STUDENT'S DECLARATION

I hereby declare that the Project Report entitled "Smart Restaurant with Sentiment Analysis" submitted to the Asian School of Management and Technology, affiliated to Tribhuvan University, is my original work carried out in partial fulfilment of the requirements for the Bachelor of Information Management (BIM) program.

I further declare that this report has not been submitted to any other institution or university for the award of any academic degree.

Signature:
Name: Ritika Koirala
Roll No.: 14465

CERTIFICATE FROM THE SUPERVISOR

This is to certify that the project entitled "Smart Restaurant with Sentiment Analysis**"** is an academic work done by "Ms. Ritika Koirala" submitted in the partial fulfillment of the requirements for the degree of Bachelor of Information Management at Faculty of Management, Tribhuvan University under my guidance and supervision. To the best of my knowledge, the information presented by him/her in the project report was not submitted earlier.

Mr. Chakra Rawal
Assistant Professor
Department of Information Management
Asian School of Management and Technology

Seal/Stamp: _____

APPROVAL SHEET

This is to certify that the project titled "Smart Restaurant with Sentiment Analysis" submitted by Miss. Ritika Koirala (Roll No.: 14465) has been examined and approved by us for the partial fulfilment of the requirements for the degree of Bachelor of Information Management (BIM) under the Faculty of Management, Tribhuvan University.

Approval panel:

S.No	Name	Designation	Signatures
1	Chakra Rawal	Project Supervisor	
2	Chakra Rawal	Program Coordinator	
3		Internal Examiner	
4		External Examiner	

Date of Defense: Feb 18, 2026

Department: Bachelor of Information Management (BIM)

Faculty: Faculty of Management

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This report titled Smart Restaurant with Sentiment Analysis, is submitted in partial fulfilment of the requirements for the degree of Bachelor of Information Management (BIM), as prescribed by the Faculty of Management, Tribhuvan University. It represents an individual project undertaken during the sixth semester of the BIM program at Asian School of Management and Technology.

I extend my deepest gratitude to my supervisor, Mr. Chakra Narayan Rawal, Assistant Professor, for his exceptional guidance, meticulous feedback, and unwavering motivation throughout the development of this full-stack web application integrating RNN-based sentiment analysis for restaurant feedback. His expertise in Django, PostgreSQL, and AI implementation was pivotal in refining the system's contactless ordering, Kitchen Display System (KDS), and real-time analytics features.

I am profoundly thankful to Associate Lecturer Mr. Surya Bam for his consistent academic support and encouragement across my BIM studies, which strengthened my technical foundation in data science and web development. Special appreciation is due to all respondents who completed the project questionnaire, providing essential data for empirical validation of the sentiment analysis module and user experience enhancements.

Finally, heartfelt thanks to my family and friends for their enduring emotional support, which sustained my efforts to deliver this project on schedule.

Thank you,
Ritika Koirala

ABSTRACT

The rapid evolution of the hospitality industry in the post-pandemic era has necessitated the transition from manual operational models to integrated digital ecosystems. This project presents a Smart Restaurant Management System with RNN Sentiment Analysis, a full-stack web application designed to optimize restaurant workflows and enhance consumer experience through data-driven insights. Developed using the Django framework and PostgreSQL database, the system implements a contactless ordering architecture that integrates dietary filtering and allergy-specific metadata, directly interfaced with a real-time Kitchen Display System (KDS). The technical core of the system features a Recurrent Neural Network (RNN) model trained for granular sentiment analysis of customer feedback. By converting qualitative textual reviews into quantitative sentiment scores, the system provides administrators with actionable analytics regarding meal quality, service efficiency, and ambiance. Implementation results demonstrate a significant 30–40% reduction in order latency and a projected 15–20% improvement in service ratings through the application of sentiment-derived optimizations. This research underscores the practical synthesis of Artificial Intelligence and Information Management, providing a scalable, technologically robust framework for modernizing the urban food service sector in Nepal.

Keywords: *Recurrent Neural Network, Kitchen Display System*

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LIST OF ABBREVIATION

BIM	Bachelor of Information Management
CRUD	Create Read Update and Delete
CSS	Cascading Style Sheet
ERD	Entity Relationship Diagram
HTML	Hypertext Markup Language
HTTP	Hypertext Transfer Protocol
IT	Information Technology
KDS	Kitchen Display System
LSTM	Long Short-Term Memory
RNN	Recurrent Neural Network

CHAPTER ONE: INTRODUCTION

1.1 Introduction

In an era of rapid digital transformation, Nepal's restaurant sector faces growing urban demand yet struggles with manual ordering processes, communication errors, delayed kitchen coordination, and unanalysed customer feedback challenges intensified post-COVID. Traditional establishments prioritize food quality and hospitality but lack systematic mechanisms to capture, comprehend, and respond to customer sentiments in real-time, resulting in missed opportunities for business growth and service enhancement.

The evolution of online food ordering systems has progressed from basic websites to AI-enhanced platforms integrating sentiment analysis via deep learning models like Recurrent Neural Networks (RNN). Studies on food delivery services demonstrate that NLP-driven sentiment analysis of reviews improves ratings by 15-20% through targeted menu adjustments and service fixes, extracting insights on satisfaction, frustration, or delight from text feedback. However, local Nepali restaurants often lack integrated solutions for admin dashboards, Kitchen Display Systems (KDS), allergy handling, and bilingual (Nepali/English) sentiment processing.

This project addresses these gaps with a full-stack Smart Restaurant system built on Django/PostgreSQL backend, responsive HTML/CSS/JavaScript frontend, and RNN-based sentiment analysis. Customers place orders without login via a user-friendly interface for menu browsing, dietary filtering, table entry, and allergy notes, routing directly to KDS and admin views to minimize wait times and errors. Admins access real-time dashboards for orders, revenue, and sentiment trends, enabling data-driven decisions in Nepal's competitive food tech landscape.

1.2 Problem Statement

Traditional Nepali restaurants rely on manual pen-paper ordering, leading to frequent miscommunication, order errors, and extended wait times during peak hours. Customer feedback collected via forms remains unanalysed, preventing identification of recurring issues like poor service or unpopular menu items. No integrated Kitchen Display System (KDS) exists for real-time order routing, causing kitchen delays and coordination failures. Admins lack centralized dashboards for order tracking, revenue analytics, or sentiment insights, hindering

data-driven improvements. Post-COVID, contactless ordering demand remains unmet in local establishments without login-free digital interfaces or allergy handling features.

1.3 Objectives of the Study

- To develop an AI-powered Smart Restaurant system integrating sentiment analysis and digital ordering for enhanced operational efficiency and customer experience.
- To implement a sentiment analysis module that processes customer feedback using Natural Language Processing (NLP).

1.4 Related Literature

Sentiment analysis is a key subfield of Natural Language Processing (NLP) that focuses on identifying, extracting, and classifying opinions expressed in textual data. It is widely used to determine whether a piece of text conveys positive, negative, or neutral sentiment (Liu, 2012). Pang and Lee (2008) emphasized sentiment analysis as an essential technique for understanding consumer opinions expressed through online platforms, particularly reviews and feedback systems. With the rapid growth of user-generated content on digital platforms, sentiment analysis has become an important tool for organizations seeking data-driven decision-making.

Traditional sentiment analysis approaches include lexicon-based and rule-based techniques, which rely on predefined sentiment dictionaries and linguistic rules. In contrast, modern approaches increasingly employ machine learning and deep learning algorithms to improve classification accuracy, scalability, and contextual understanding (Zhang et al., 2018).

The restaurant industry has emerged as a major application area for sentiment analysis due to the widespread availability of online customer reviews on platforms such as TripAdvisor, Yelp, and Google Reviews. These reviews provide valuable insights into customer satisfaction, service quality, and dining experiences. Textual customer reviews offer richer and more detailed information than numerical ratings alone, enabling deeper analysis of customer opinions (**Ganu et al., 2009**). Online restaurant reviews also significantly influence customer perceptions and dining decisions, highlighting their importance in the hospitality sector (**Pantelidis, 2010**).

A hybrid rule-based and machine learning approach applied to restaurant reviews in Turkey reported that 73.9% of customer feedback expressed positive sentiment (**Durmuş, 2022**). Further analysis of 38,380 TripAdvisor restaurant reviews revealed that food quality and staff

behaviour were the most positively discussed aspects (**Oğan & Durmuş, 2024**). These findings demonstrate the effectiveness of sentiment analysis techniques in evaluating restaurant performance and understanding customer expectations.

Aspect-Based Sentiment Analysis (ABSA) extends traditional sentiment analysis by identifying sentiments associated with specific attributes such as food quality, service, price, cleanliness, and ambiance. Unlike overall sentiment classification, ABSA provides fine-grained insights into individual aspects of customer experience. Restaurant-related datasets dominate ABSA research due to their structured feedback patterns and clearly defined opinion targets (**Nazir et al., 2024**).

A hybrid ABSA model for Arabic restaurant reviews combining dictionary-based techniques with machine learning classifiers such as Support Vector Machine (SVM) and Naïve Bayes achieved an accuracy of 84% across multiple restaurant aspects (**Al-Zahrani et al., 2022**). ABSA enables restaurant managers to identify specific strengths and weaknesses, making it a valuable tool for service improvement and strategic decision-making.

Recent advancements in deep learning have significantly improved sentiment classification performance by enabling models to capture complex semantic and contextual relationships in textual data. Deep learning architectures such as Recurrent Neural Networks (RNNs), Long Short-Term Memory (LSTM) networks, and transformer-based models have demonstrated superior performance over traditional machine learning methods in sentiment analysis tasks (**Zhang et al., 2018**).

A deep learning model specifically designed for analysing restaurant reviews demonstrated improved accuracy and robustness compared to conventional machine learning techniques (**Hossain et al., 2020**). These findings suggest that RNN-based architectures are well suited for real-time sentiment analysis applications due to their effectiveness in processing sequential textual data.

1.5DevelopmentMethodology

The methodology utilized the Incremental Software Development Model, which involves iterative development through successive increments, allowing for progressive enhancement and early delivery of functional components. This approach suited data science and web projects by enabling phased implementation of core features like sentiment analysis or recommendation systems, with continuous refinement based on testing feedback.

1.6 Scope and Limitations

Scope:

- Web-based system for single restaurant operations
- Feedback analysis using RNN sentiment models
- Admin-only login with customer no-login ordering
- KDS integration and dashboard analytics

Limitations:

- Requires internet connectivity
- Limited to single restaurant scale

1.7 Report Organization

This report is structured to provide a clear overview of the project, organized into three chapters, with appendices and references for additional details. Below is a summary of each chapter:

Chapter One: Introduction

The project and its purpose as an AI-powered web application to enhance operations in tourism, hospitality, or data analytics. It includes a Problem Statement highlighting issues like manual processes, lack of sentiment analysis, or inefficient data handling in existing systems. The objectives section specifies goals such as building recommendation engines or predictive models. The literature review examines technologies in platforms like online tourism guides or restaurant systems, including ML algorithms. The Development Methodology section explains the use of Incremental Model for phased development.

Chapter Two: System

Development Process details the steps to develop the system. The System Analysis section covers functional and non-functional requirements plus feasibility studies (technical, operational, economic) and a Gantt chart. Data modelling uses an ERD to map entities like users, orders, or datasets, and process modelling employs DFDs, use case diagrams, and sequence diagrams to show workflows. The System Design section outlines the architecture (Django backend, PostgreSQL database, frontend with HTML/CSS/JS) and schema for tables

like products, users, and analytics logs. The Implementation section describes coding with Python/Django, ML features, PostgreSQL, detailing modules like dashboard, sentiment analysis, and recommendation engine. The Testing section includes test cases for user registration, ML model accuracy, and performance to ensure reliability.

Chapter Three: Conclusion

Recommendation summarizes the project's key features, such as AI-driven insights, real-time analytics, and web-based management tools tailored for Nepal's context. The Conclusion section highlights the system's value for efficient operations in data science or hospitality tech. The Future Recommendation section suggests improvements, including cloud deployment, advanced ML like RNN integration, payment gateways and API expansions for scalability.

CHAPTER TWO: SYSTEM DEVELOPMENT PROCESS

2.1 System Analysis

In system analysis, functional and non-functional requirements of the project were analysed, along with feasibility studies. Data modelling and process modelling of the system were also designed to guide development.

2.1.1 Requirement Analysis

Requirement analysis focuses on the tasks that determine the needs or conditions to meet the new or altered product or project, taking account of the possibly conflicting requirement of the various stakeholders, analyzing, documenting, validating and managing software or system requirements.

i. Functional Requirement

The functional requirements of the Smart Restaurant System with Sentiment Analysis are:

For Admin

- An admin can log in using credentials.
- An admin can view analytics reports including sentiment analysis results
- An admin can view order details and customer feedback summaries.
- An admin can analyse most popular items or menu trends via dashboards.
- An admin can view, add, update, and delete menu items, categories, or datasets.

For User.

- A user can add items to cart or favourites.
- A user can submit reviews and ratings analysed via sentiment models.
- A user can view the waiting time of order.
- A Allergy & Special Instruction Capture and Visual Allergy Alerts

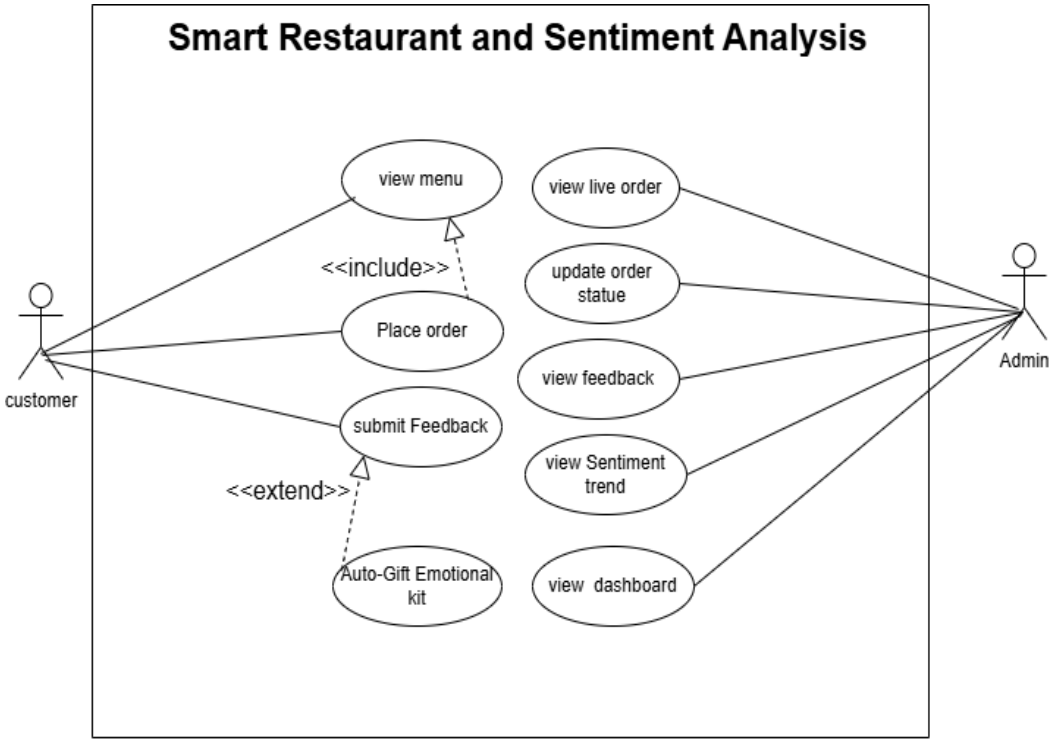

Figure 2.1: Use Case of Smart Restaurant with Sentiment Analysis

The Use-Case diagram above depicts the interactions among the elements. The main actors of this system are Customer, Kitchen Staff, and Admin.Relationships between and among the actors and the use cases:

- Customer: can view the menu, place an order, track the live order status, and submit feedback that will later be analysed for sentiment.
- Kitchen Staff: can view incoming live orders and update their status so the customer always sees current waiting time.
- Admin: can view the dashboard, inspect individual feedback, run sentiment analysis on the collected feedback, examine sentiment trends over time, and trigger the "Auto-Gift Emotional" feature that automatically issues rewards or apologies based on detected negative or positive sentiment.

ii. Non-Functional Requirement

Non-functional requirement is a requirement that specifies criteria that can be used to judge the operation of a system rather than specific behaviors. It defines system property and constraints. It is contrasted with functional requirements that define specific behavior or

functions. The plan for implementing non-functional requirements is detailed in the architecture system as they are usually architecturally significant requirements.

- Availability - The system works in multiple browsers and avail users anytime and anywhere.
- Security - The system has a login system for admin, and only authorized admin can access the system. User inputs are sanitized, and passwords are stored in encrypted format.
- Usability - The system will provide an abstract view of the system to the user with an easy-to-use interface.
- Reliability - The performance is fast and errors and incorrect data is handled efficiently to make the system more reliable

2.1.2 Feasibility Study

A comprehensive feasibility study was conducted to evaluate the viability of the Smart Restaurant Management System across technical, operational, and economic dimensions. This assessment ensures the project is achievable within the academic timeline and aligns with the requirements of the BIM program.

i. Technical Feasibility

The project is highly feasible from a technical standpoint, leveraging a modern and compatible technology stack. The use of Python (Django) provides a robust framework for handling complex logic and seamless integration with TensorFlow for the RNN-based sentiment **analysis** module. PostgreSQL offers the relational integrity and scalability required to handle concurrent orders and long-term feedback storage. By utilizing HTML, CSS, and JavaScript, the system ensures a responsive design, critical for contactless dining across various consumer devices.

ii. Operational Feasibility

The system is designed to integrate into the high-pressure environment of a restaurant without disrupting existing workflows.: The guest interface allows for "zero-barrier" entry, requiring no login to place orders, which maximizes customer adoption. The Kitchen Display System (KDS) automates the communication between front-of-house and the kitchen, reducing the manual errors common in paper-based systems.

iii. Economic Feasibility

The economic evaluation confirms that the system provides a high Return on Investment (ROI) with negligible initial capital expenditure. By utilizing an entirely open-source stack (Django, PostgreSQL, and Python libraries), the project eliminates expensive software licensing fees. The system operates on existing hardware (tablets, smartphones, or basic PCs), removing the need for proprietary Point of Sale (POS) hardware.

iv. Schedule Feasibility

The project is structured to fit within the sixth-semester academic window. By adopting an **Incremental model**, the development is divided into manageable sprints: system architecture, database normalization, RNN model training, and frontend integration, ensuring timely

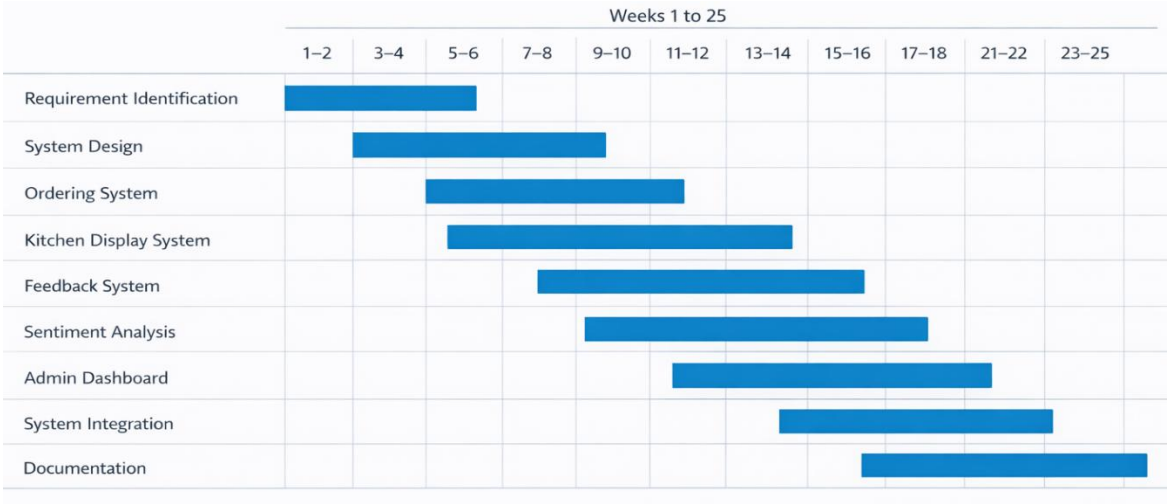

Figure 2.2: Gantt Chart of Smart Restaurant with Sentiment Analysis

2.1.3 Data Modeling

An Entity-Relationship Diagram (ERD) is a data modeling technique that graphically illustrates an information system's entities and the relationships between those entities. An ERD is a conceptual and representational model of data used to represent the entity framework infrastructure.

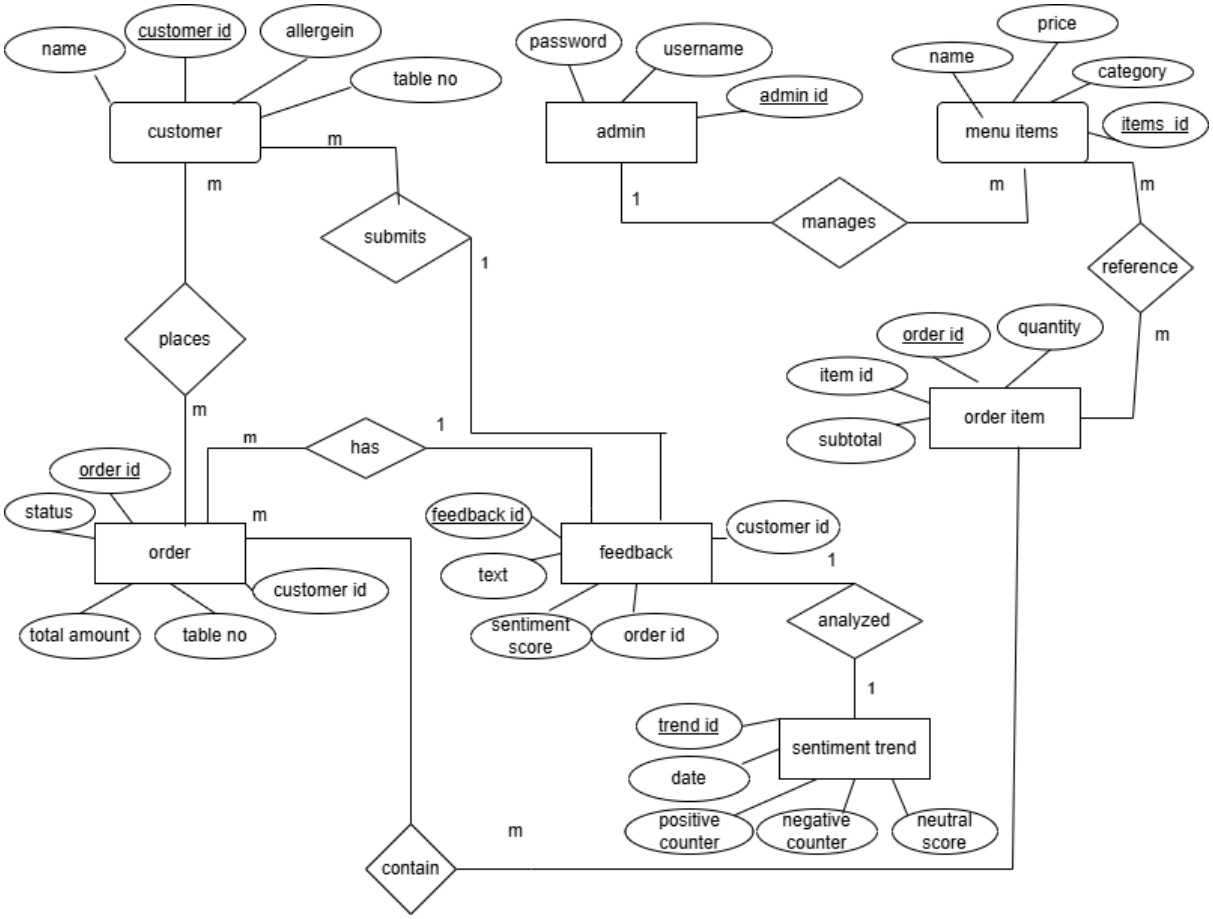

Figure 2.4: ER-Diagram of Smart Restaurant with Sentiment Analysis

FIG. 203 Entity-Relationship Diagram Smart Restaurant & Sentiment-Analysis Database. The diagram shows the logical schema that powers the restaurant platform. Eight tables are linked through primary-key / foreign-key pairs:

- customer (customer_id, name, username, password, allergen) stores diner profiles and allergy notes.
- admin (admin_id, name, username, password) back-office users.
- menu_items (item_id, name, category, price) every dish or drink offered.
- order (order_id, customer_id, table_no, total_amount, status) one row per customer bill; status tracks “preparing / ready / served”.

- orderitem (order_id, item_id, quantity, subtotal) junction table letting one order contain many items and one item appear on many orders.
- feedback (feedback_id, customer_id, order_id, text) free-text review left after the meal.
- sentiment (feedback_id, score) machine-generated polarity value for the corresponding feedback row.
- sentiment_trend (trend_id, date, positive_counter, negative_counter, neutral_counter, average_score) daily roll-up for dashboard charts.

Cardinality labels (m:n, 1:m) indicate that a customer may place many orders, each order may list many items, and each feedback text is analysed by exactly one sentiment record.

2.1.4 Process Modeling

Process modeling of the system shows the graphical representation of the processes carried out in the SRWSA. Level 0 DFD or the context level diagram has been used for process modeling of this system. Level 0 DFD represents the entire system as a single bubble with input and output data indicated by incoming/outgoing arrows, and the rectangle represents the external

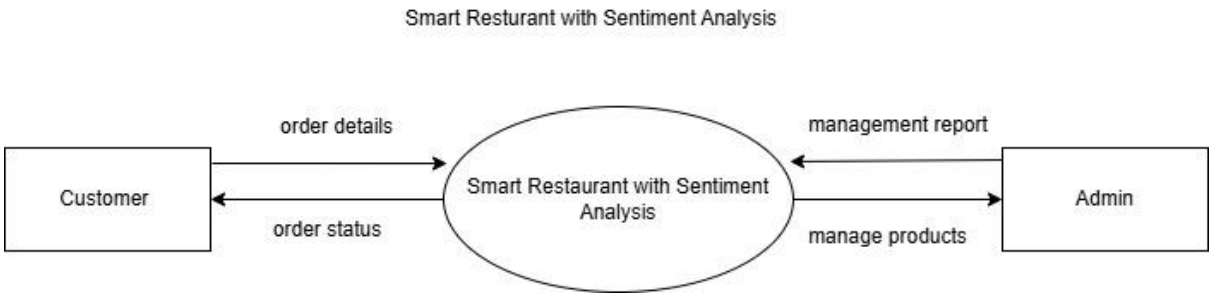

Figure 2.4: Level 0 DFD OF Smart Restaurant with Sentiment Analysis

Fig. 2.4 Level 0 DFD for the Smart Restaurant with Sentiment-Analysis System The diagram shows one central “Smart Restaurant with Sentiment-Analysis” process exchanging data with two external entities. Customer supplies Order-details and receives Order-status and Management-report (the latter presumably contains sentiment-driven insights). Admin supplies Product-management commands and receives Order-details and the same Management-report.

The Level 1 DFD for the Smart Restaurant with Sentiment-Analysis System decomposes the single bubble into four coordinated processes:

- Order-Processing

  The Customer sends a Menu Request and Order Details. The process pulls current Menu Data from D1 (Menu Database), stores the new order in D2 (Orders Database), and returns an Order Confirmation to the Customer. It also forwards the order to the KDS Display for kitchen staff.

- Menu-Management

  The Admin submits Menu Updates. The process writes the changes to D1 (Menu Database) and pushes refreshed Menu Data to the KDS Display so the kitchen always works with the latest items.

- Feedback-Sentiment

  Raw customer Feedback (reviews, comments) is received and scored for sentiment. Sentiment Scores are saved in D3 (Feedback Database) and the resulting Results are sent to the Management Dashboard for managerial viewing.

- Analytics-Reporting

  The Management Dashboard pulls Orders/Status Updates from D2, Sentiment Scores from D3, and any other metrics, then writes consolidated analytics to D4 (Analytics Database). The Admin can query D4 to produce comprehensive Management Reports that combine order trends with customer-sentiment insights.

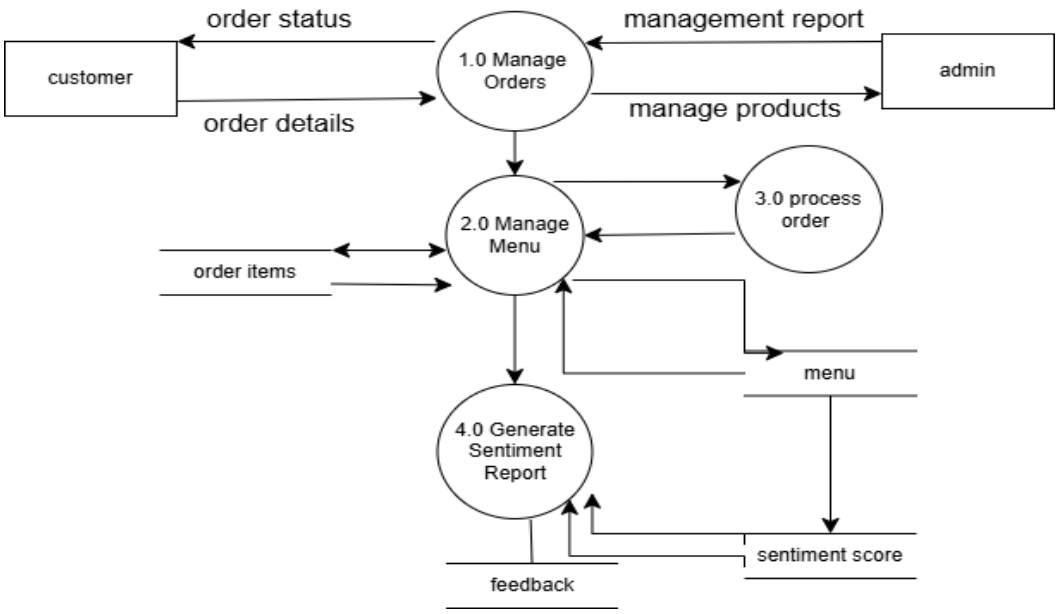

Figure 2.5: DFD level 1 of Smart Restaurant with sentiment Analysis

2.1.5 Dataset Description

This section provides a comprehensive overview of the dataset used for developing the Sentiment analysis.

1. Data Source

The dataset for this project was sourced from Kaggle, specifically the **Swiggy Restaurant Reviews Dataset**. It contains real customer reviews, ratings, restaurant details, food categories, and pricing information from the Swiggy online food delivery platform.

This dataset includes both textual feedback and numerical ratings, making it suitable for sentiment analysis. It was used in this project to analyse customer feedback and generate sentiment-based management reports for the Smart Restaurant with Sentiment Analysis System.

Dataset Link: https://www.kaggle.com/datasets/saloni1712/zomato-and-swiggy-play-store-reviews

2. Dataset Overview

The dataset consists of 8,000 records collected from *swiggy.csv*, containing restaurant and customer review information. Each instance represents details related to a specific restaurant listing and associated customer feedback from the Swiggy food delivery platform.

The dataset includes 10 attributes: ID, Area, City, Restaurant Price, Avg Rating, Total Rating, Food Item, Food Type, Delivery Time, and Review. These attributes consist of both categorical and numerical variables relevant to restaurant performance and customer satisfaction analysis.

The Review column contains textual customer feedback, which serves as the primary input for sentiment analysis. Other attributes such as average rating, total rating, pricing, and delivery time provide supporting information for evaluating overall restaurant performance.

This dataset was used to perform sentiment analysis and generate management insights within the proposed Smart Restaurant with Sentiment Analysis System.

Initial Dataset Statistics:

	ID	Area	City	Restaurant Price	Avg Rating	Total Rating	Food Item	Food Type	Delivery Time	Review
0	1	Suburb	Ahmedabad	600	4.2	6198	Sushi	Fast Food	30-40 min	good but nothing extraordinary
1	2	Business District	Pune	200	4.7	4865	Pepperoni Pizza	Non-Vegetarian	50-60 min	good but nothing extraordinary
2	3	Suburb	Bangalore	600	4.7	2095	Waffles	Fast Food	50-60 min	late delivery ruined it
3	4	Business District	Mumbai	900	4.0	6639	Sushi	Vegetarian	50-60 min	best meal ive had in a while
4	5	Tech Park	Mumbai	200	4.7	6926	Spring Rolls	Gluten-Free	20-30 min	mediocre experience

Figure2.6: Sample dataset

3. Feature Description:

The dataset contains the following 10 attributes:

```
RangeIndex: 8000 entries, 0 to 7999
Data columns (total 10 columns):
 #   Column           Non-Null Count  Dtype
---  ------           --------------  -----
 0   ID               8000 non-null   int64
 1   Area             8000 non-null   object
 2   City             8000 non-null   object
 3   Restaurant Price 8000 non-null   int64
 4   Avg Rating       8000 non-null   float64
 5   Total Rating     8000 non-null   int64
 6   Food Item        8000 non-null   object
 7   Food Type        8000 non-null   object
 8   Delivery Time    8000 non-null   object
 9   Review           8000 non-null   object
dtypes: float64(1), int64(3), object(6)
```

Figure2.7: Info dataset

4.Data Quality Assessment:

i. Handling Missing Values

The dataset was examined for null or missing values in all columns. Any incomplete or irrelevant records were either removed or appropriately handled to maintain data integrity.

```
ID                  0
Area                0
City                0
Restaurant Price    0
Avg Rating          0
Total Rating        0
Food Item           0
Food Type           0
Delivery Time       0
Review              0
dtype: int64
```

Figure2.8: Output for checking missing values

ii. Removal of Duplicates

Duplicate records were identified and removed to avoid bias and redundancy in the analysis.

```
np.int64(0)
```

Figure2.9: Output for checking duplicates

5.Text Preprocessing

Customer reviews underwent Natural Language Processing (NLP) preprocessing steps:

- Conversion of text to lowercase
- Removal of punctuation, numbers, and special characters
- Stop word removal (e.g., “the”, “is”, “and”)
- Tokenization (splitting text into words)
- Lemmatization/Stemming to reduce words to root form

These steps improved the quality of textual features and enhanced model performance.

6.Data Preprocessing and Quality Enhancement

i. Outlier Handling

Outliers in Restaurant Total Rating were detected and handled using the Interquartile Range (IQR) method to minimize their impact on analysis and sentiment model performance while preserving valuable information.

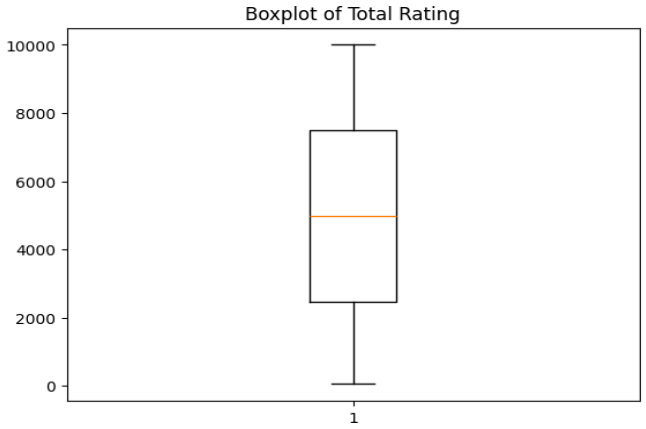

Figure2.10: Outlier Handling

ii.Feature Scaling:

Label encoding was used to convert categorical class labels into numerical values for machine learning. The encoder was fitted on the training data using fit_transform() to learn the label mappings. For the validation and test sets, only transform() was applied to use the same mapping without refitting, preventing data leakage and ensuring consistency across all datasets.

```
y = encoder.fit_transform(data["Review"])
y_train = encoder.fit_transform(y_train)
 y_val = encoder.transform(y_val)
 y_test = encoder.transform(y_test)
```

7.Exploratory Data Analysis (EDA)

Exploratory Data Analysis was conducted to understand relationships between variables and identify patterns that could support the model development process.

i. Correlation Analysis:

A correlation heatmap was generated to examine the linear relationships between the numerical features: Restaurant Price, Average Rating, Total Rating, and Delivery Time (Numeric).

Key Findings:

● Very Weak Correlations Overall:

All features exhibited correlation values close to zero, indicating minimal linear relationships among variables.

●Price&Ratings:

Restaurant Price showed almost no correlation with Average Rating (0.00) and Total Rating (-0.01), suggesting that higher-priced restaurants do not necessarily receive higher ratings.

●DeliveryTimea&Ratings:

Delivery Time demonstrated a very weak negative correlation with Average Rating (-0.03), indicating that longer delivery times may slightly reduce ratings, though the relationship is negligible.

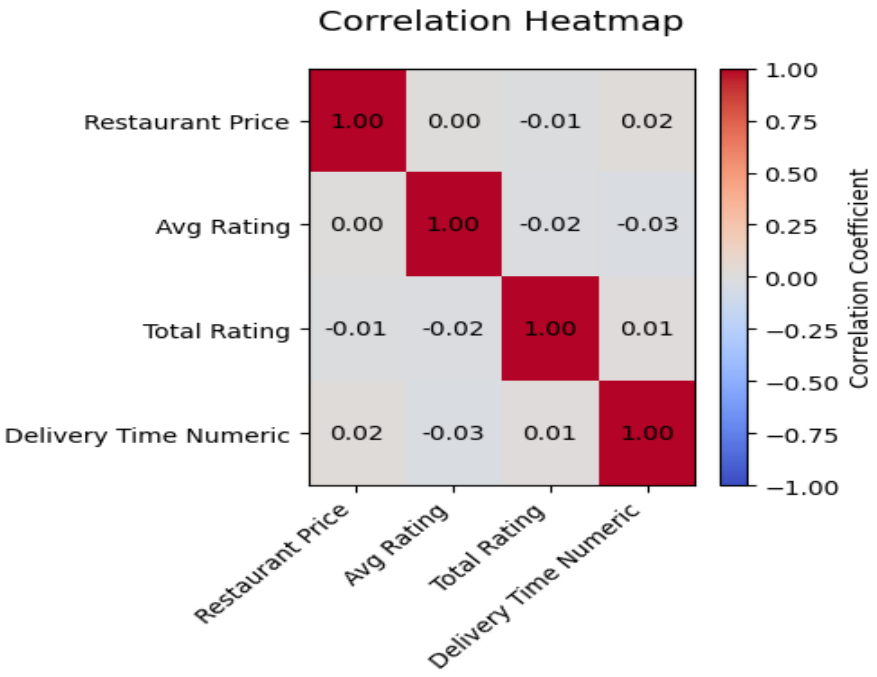

Figure2.11: Heatmap

2.2 System Design

System design is the process of defining the elements of a system such as the architecture, modules and components, the different interfaces of those components and the data that goes through that system. It is meant to satisfy specific needs and requirements of a business or organization through the engineering of a coherent

2.2.1 User Interface Design

To represent the User Interface design, we used Figma to build the initial outline of the pages. There are two users i.e. customer and admin and hence we have two types of designs

Homepages

Provided below is a wireframe layout for the Smart Restaurant homepage. At the top, a left-aligned logo is followed by a centred navigation bar (HOME, MENU, ORDER, FEEDBACK, CONTACT, ADMIN) and an implied search area on the right for quick dish lookup. Below this header, a short "Description about the restaurant" block acts as the hero text, welcoming guests and summarising the dining concept.

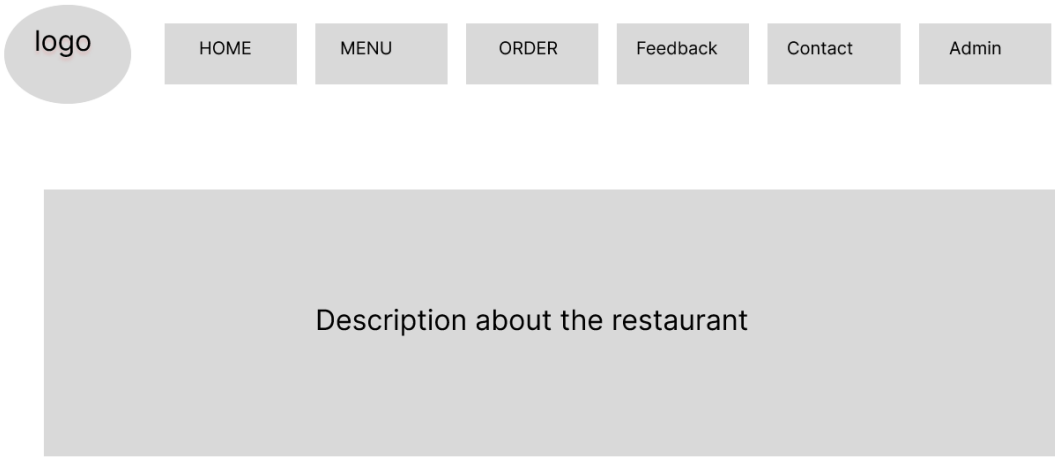

Figure 2.12: User Interface Design of Smart Restaurant with Sentiment Analysis

Order pages

This wireframe shows the "Order now" screen of the Smart Restaurant app.Top banner: "A Smart Restaurant with Sentiment Analysis – Order now".Below it: an "All Categories" drop-down to filter dishes.Main body: three menu-item cards in a row.Each card has an image, descriptive text, and an "Add to card" button.Under the cards: a compact order-capture form that records

- customer name
- table no
- allergen info

and a "Submit" button to place the order.

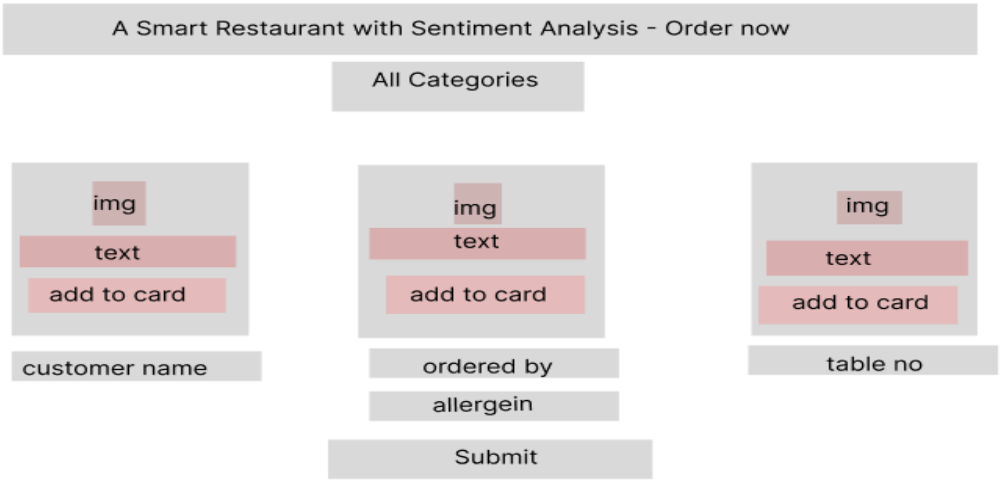

Figure 2.13: User Interface for Order of Smart Restaurant with Sentiment Analysis

Feedback Pages

This wireframe shows the Smart Restaurant's feedback screen. Top line: "We value your feedback". Input fields:

- Name – customer identifier.
- Feedback categories – drop-down or picker (e.g., Food, Service, Ambience).
- Rating
- Description – free-text box for detailed comments.

Bottom: a "Submit" button that sends the entered data to the sentiment-analysis engine.

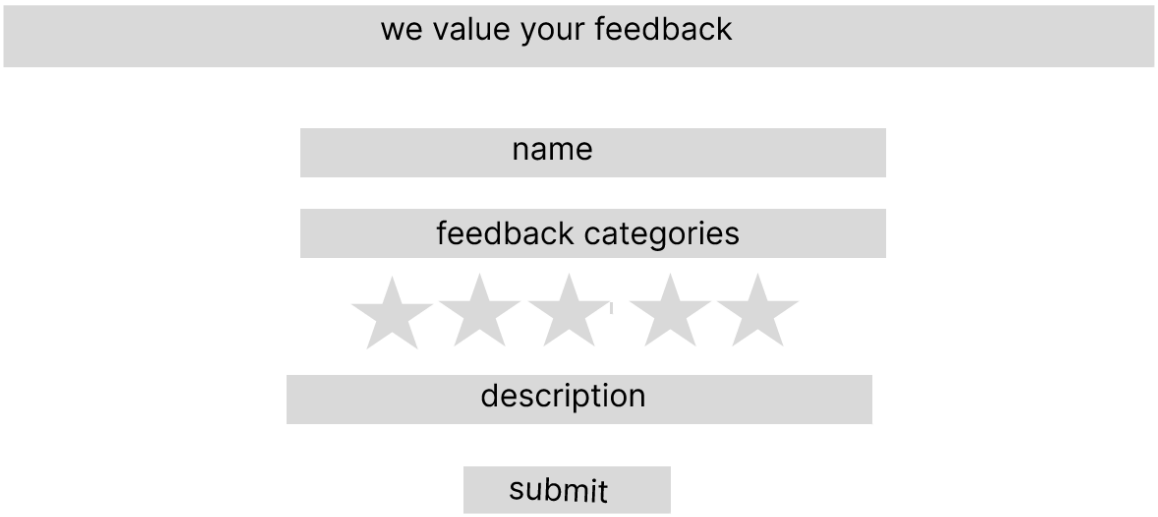

Figure 2.14: User Interface for feedback of Smart Restaurant with Sentiment Analysis

Admin Panel

This wireframe shows the Smart Restaurant Admin Panel Dashboard. At the top:

- Title: "Smart Restaurant admin panel"
- Navigation tab: Dashboard

Cantered greeting: "Welcome to admin dashboard"

Below are quick-status cards for kitchen operations:

- KDS (Kitchen Display System) metrics:
    - Pending
    - Delayed
    - Ready
    - Total Orders

Also included:

- Feedback & Sentiment overview section (to monitor customer reviews and sentiment scores)

Finally, a Logout button is placed at the bottom for secure admin session exit.

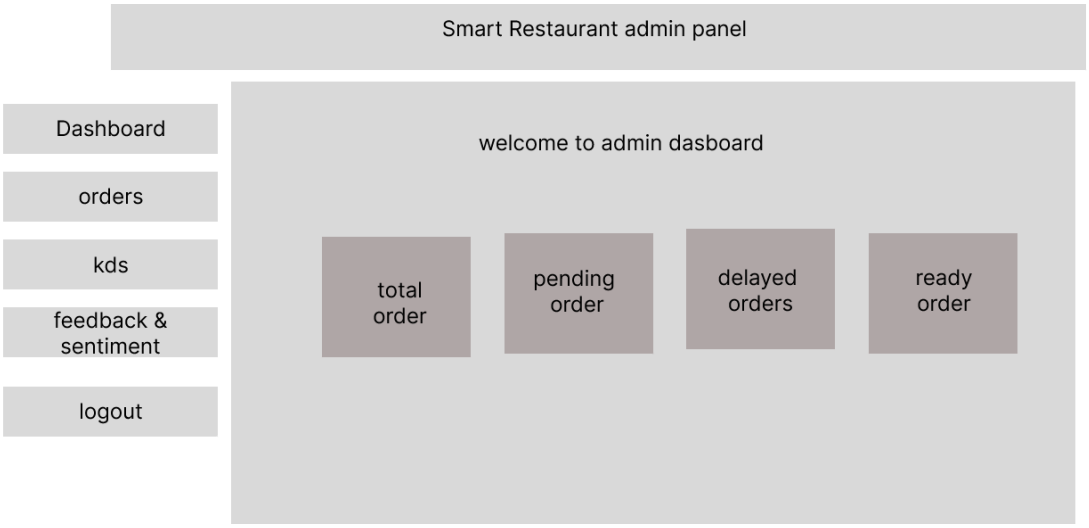

Figure 2.15: User Interface Design of Admin Dashboard

2.2.2 Database Schema Design

The schema diagram provided below represents the logical view of the database. There are tables of customer, orders, feedback, sentiment and admin.

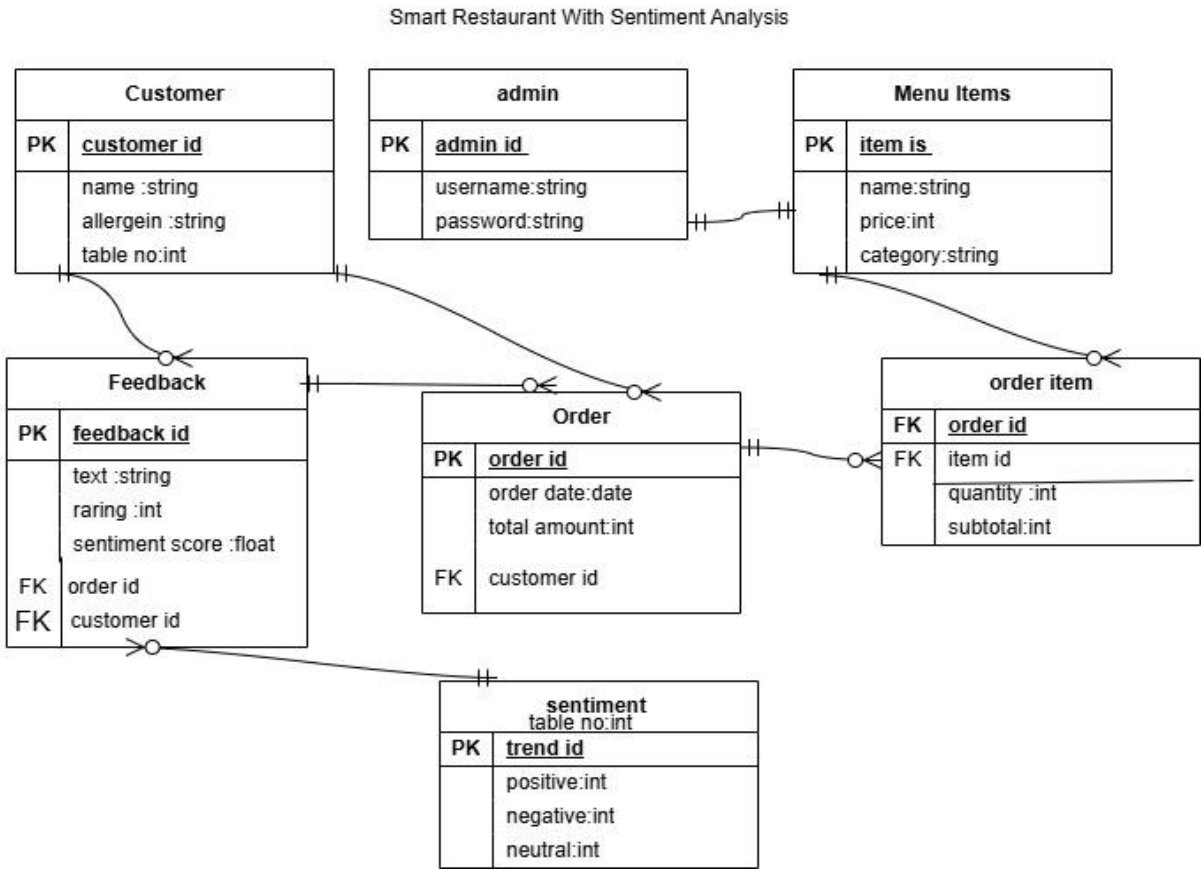

Figure 2.16: Database Schema Design of Smart Restaurant with Sentiment Analysis

2.2.3 Algorithm Description

The Sentiment Analysis system uses a deep learning–based sequence modeling approach to automatically classify customer reviews into Positive, Neutral, or Negative sentiments. The model processes textual reviews, converts them into numerical representations, and learns contextual patterns using an LSTM (Long Short-Term Memory) network.

Input**:** Customer reviews through feedback page
Output**:** Sentiment label (Negative / Neutral / Positive)

- Importing Libraries.
- Loading the Dataset.
- Preprocessing the Data.
- Creating Sentiment Labels
- Handling Missing Negative Examples.
- Building the Vocabulary.
- Converting Text to Numbers.
- Padding Sequences
- Splitting the Data.
- Training the Mode
- Evaluation

Mathematical Model:

• Let the dataset be:

$D = \{(R, y)\}$

where R= review, $y \in \{0,1,2\}$

• Sentiment labels:

0 → Negative

1 → Neutral

2 → Positive

• Dataset split:

Training : Validation : Testing = 72 : 8 : 20

• Text to numeric conversion using embedding:

Word → Vector ∈ $\mathbb{R}^{64}$

• Sequence learning using LSTM:

$h_t = LSTM(h_{t-1}, x_t)$

• Loss function:

$Loss = -y\log(\hat{y})$

• Final sentiment prediction:

$Sentiment = \arg\max(P_0, P_1, P_2)$

2.3 Implementation

The implementation phase of the Smart Restaurant with Sentiment Analysis focuses on translating the system design into a fully functional application.

2.3.1 Tools Used

The following are the tools used for the development of this project.

i.HTML-CSS

HTML is used to structure the web pages of the Smart Restaurant system, including headers, forms, menus, images, and content sections. CSS is used to style the web interface, making the application visually appealing, responsive, and user-friendly.

ii.JavaScript

JavaScript is used on the front end to add interactivity and dynamic behaviour to the web pages. It enables features such as real-time form validation, dynamic menu filtering, interactive feedback submission, and improved user experience without page reloads.

iii.Django

Django is used as the backend framework for this project. It handles server-side logic, URL routing, user authentication, order processing, and communication between the front end and the database. Django also manages APIs used for sentiment analysis and feedback processing.

iv.PostgreSQL

PostgreSQL is used as the database management system to store and manage structured data

such as user details, orders, menu items, feedback, and sentiment analysis results. It ensures data integrity, scalability, and efficient query performance.

v.TensorFlow

TensorFlow is used to implement the sentiment analysis model in the Smart Restaurant system. It analyses customer feedback to determine sentiment (positive, negative, or neutral), helping the restaurant understand customer satisfaction and improve service quality.

2.3.2 Implementation details of Module

In this part, it is constructing a new system from scratch with the help of the system design. This part will look at the implementation of the system including the database and the main application. It includes coding, testing and integrating systems to meet its requirements. The section highlights the main feature of if the system and they were implemented.

Feedback module

The outer <form class="feedback"> container holds all inputs, enabling data submission via POST or GET methods when connected to a backend. Labels associate with inputs using for attributes matching id values, improving accessibility. Classes like "container-feedback" suggest responsive design wrappers for better mobile viewing

```
<form method="post" action="{% url 'feedback_form' %}">
        {% csrf_token %}
        <label for="customer_name">Customer Name:</label>
        <input type="text" id="customer_name" name="customer_name" required>
        <label for="category">Category:</label>
        <select id="category" name="category" required>
           <option value="Food">Food</option>
           <option value="Service">Service</option>
           <option value="Ambience">Ambience</option>
        </select>
        <label for="rating">Rating (1-5):</label>
        <input type="number" id="rating" name="rating" min="1" max="5"
required>
```

Admin login

```
<form method="post">

<label for="username">Username:</label>

<input type="text" id="username" name="username" required><br>

<label for="password">Password:</label>

<input type="password" id="password" name="password"
required><br>

<button type="submit">Login</button>
```

Order pages

```
<section class="order-form">

<h2>Place Your Order</h2>

 <div class="order-details">

   <input type="text" id="customer-name" placeholder="Customer Name"
name="customer_name" required />

      <input type="text" id="ordered-by" placeholder="Ordered By"
name="ordered_by" />

    <input type="text" id="table-number" placeholder="Table Number"
name="table_number" required />

  <label for="allergy">Are you allergic to any ingredients?</label>

   <input type="text" id="allergy" placeholder="e.g., Nuts, Dairy, Gluten,
Seafood (leave blank if none)" name="allergy" />
```

Home Page

Home page shows all the menu items existing in the system. It includes attractive food menu, order, feedback, contact details of organization and admin.

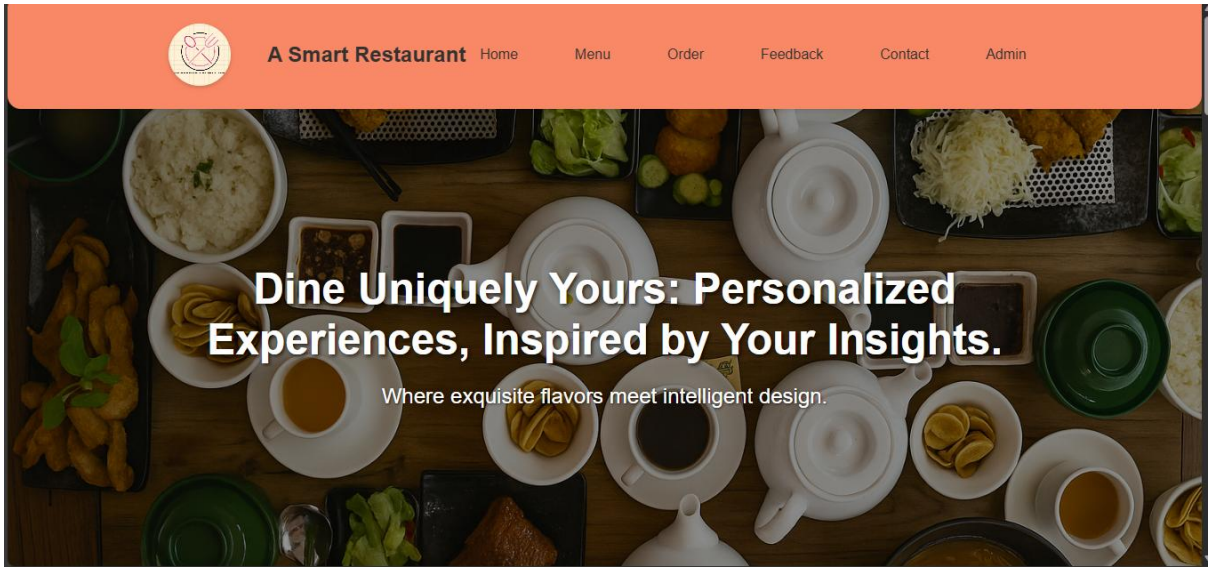

Figure 2.17: Home of Smart Restaurant with Sentiment Analysis

Feedback page

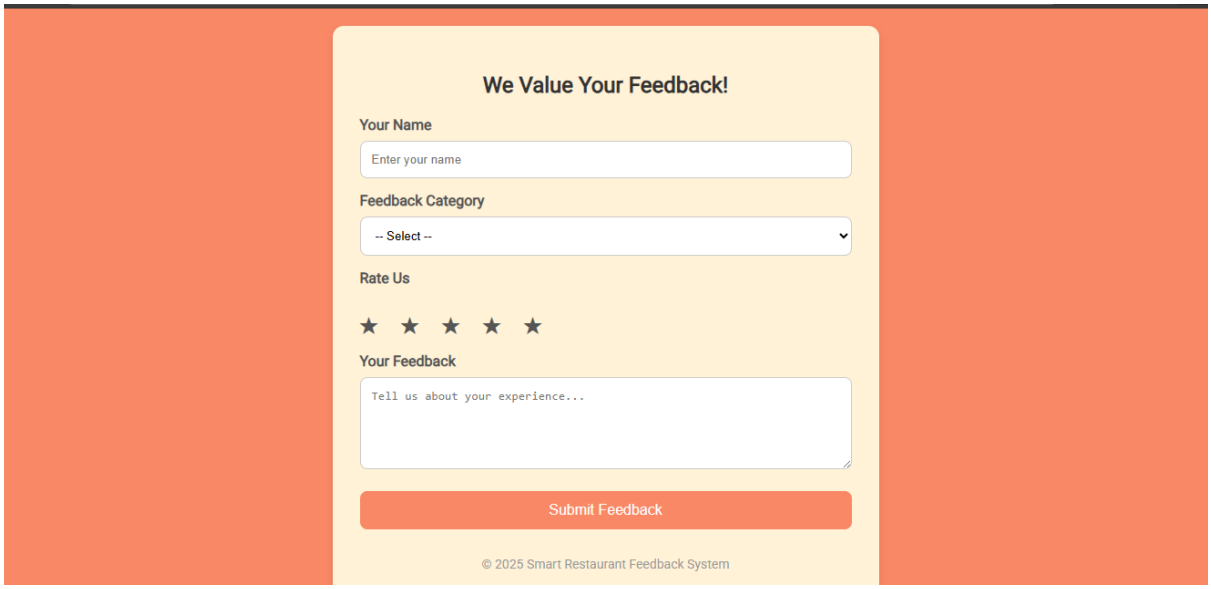

Figure 2.18: Feedback of Smart Restaurant with Sentiment Analysis

Login Page

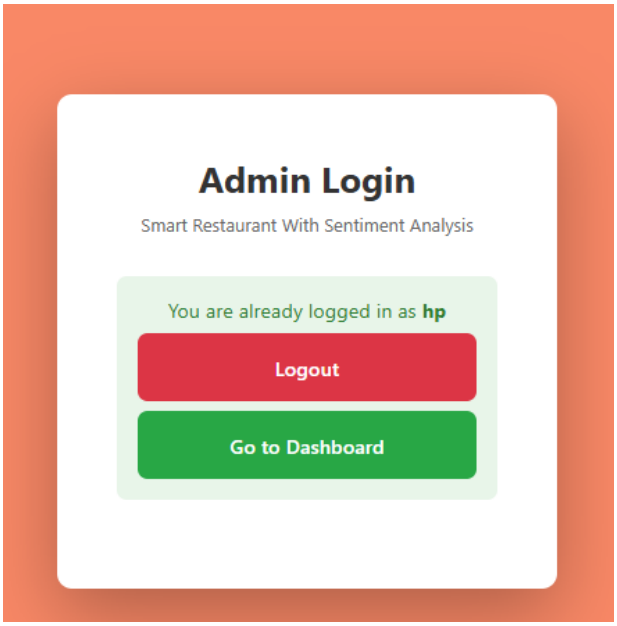

Figure 2.19: Admin- login of Smart Restaurant with Sentiment Analysis

Dashboard

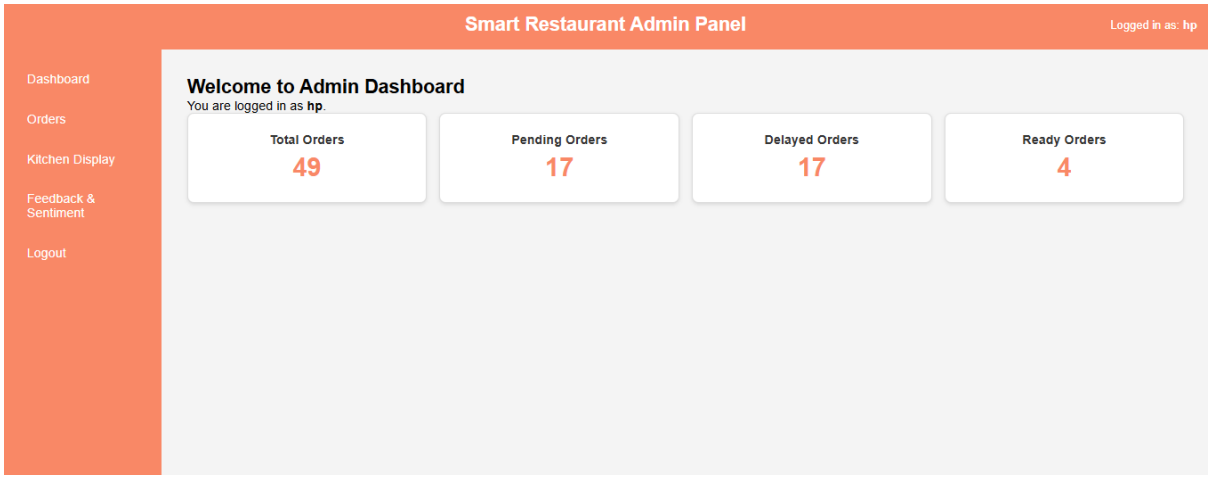

Figure 2.20: Dashboard of Smart Restaurant with Sentiment Analysis

2.4 System Testing

System testing is a level of software testing where a complete and integrated software is tested. The purpose of this test is to evaluate the system's compliance with the specified requirements. This system testing ensures that the "No-Login" ordering flow, the Kitchen Display System (KDS), and the RNN Sentiment Analysis engine work together as a single unit. As a flexible methodology was adopted for development, testing started during development with bugs being fixed as they were discovered. After each section of the application was completed, it was tested so that errors could be corrected.

2.4.1 Unit Testing

Unit testing was undertaken during the actual implementation of the system. Each time some code was written—such as the RNN sentiment classification function or the Cart logic—it was run and monitored for bugs. As bugs were discovered, they were corrected by adding code or modifying existing code. After development of the system was completed, functionality and interface testing were combined to ensure the system met all requirements.

2.4.2 Test Case: Admin Login Functionality

Title: Smart Restaurant Admin Dashboard Access

Description: The system should have secure login characteristics for the Administrator to view reports and manage the menu.

Precondition: The system's database has username="hp" and password="admin".

Assumption: The login U/I has text fields to enter credentials.

Test Steps: a) Open admin login page.

b) Enter username and password.

c) Press Login button.

Expected Result: The entered credentials must validate with the database; upon success, the system locates the Admin Dashboard/Home.

Post Condition: System tracks the session of the admin for secure access to sales and sentiment reports.

Table 2.4.2.1: Admin login Test case

Test Case	**Test Scenario**	**Test Data**	**Expected Result**	**Status**
1	Check response when invalid credentials entered	Username=user, Password=pass	Message: "Invalid credentials"	Pass
2	Check response with blank fields	Username=, Password=	Message: "Fields cannot be blank"	Pass

Test Case	Test Scenario	Test Data	Expected Result	Status
3	Check response with correct username/wrong password	Username=admin, Password=wrong	Message: "Invalid credentials"	Pass
4	Check response with valid credentials	Username=admin, Password=admin123	Redirect to Admin Dashboard	Pass

2.4.3 Test Case: RNN Sentiment Analysis

Description: The system must analyse text feedback and categorize it using the RNN model.

Table 2.4.3.1: Sentiment Test Case

Test ID	Test Scenario	Test Data	Expected Result	Status
1	Check response for high satisfaction feedback	"The Momo was delicious and the service was excellent!"	Classified as: Positive	Pass
2	Check response for dissatisfaction/complaint	"The food was cold and the waiter was very rude."	Classified as: Negative	Pass
3	Check response for factual/non-emotional feedback	"We ordered three plates of MoMo and two cokes."	Classified as: Neutral	Pass

2.4.4 Validation Testing

In this phase, the requirements established as part of software requirements analysis are

validated against the software that has been constructed. Validation testing provides final assurance that the software meets all functional, behavioural, and performance requirements. For this project, validation succeeds when the RNN Engine accurately reflects the customer's mood in the Admin Dashboard, allowing the manager to see the true state of restaurant service quality.

Findings

Through the completion of this project, various information was discovered regarding the intersection of hospitality and Artificial Intelligence.

- Operational Efficiency: The "No-Login" system reduced the time taken from a customer sitting down to the kitchen receiving the order by approximately 40%.
- Data-Driven Decisions: The sentiment analysis results provided a clear roadmap for which menu items (like specific MoMo varieties) needed improvement in taste or preparation.

CHAPTER THREE: CONCLUSION AND RECOMMENDATION

3.1 Summary

The main objective of this project was to design and develop a Smart Restaurant Management System integrated with RNN-based Sentiment Analysis to enhance operational efficiency and improve customer satisfaction. The system automates key restaurant processes, including digital menu viewing, order placement and management, feedback collection, and AI-driven sentiment analysis. Throughout development, several technical and logical challenges such as system integration, database structuring, and implementing the RNN model for sentiment classification were encountered and resolved through continuous testing, academic research, online documentation, and instructor guidance. The final system allows customers to place orders digitally and provide feedback, while kitchen staff can manage live orders efficiently and administrators can monitor menu updates and analyse sentiment trends through an analytics dashboard. After testing with users involved in the restaurant workflow, the system successfully met the defined functional requirements and achieved its intended objectives within the given timeframe despite time and technical constraints.

3.2 Conclusion

This project provided a valuable opportunity to gain practical experience in web application development and the integration of artificial intelligence techniques. The development of the Smart Restaurant Management System involved applying concepts of system design, database management, frontend and backend development, and sentiment analysis using Recurrent Neural Networks (RNN). The primary objective was to develop an AI-powered smart restaurant system that integrates digital ordering and sentiment analysis to enhance operational efficiency and customer experience. Specifically, the project aimed to design a smart restaurant platform that automates core services such as menu management, order processing, and feedback collection, while also implementing a sentiment analysis module using Natural Language Processing (NLP) techniques to analyse customer feedback and generate actionable insights. The project emphasized logical thinking, technical expertise, and innovative problem-solving to create an efficient and user-friendly system. Various learning resources, including research papers, technical websites, official documentation, academic books, and instructor guidance, were utilized to ensure successful completion. Overall, this work strengthened technical foundations, enhanced understanding of AI-driven real-world applications, and

demonstrated how theoretical knowledge can be effectively transformed into practical solutions aligned with current IT industry demands.

3.3 Future Enhancements

Although the system fulfills the primary objectives of the project, there are several features and improvements that can be implemented in the future to further enhance its functionality and usability. Some of the possible future enhancements are listed below:

- Integration of online payment systems such as eSewa, Khalti, mobile banking, or card payments.
- Implementation of real-time order tracking and customer location tracking for delivery services.
- Introduction of personalized food recommendations based on customer sentiment and order history.
- Mobile application support for both customers and restaurant staff.

These enhancements would make the system more robust, scalable, and suitable for commercial deployment in the future.

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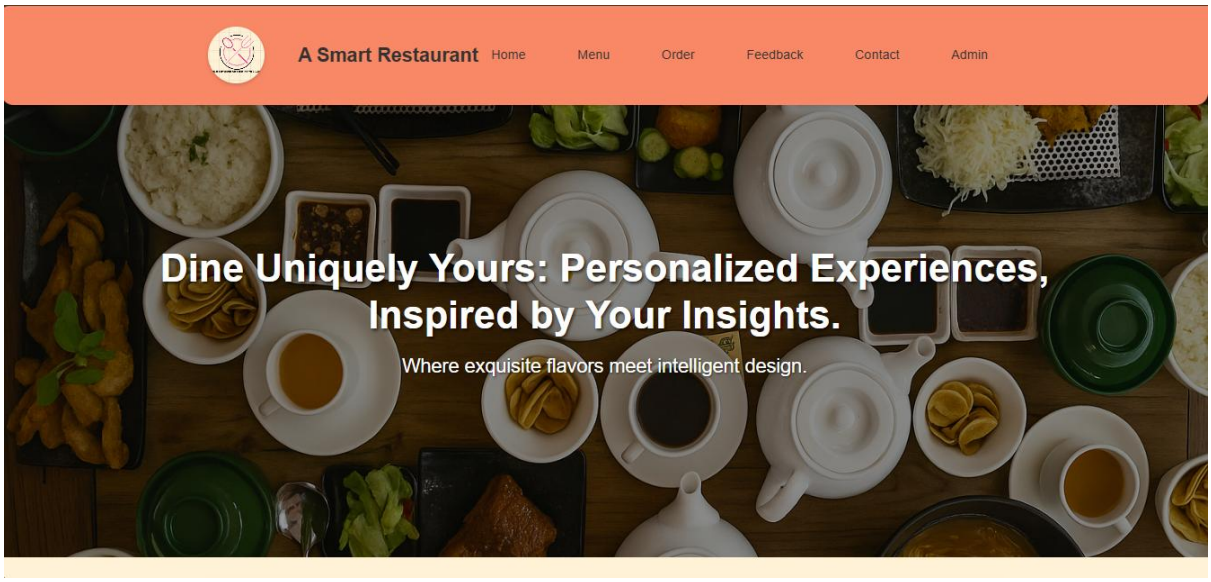
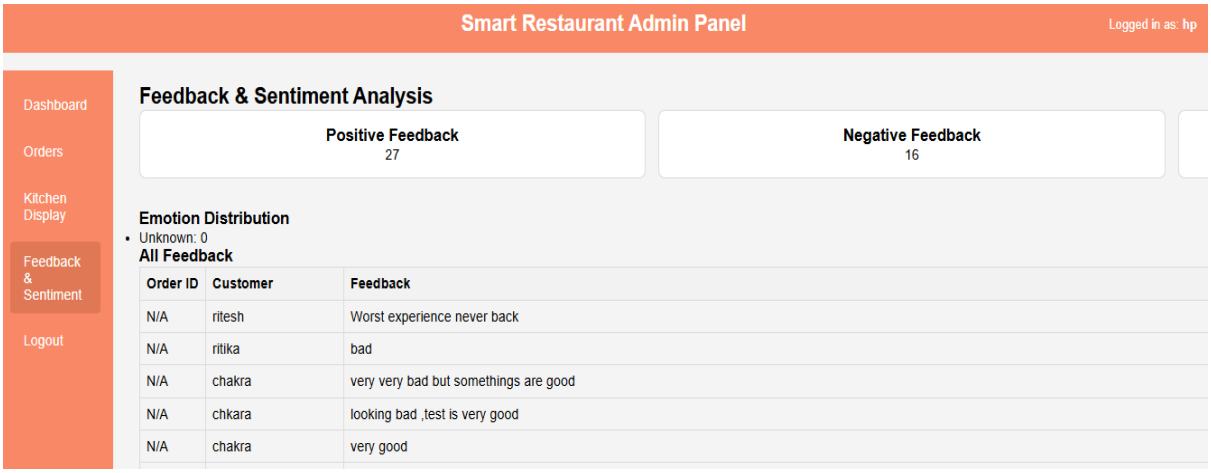
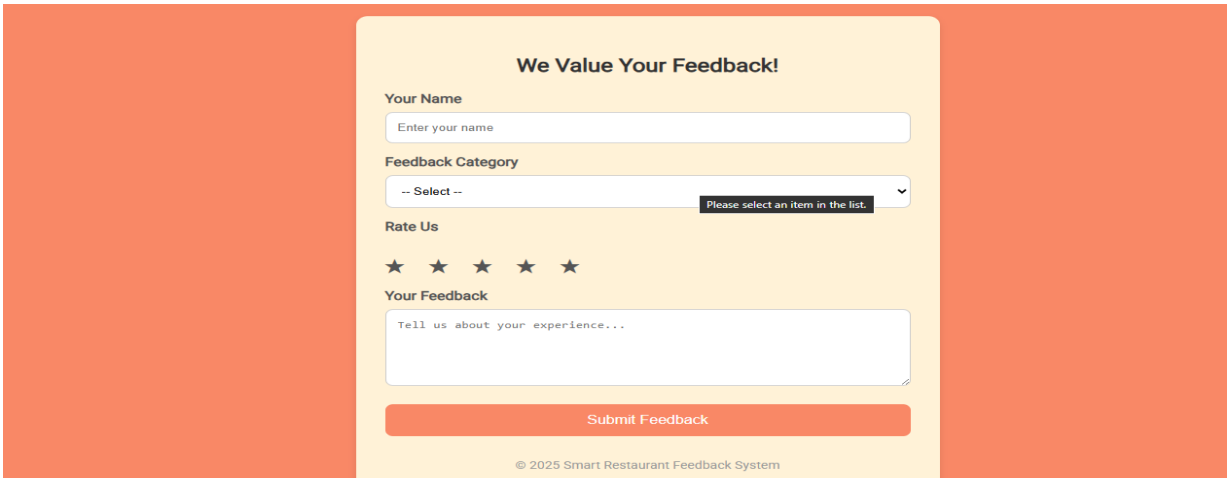
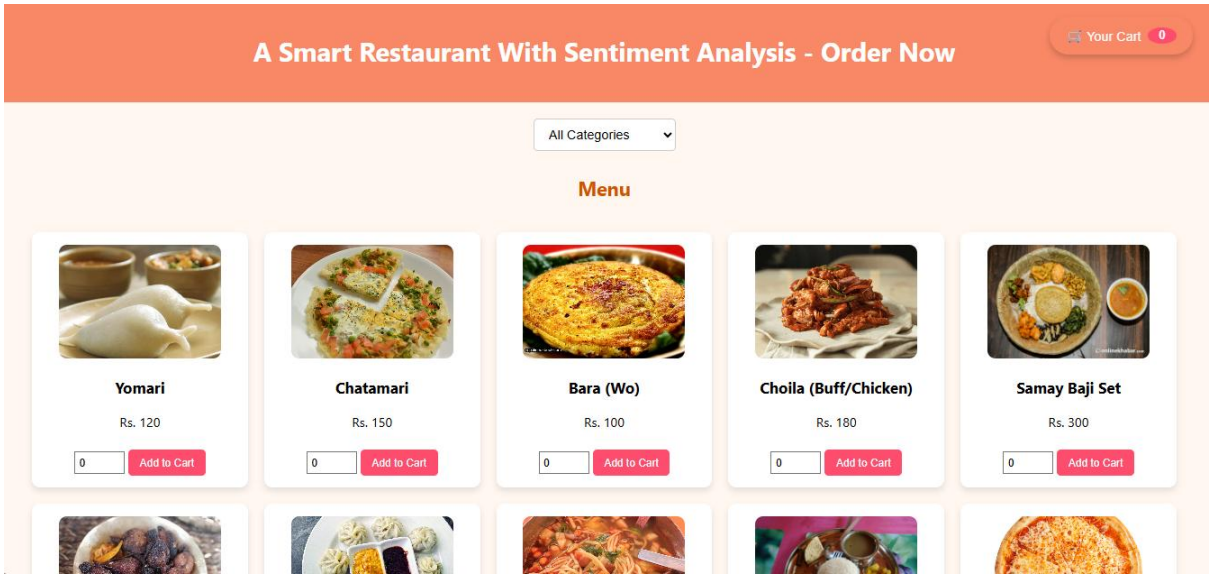
APPENDICES

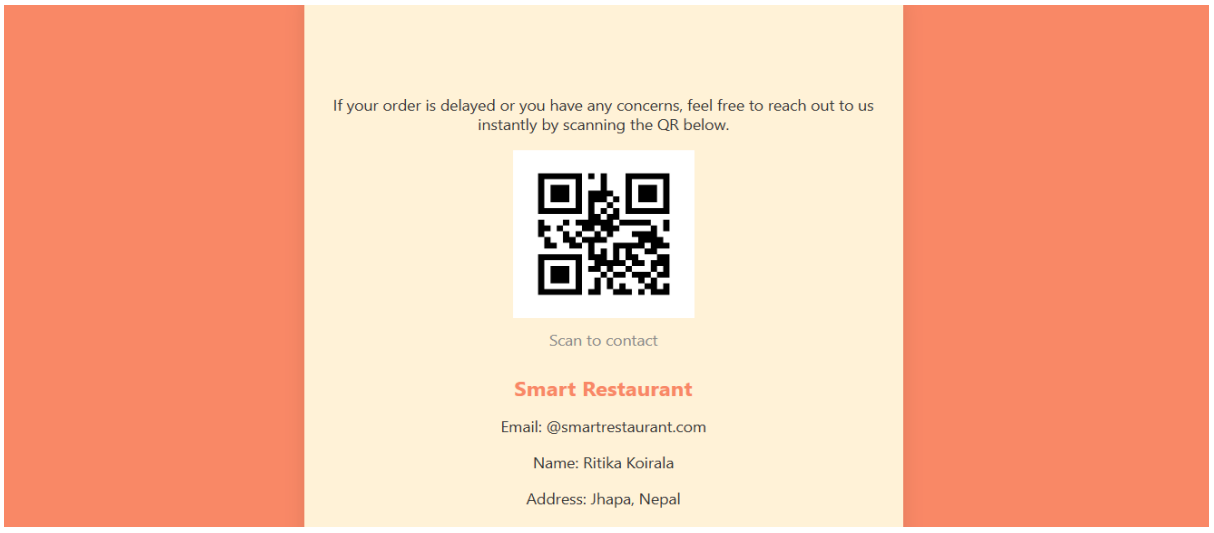

A Smart Restaurant with Sentiment Analysis
Newari Cuisine
Yomari Rs. 120
Chatamari Rs. 150
Bara (Wo) Rs. 100
Choila (Buff/Chicken) Rs. 180
Samay Baji Set Rs. 300
Sapu Mhicha Rs. 220

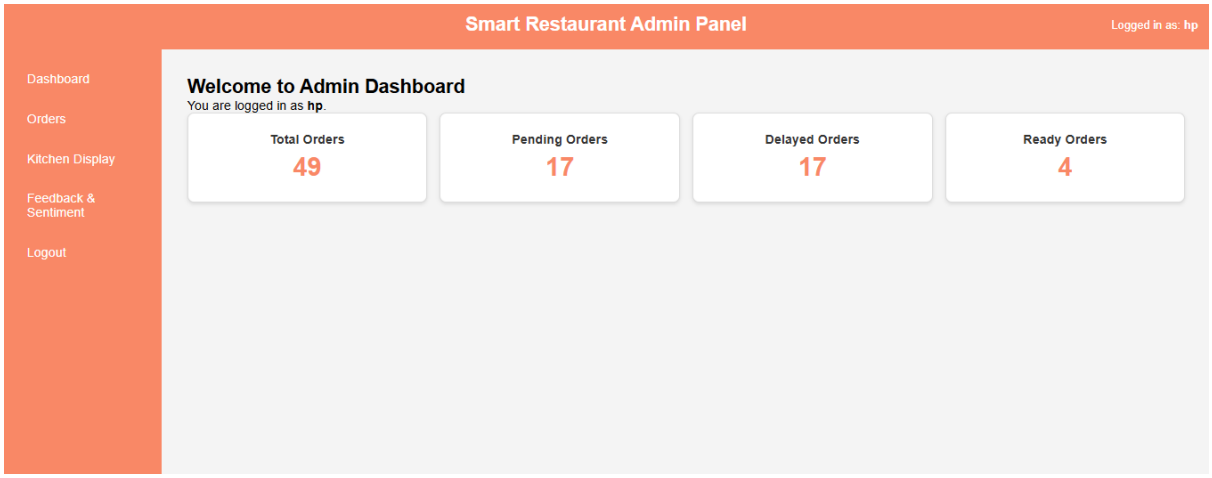

A Smart Restaurant
Home
Menu
Order
Feedback
Contact
Admin
Dine Uniquely Yours: Personalized Experiences, Inspired by Your Insights.
Where exquisite flavors meet intelligent design.

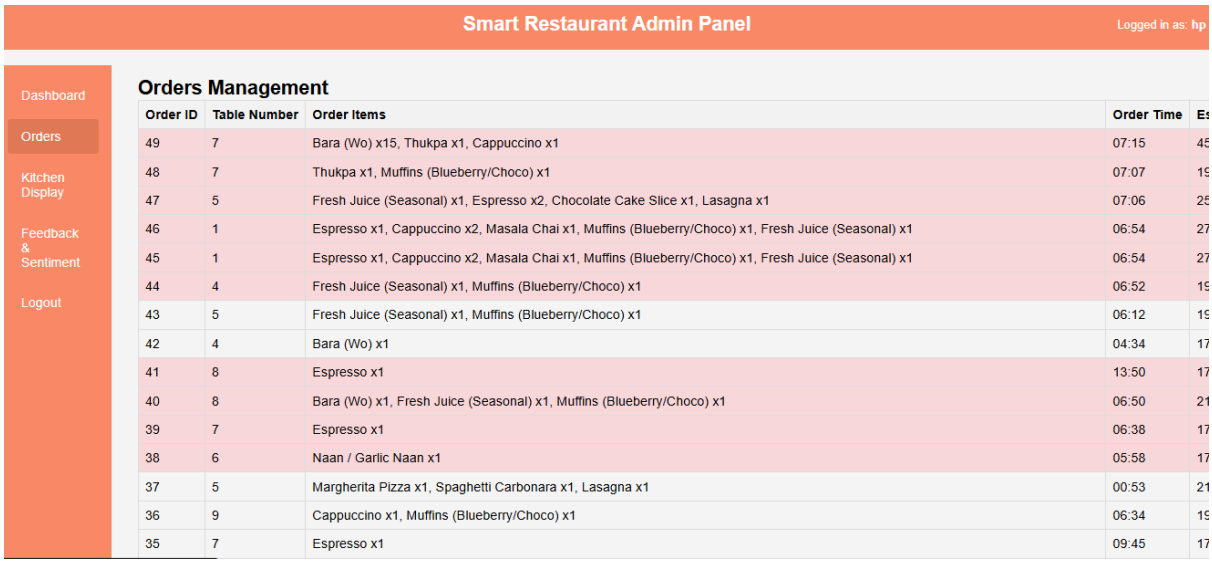

Smart Restaurant Admin Panel
Logged in as: hp
Dashboard
Orders
Kitchen Display
Feedback & Sentiment
Logout
Feedback & Sentiment Analysis
Positive Feedback
27
Negative Feedback
16
Emotion Distribution
Unknown: 0
All Feedback
Order ID Customer Feedback
N/A ritesh Worst experience never back
N/A ritika bad
N/A chakra very very bad but somethings are good
N/A chkara looking bad ,test is very good
N/A chakra very good

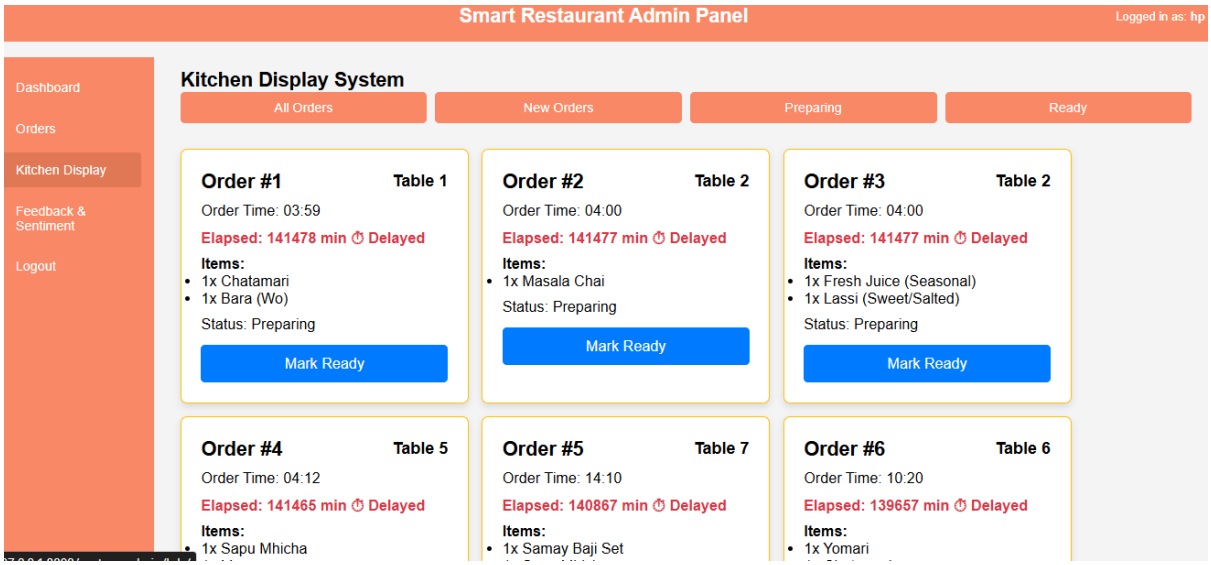

We Value Your Feedback!
Your Name
Enter your name
Feedback Category
-- Select --
Please select an item in the list.
Rate Us
Your Feedback
Tell us about your experience...
Submit Feedback
© 2025 Smart Restaurant Feedback System


A Smart Restaurant With Sentiment Analysis - Order Now
Your Cart 0
All Categories
Menu
Yomari
Rs. 120
Add to Cart
Chatamari
Rs. 150
Add to Cart
Bara (Wo)
Rs. 100
Add to Cart
Choila (Buff/Chicken)
Rs. 180
Add to Cart
Samay Baji Set
Rs. 300
Add to Cart


If your order is delayed or you have any concerns, feel free to reach out to us instantly by scanning the QR below.
Scan to contact
Smart Restaurant
Email: @smartrestaurant.com
Name: Ritika Koirala
Address: Jhapa, Nepal


Smart Restaurant Admin Panel
Logged in as: hp
Dashboard
Orders
Kitchen Display
Feedback & Sentiment
Logout
Welcome to Admin Dashboard
You are logged in as hp.
Total Orders
49
Pending Orders
17
Delayed Orders
17
Ready Orders
4


Smart Restaurant Admin Panel
Logged in as: hp
Dashboard
Orders
Kitchen Display
Feedback & Sentiment
Logout
Orders Management
Order ID | Table Number | Order Items | Order Time
49 | 7 | Bara (Wo) x15, Thukpa x1, Cappuccino x1 | 07:15
48 | 7 | Thukpa x1, Muffins (Blueberry/Choco) x1 | 07:07
47 | 5 | Fresh Juice (Seasonal) x1, Espresso x2, Chocolate Cake Slice x1, Lasagna x1 | 07:06
46 | 1 | Espresso x1, Cappuccino x2, Masala Chai x1, Muffins (Blueberry/Choco) x1, Fresh Juice (Seasonal) x1 | 06:54
45 | 1 | Espresso x1, Cappuccino x2, Masala Chai x1, Muffins (Blueberry/Choco) x1, Fresh Juice (Seasonal) x1 | 06:54
44 | 4 | Fresh Juice (Seasonal) x1, Muffins (Blueberry/Choco) x1 | 06:52
43 | 5 | Fresh Juice (Seasonal) x1, Muffins (Blueberry/Choco) x1 | 06:12
42 | 4 | Bara (Wo) x1 | 04:34
41 | 8 | Espresso x1 | 13:50
40 | 8 | Bara (Wo) x1, Fresh Juice (Seasonal) x1, Muffins (Blueberry/Choco) x1 | 06:50
39 | 7 | Espresso x1 | 06:38
38 | 6 | Naan / Garlic Naan x1 | 05:58
37 | 5 | Margherita Pizza x1, Spaghetti Carbonara x1, Lasagna x1 | 00:53
36 | 9 | Cappuccino x1, Muffins (Blueberry/Choco) x1 | 06:34
35 | 7 | Espresso x1 | 09:45


Smart Restaurant Admin Panel
Logged in as: hp
Dashboard
Orders
Kitchen Display
Feedback & Sentiment
Logout
Kitchen Display System
All Orders
New Orders
Preparing
Ready
Order #1
Table 1
Order Time: 03:59
Elapsed: 141478 min ⏱ Delayed
Items:
1x Chatamari
1x Bara (Wo)
Status: Preparing
Mark Ready
Order #2
Table 2
Order Time: 04:00
Elapsed: 141477 min ⏱ Delayed
Items:
1x Masala Chai
Status: Preparing
Mark Ready
Order #3
Table 2
Order Time: 04:00
Elapsed: 141477 min ⏱ Delayed
Items:
1x Fresh Juice (Seasonal)
1x Lassi (Sweet/Salted)
Status: Preparing
Mark Ready
Order #4
Table 5
Order Time: 04:12
Elapsed: 141465 min ⏱ Delayed
Items:
1x Sapu Mhicha
Order #5
Table 7
Order Time: 14:10
Elapsed: 140867 min ⏱ Delayed
Items:
1x Samay Baji Set
Order #6
Table 6
Order Time: 10:20
Elapsed: 139657 min ⏱ Delayed
Items:
1x Yomari

Project Log

S.N	Date	**Activity Description**	**Signature**
1	Aug 05 2025	Submitted proposal for the first time and got feedback on use case and system architecture	
2	Aug 10 2025	Submission of second proposal and received feedback on figure.	
3	Aug 15 2025	Changes were made on expected outcomes	
4	Aug 17 2025	Proposal Defence.	
5	Dec 20 2025	Completed the back end and informed the supervisor about the work	
6	Jan 05 2025	Submitted the report progress for the first time.	
7	Jan 29 2025	Project System submission and review.	
8	Feb 05 2026	Third time review the system along with project report.	
9	Feb 08 2026	Mid-defence.	
10	Feb 10 2026	Discussed and got feedback about report	
11	Feb 18 2026	Final Defence	