 67+, Opera 51+, Safari 12+)
- GPS WGS 84 (World Geodetic System 1984) datum for Google Maps

4.6 Evaluation

Each element of our website is meticulously designed based on the findings of Market Shop Sellers and Customer Research, which takes into account criteria such as technical knowledge, and comprehension. The user is given a seamless experience, allowing them to easily see, update, upload, and manage their data. While designing the website, Human Computer Interaction concepts were taken into account, allowing the user to see where they are presently working and easy to use. Before releasing the website, we make sure that all of the tabs and buttons are visible and double-checked and everything is working properly. Once the website is ready for the user, it will be extensively tested and any necessary changes will be done. Hence the website is user friendly and unambiguous.

4.7 Unit Testing

Unit testing is a crucial component of the development process in "Track My Shop." It involves testing individual units or components of the application to ensure their accuracy, reliability, and correctness. The primary focus is to verify that each unit of the software performs as designed.

In this project, unit testing will encompass the following aspects:

4.7.1 Frontend Components

Test individual frontend components like UI elements, input fields, buttons, and their respective functionalities to ensure proper rendering and interactivity.

4.7.2 Backend API Endpoints

Test the backend API endpoints using testing frameworks to verify their response, data integrity, error handling, and authentication mechanisms.

4.7.3 Database Interactions

Test the interactions with the database, including CRUD operations, to ensure accurate data retrieval, storage, and manipulation.

4.7.4 Integration Testing

Conduct integration tests to validate the interaction and communication between different modules, ensuring the overall system functions seamlessly.

4.7.5 Error Handling and Edge Cases

Perform tests to evaluate the system's behavior under various error conditions and edge cases to guarantee robustness and graceful error handling.

Adopting a comprehensive unit testing strategy will enhance the project's quality, reduce bugs, and provide a stable and reliable application for users.

4.8 Test Cases

Unit testing is a crucial component of the development process in "Track My Shop". It involves testing individual units or components of the application to ensure their accuracy, reliability, and correctness. The primary focus is to verify that each unit of the software performs as designed. Here are some test cases for major units of the application:

4.8.1 Frontend Components

Here are the unit test cases for the frontend components:

4.8.1.1 Test Case 1: User Registration Form Validation

TABLE 4.1: User Registration Form Validation (TC1)

Test Case ID	TC1
Test Case Name	User Registration Form Validation
Component	User Registration Form
Input	Incomplete or incorrect user registration details
Expected Output	Prevent registration and display appropriate validation errors
Test Steps	<ol style="list-style-type: none">1. Fill the registration form with incomplete or incorrect details2. Attempt to submit the registration form3. Check the interface to verify appropriate validation errors are displayed
Execution Result	Pass

4.8.1.2 Test Case 2: Product/Service Image Uploading & Recognition

TABLE 4.2: Product Image Uploading (TC2)

Test Case ID	TC2
Test Case Name	Product/Service Image Uploading and Recognition
Component	Product/Service Image Chooser / Image Capturing Camera
Input	Image upload/capture request
Expected Output	Successful image upload and display in the product/service management UI
Test Steps	<ol style="list-style-type: none"> 1. Initiate image upload process 2. Check the Recognize Image button visibility under image 3. Recognize Image by using button 4. Check the UI to verify the image is displayed appropriately 5. Check the product/service form to verify recognized data
Execution Result	Pass

4.8.1.3 Test Case 3: Product/Service Component Rendering

TABLE 4.3: Unit Test for Rendering Product/Service Display Component (TC3)

Test Case ID	TC3
Test Case Name	Rendering Product/Service Display
Component	Product/Service Display Component
Input	None (Component rendering)
Expected Output	Rendered product/service display
Test Steps	<ol style="list-style-type: none"> 1. Load the application 2. Navigate to the page where the products/services display component is rendered
Execution Result	Pass

4.8.1.4 Test Case 4: Order Request with Message

TABLE 4.4: Order Request with Message (TC4)

Test Case ID	TC4
Test Case Name	Order Request with Message
Component	Order Management UI
Input	Order request along with an optional message from the customer
Expected Output	Successful submission of the order request with the attached message
Test Steps	<ol style="list-style-type: none"> 1. Select a product and initiate the order request process 2. Provide additional instructions or messages (optional) 3. Complete the order request 4. Check all order requests table to verify the order request was successful
Execution Result	Pass

4.8.1.5 Test Case 5: Search Box Functionality

TABLE 4.5: Search Bar Functionality (TC5)

Test Case ID	TC5
Test Case Name	Search Box Functionality
Component	Search Bar, Image Capturing Camera, Search Radius Field
Input	Search query, Search Image, Distance radius
Expected Output	Display of relevant search results
Test Steps	<ol style="list-style-type: none"> 1. Enter a search query in the search bar 2. Initiate the search process 3. Check the interface to verify relevant search results are displayed
Execution Result	Pass

4.8.2 Backend API Endpoints

Here are the unit test cases for the backend API endpoints:

4.8.2.1 Test Case 6: Response of Product Listing Endpoint

TABLE 4.6: Test Case for Response of Product Listing Endpoint (TC6)

Test Case ID	TC6
Test Case Name	Response of Product Listing Endpoint
Endpoint	Product Listing
Input	Send a request to the product listing endpoint
Expected Output	Receive a list of products
Test Steps	<ol style="list-style-type: none"> 1. Send a valid request to the product listing endpoint 2. Receive the response from the endpoint
Execution Result	Pass

4.8.2.2 Test Case 7: Error Handling of Invalid Request

TABLE 4.7: Test Case for Error Handling of Invalid Request (TC7)

Test Case ID	TC7
Test Case Name	Error Handling of Invalid Request
Endpoint	Any API Endpoint
Input	Send an invalid request
Expected Output	Receive an appropriate error response
Test Steps	<ol style="list-style-type: none"> 1. Send an invalid request to the specified endpoint 2. Receive the error response from the endpoint
Execution Result	Pass

4.8.3 Database Interactions

4.8.3.1 Test Case 8: Product Data Retrieval

TABLE 4.8: Product Data Retrieval (TC8)

Test Case ID	TC8
Test Case Name	Product Data Retrieval
Component	Database Interaction
Input	Request to retrieve product data
Expected Output	Valid product data from the database
Test Steps	<ol style="list-style-type: none"> 1. Send a request to retrieve product data 2. Check the received product data
Execution Result	Pass

4.8.3.2 Test Case 9: Adding New Product

TABLE 4.9: Adding New Product (TC9)

Test Case ID	TC9
Test Case Name	Adding New Product
Component	Database Interaction
Input	New product details (name, description, price, etc.)
Expected Output	Product added successfully in the database
Test Steps	<ol style="list-style-type: none"> 1. Provide input for a new product 2. Initiate the process to add the product 3. Check the response to verify successful addition
Execution Result	Pass

4.8.4 Integration Testing

4.8.4.1 Test Case 10: Integration of User Authentication

TABLE 4.10: Integration of User Authentication (TC10)

Test Case ID	TC10
Test Case Name	Integration of User Authentication
Components	Authentication Module, Database Interaction
Input	User credentials
Expected Output	Successful user authentication
Test Steps	<ol style="list-style-type: none"> 1. Provide user credentials 2. Initiate the authentication process 3. Check the response to verify successful authentication
Execution Result	Pass

4.8.4.2 Test Case 11: Integration of Product Listing

TABLE 4.11: Integration of Product Listing (TC11)

Test Case ID	TC11
Test Case Name	Integration of Product Listing
Components	Product Listing Module, Database Interaction
Input	Request to list products
Expected Output	Successful retrieval of product listing
Test Steps	<ol style="list-style-type: none"> 1. Send a request to list products 2. Check the response to verify the successful retrieval of product listing
Execution Result	Pass

4.8.5 Error Handling and Edge Cases

4.8.5.1 Test Case 12: Invalid User Authentication

TABLE 4.12: Invalid User Authentication (TC12)

Test Case ID	TC12
Test Case Name	Invalid User Authentication
Components	Authentication Module, Database Interaction
Input	Incorrect user credentials
Expected Output	Authentication failure with appropriate error message
Test Steps	<ol style="list-style-type: none"> 1. Provide incorrect user credentials 2. Initiate the authentication process 3. Check the response to verify authentication failure and error message
Execution Result	Pass

4.8.5.2 Test Case 13: Product Listing Empty

TABLE 4.13: Product Listing Empty (TC13)

Test Case ID	TC13
Test Case Name	Product Listing Empty
Components	Product Listing Module, Database Interaction
Input	Request to list products when no products are available
Expected Output	Successful retrieval with an empty product list
Test Steps	<ol style="list-style-type: none"> 1. Send a request to list products 2. Check the response to verify an empty product list
Execution Result	Pass

4.8.5.3 Test Case 14: Invalid Product Addition

TABLE 4.14: Invalid Product Addition (TC14)

Test Case ID	TC14
Test Case Name	Invalid Product Addition
Components	Product Management Module, Database Interaction
Input	Incomplete or incorrect product details
Expected Output	Failure to add the product with an appropriate error message
Test Steps	<ol style="list-style-type: none"> 1. Provide incomplete or incorrect product details 2. Attempt to add the product 3. Check the response to verify the error message
Execution Result	Pass

4.9 Functional Testing

Functional testing is a critical aspect of ensuring the "Track My Shop" application meets its intended functional requirements. This type of testing involves validating the software's functions and features against the specified requirements and design. It primarily focuses on what the system does.

Functional testing for this project encompasses the following areas:

4.9.1 User Authentication and Authorization

Validate the authentication process to ensure users can securely create accounts, log in, and access appropriate functionalities based on their roles.

4.9.2 Product and Service Listings

Verify that sellers can effectively list their products and services using various methods, including image recognition and manual entry, and customers can view and search these listings.

4.9.3 Order Placement and Management

Test the ordering process to ensure customers can place orders for products and services, sellers receive order requests, and they can manage and respond to these orders appropriately.

4.9.4 Location-Based Features

Validate the location-based functionalities such as finding nearby shops, setting a search radius, and accessing directions to physical shops.

4.9.5 Search and Filtering

Verify the accuracy and efficiency of the search and filtering capabilities, allowing users to search for products, services, or shops based on various criteria.

4.9.6 Error Handling

Test the system's behavior under erroneous conditions, ensuring that appropriate error messages and notifications are displayed to users.

4.9.7 UI/UX Testing

Evaluate the user interface and overall user experience to ensure it is intuitive, consistent, and adheres to design guidelines.

Functional testing ensures that the "Track My Shop" application performs its intended functions correctly, providing users with a seamless and reliable experience.

4.9.8 Testing Requirements

Functional testing for this web application necessitates a comprehensive approach that covers various functionalities and ensures their correctness and reliability. The testing requirements include:

4.9.8.1 User Authentication:

- Verify that users can create accounts securely with the necessary role and personal information.
- Test login functionality, ensuring users can authenticate themselves with correct credentials.

- Validate the behavior of the system in case of incorrect login attempts, including appropriate error messages.

4.9.8.2 Product and Service Listings:

- Ensure sellers can accurately list products and services using various methods like image recognition, capturing image, and choosing image manually or manual entry.
- Validate that sellers can edit, delete, and update product and service information as needed.
- Verify that customers can view and filter product and service listings with ease.

4.9.8.3 Orders Management:

- Test the process of requesting orders, ensuring customers can successfully initiate orders for desired products and services.
- Validate that sellers receive order requests promptly and can manage them effectively, including accepting or rejecting order requests.
- Verify that customers receive timely notifications and updates on their orders.

4.9.8.4 Location-Based Features:

- Ensure users can find nearby shops based on their location and specified search radius.
- Validate the accuracy of location-based search results, providing users with relevant and nearby options.
- Test the functionality of accessing directions to physical shops from the user's current location.

4.9.8.5 Search and Filtering:

- Validate the accuracy and efficiency of the search feature, allowing users to search for products, services, or shops based on keywords.
- Test capabilities to ensure users can search based on image, categories, or other relevant criteria.

4.9.8.6 Error Handling:

- Verify that the system displays appropriate error messages and notifications for incorrect inputs or erroneous actions.
- Test the behavior of the system under unexpected conditions, ensuring graceful handling of errors to prevent system crashes.

4.9.8.7 UI/UX Testing:

- Validate that the user interface is consistent, intuitive, and adheres to design guidelines.
- Test the responsiveness of the application across various devices and screen sizes.

These testing requirements form the basis for comprehensive functional testing, ensuring the application meets its intended functionalities reliably and accurately.

Chapter 5

Conclusion & Future Work

5.1 Conclusion

The "Track My Shop" project introduces a user-friendly and affordable web application tailored for small businesses and local service providers. By offering a centralized platform accessible through standard web browsers on various devices, the project enables businesses to showcase their products and services online. Leveraging image recognition and geolocation features, the application simplifies the process of product listing and enhances the search experience for customers.

The main focus of the project has been to make digitalization affordable and accessible for small businesses. Through a well-structured codebase and an intuitive user interface, the application ensures a seamless and engaging experience for both sellers and customers. The use of modern technologies like Next.js, Ruby on Rails, AWS, and PostgreSQL ensures the application is robust and scalable.

Moving forward, gathering user feedback and staying updated with evolving technologies will be key to refining and improving the application. "Track My Shop" strives to contribute to a more connected digital economy, facilitating a stronger bond between local businesses and their communities.

5.2 Future Work

While achieving its core objectives, offers exciting avenues for future enhancements and expansions:

5.2.1 Enhanced User Experience:

Conduct usability testing and gather extensive user feedback to refine the user interface, making it even more intuitive and appealing to a broader user base.

5.2.2 Machine Learning Integration:

Explore the integration of machine learning algorithms to enhance the image recognition capabilities, allowing for more accurate and efficient product and service identification from uploaded images.

5.2.3 Facial Recognition

Investigate the possibility of integrating facial recognition technology for profile data completion using profile image and enhanced security within the application.

5.2.4 Personalized Recommendations:

Implement recommendation algorithms based on user preferences and behavior, offering personalized product and service recommendations to customers, thereby enhancing user engagement and sales.

5.2.5 Integration of Payment Gateways:

Incorporate secure and widely used payment gateways to facilitate online transactions directly within the application, streamlining the purchase process for customers.

5.2.6 Multi-Language Support:

Introduce multi-language support to make the application accessible to a more diverse audience, promoting inclusivity and user engagement across different regions and languages.

5.2.7 Real-Time Chat and Customer Support:

Integrate a real-time chat feature to enable direct communication between customers and sellers, fostering better customer support and trust.

5.2.8 Inventory Management System:

Develop an integrated inventory management system for sellers to efficiently track, manage, and update their product and service offerings in real-time.

5.2.9 Social Media Integration:

Integrate social media sharing functionalities to enable users to easily share their favorite products and services with their social network, enhancing the application's reach and user engagement.

5.2.10 Third Party Integration for Sign-in:

Integrate popular third-party authentication services (e.g., Google (for Google My Business), Facebook, Instagram etc.) to allow users to sign in using their existing credentials, enhancing user onboarding and convenience.

5.2.11 Integration with Other E-commerce Platforms:

Investigate the potential for integrating with established e-commerce platforms to allow seamless synchronization of product listings and sales, potentially broadening the reach and opportunities for sellers.

5.2.12 Customer Analytics Dashboard:

Create a comprehensive analytics dashboard for sellers, providing insights into customer behavior, purchase patterns, and popular products, aiding in informed business decisions.

5.2.13 Mobile Application Development:

Extend the project by developing dedicated mobile applications (iOS and Android) to cater to the increasing number of users accessing the platform via mobile devices.

5.2.14 Offline Access and Progressive Web App (PWA):

Implement Progressive Web App features to ensure limited functionality and access to the application even in offline mode, enhancing user experience.

5.2.15 Import data from Business Websites:

Explore features that allow sellers to import or list their existing products or services from already established business websites, streamlining the onboarding process and saving time for sellers.

5.2.16 Integration with Local Services:

Collaborate with local delivery services to enable seamless integration for order deliveries, further enhancing convenience for customers and boosting sales for sellers. These future directions offer a glimpse into the potential growth and evolution of the "Track My Shop" project, ensuring its continual adaptation to emerging technologies and the evolving needs of both businesses and consumers in the dynamic digital landscape.

Bibliography

[1] <http://scribd.com>.

Index

Computer Science, [i](#)

sample, [1](#)