Food Feedback: AI Driven Review Insights

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Abstract: *Restaurants often struggle with challenges such as declining profits and ineffective improvement strategies. One of the primary reasons behind this is the inability to accurately determine which food items are disliked by customers based on their feedback. Many restaurants collect reviews, but without a structured approach to analyzing them, valuable insights are often overlooked. Understanding customer preferences is crucial for enhancing food quality, service, and overall dining experiences. Addressing these challenges can significantly boost customer satisfaction and, in turn, improve business performance. This project introduces a system that helps restaurant owners identify weaknesses in their offerings through automated customer feedback analysis. By utilizing a machine learning-based classification model, specifically the Naïve Bayes algorithm, the system processes and categorizes textual feedback to determine sentiment. The extracted insights are stored in an SQLite database, allowing restaurant owners to access structured and meaningful data. Natural Language Processing (NLP) techniques, implemented using the NLTK library, enhance the accuracy of text analysis. Additionally, a user-friendly interface built with Tkinter ensures that restaurant owners and managers can easily navigate the system without requiring technical expertise. Unlike traditional feedback collection methods, this system ensures that only customers who have actually tried the food can submit reviews, eliminating unreliable or irrelevant feedback. Byleveraging this intelligent feedback system, restaurant owners can make informed decisions to refine their menus, adjust recipes, and improve service. This data-driven approach helps businesses identify patterns in customer preferences, leading to better customer retention, increased profits, and overall operational efficiency. Ultimately, this project provides a practical solution for enhancing restaurant performance and customer satisfaction.*

Key Words: Customer Feedback, Machine Learning, Naive Bayes Algorithm, Natural Language Processing, SQLite Database, Sentiment Analysis, Operational Efficiency.

1. INTRODUCTION

In today's highly competitive restaurant industry, ensuring high customer satisfaction and maintaining a steady revenue stream is crucial for success. However, many restaurants face challenges in understanding and addressing the areas where they can improve. A major obstacle is the difficulty in interpreting customer feedback effectively, as traditional methods of gathering reviews such as comment cards, online forms, or word-of-mouth often fail to provide meaningful insights. These methods are typically biased, incomplete, or not representative of the overall customer experience, which leads to missed opportunities for improvement [1-4]. To overcome these limitations, more restaurants are adopting advanced technologies like machine learning and natural language processing (NLP) to analyze customer feedback more accurately and efficiently. Sentiment analysis, in particular, has proven to be a valuable tool in extracting meaningful in- formation from customer reviews. By identifying the sentiments behind the feedback whether positive, negative, or neutral restaurants can better understand what aspects of their service or menu are well-received and where improvements are needed [5-7]. This automated process eliminates human biases and enables restaurant owners to make data-driven decisions. Machine learning techniques, especially the Naïve Bayes algorithm, have shown great promise in classifying textual data into predefined categories such as sentiment

or topic [8-10]. These algorithms, combined with NLP tools, help in efficiently processing large volumes of customer feedback. Additionally, NLP libraries like NLTK offer powerful tools for text processing, including tokenization, stemming, and stop word removal, which help enhance the accuracy of sentiment analysis [11-12]. This project aims to develop an intelligent feedback analysis system that assists restaurant owners by providing action- able insights based on customer reviews. The system utilizes the Naıve Bayes classification algorithm to analyze customer feedback, categorize the sentiments, and store the results in an SQLite database for easy access. The system's accuracy is further refined through NLP techniques implemented via the NLTK library, which enables it to process feedback in multiple languages and formats [13-17]. A key feature of the system is its ability to ensure that only customers who have actually experienced the food are able to leave reviews. This helps eliminate irrelevant or untrustworthy feedback, thus ensuring that the insights derived are relevant and actionable. The user interface, designed using Tkinter, pro- vides an intuitive experience for restaurant owners and staff, enabling them to easily navigate the system and derive valuable insights from customer feedback. By making informed decisions on menu adjustments, ingredient modifications, and service improvements, restaurant owners can enhance customer satisfaction, drive customer retention, and ultimately increase business profitability. Through the use of advanced machine learning techniques and NLP, this project aims to transform how restaurants under- stand and respond to customer feedback. It provides a scalable, reliable, and user-friendly solution to optimize restaurant operations, improve service quality, and contribute to sustained business growth.

2. LITERATURE SURVEY

Existing System: The existing system features a user-friendly graphical user interface (GUI) tailored for both customers and restaurant owners. Customers can easily submit reviews of the restaurant's food items by providing textual feedback through the application. The customer-facing GUI is intuitive, allowing users to navigate the menu, select the items they've tried, and submit their reviews with ease, ensuring a smooth and engaging user experience. This ease of use encourages customer participation, allowing them to provide valuable feedback on their dining experience [18-22]. On the other hand, restaurant owners have access to a dedicated interface where they can view, analyze, and interpret the customer reviews. This helps them identify under- performing dishes or aspects of service that require attention and improvement. The system integrates a range of tools and technologies, including NLTK for natural language processing, machine learning for sentiment analysis and pattern detection, Python for core functionality, Tkinter for GUI development, SQLite3 for managing data storage, and Pandas for data manipulation and analysis. These components work cohesively to provide a streamlined and efficient platform for collecting and evaluating customer feedback [23]

Limitations of Existing System: The existing system, despite its strengths, has several notable limitations. One key issue is that customers may provide negative reviews for food items they haven't actually tried, whether due to misunderstandings, personal biases, or other factors [24-25]. This can mislead restaurant owners, resulting in inaccurate conclusions about which dishes need improvement. Additionally, the system relies solely on textual feedback, which may not be accessible for customers who are uncomfortable with writing or who face language barriers. This limits inclusivity and may exclude a significant portion of the customer base from providing valuable feedback. Another limitation is the tendency for many customers to skip the review process altogether, leading to in- complete or insufficient data for analysis. This lack of participation undermines the system's ability to provide restaurant owners with a complete picture of customer preferences, hindering data-driven decision making. Furthermore, the system lacks advanced features for analyzing voice-based feedback and does not offer multilingual support. This reduces its ability to capture a more comprehensive and diverse range of customer opinions, which is critical for accurately assessing the performance of various menu items across different demographic groups.

Gaps Identified:

1. **Inaccurate Feedback for Untested Items:**
One significant gap in the existing system is the potential for customers to provide negative reviews for food items they haven't actually tried. This can occur due to personal biases, misunderstandings, or confusion about the menu. Such inaccurate feedback may mislead restaurant owners, leading them to make unwarranted changes or removals of certain dishes, negatively affecting their ability to properly assess and improve menu items.

2. Reliance on Textual Feedback:
Another limitation is the system's exclusive reliance on textual feedback, which may not be suitable for all customers. Those who are uncomfortable with writing or who face language barriers may find it difficult to provide feedback. This lack of inclusivity can result in an underrepresentation of certain customer segments, leaving restaurant owners without a comprehensive understanding of the experiences and preferences of all diners.

3. Low Customer Participation:
A third gap identified is the low participation rate in the re- view submission process. Many customers tend to skip providing feedback altogether, resulting in incomplete or insufficient data for analysis. This leads to a lack of valuable insights, pre- venting restaurant owners from fully understanding customer preferences and hindering their ability to make informed, data- driven decisions regarding menu changes or service improvements.

4. Lack of Voice and Multilingual Support:
Finally, the existing system does not offer voice-based feed- back or multilingual support, limiting its accessibility to a wider customer base. This gap excludes customers who prefer speak- ing over writing or are more comfortable providing feedback in their native language. As a result, the system misses out on valuable insights that could be gathered through diverse and more detailed customer input, reducing its ability to capture the full spectrum of customer sentiment.

Problem Statement: In the restaurant industry, accurately capturing customer preferences and dissatisfaction is vital for improving menu offerings and enhancing the dining experience. Current feed- back collection systems have notable limitations, including customers submitting negative reviews for items they haven't tried, which can mislead restaurant owners. Moreover, the exclusive reliance on textual feedback excludes those uncomfortable with writing or who face language barriers, leading to underrepresentation of diverse opinions. Low participation rates in the review process also result in incomplete data, further hindering informed decision-making. To address these issues, this project aims to develop a more inclusive feedback collection system that integrates both textual and voice-based input in multiple languages. This approach seeks to provide restaurant owners with accurate, actionable insights, ultimately improving customer satisfaction and overall dining experiences.

Objectives

> ➢ Develop an Inclusive Feedback System: Create a user- friendly platform that allows customers to provide feedback through both textual and voice-based inputs in multiple languages, including Telugu, Hindi, and English.
> ➢ Enhance Data Accuracy: Implement machine learning and natural language processing techniques to accurately analyze customer sentiments and detect patterns related to individual menu items, minimizing the impact of misleading reviews.
> ➢ Increase Customer Participation: Design the system to encourage higher engagement rates in the review process by offering a seamless and intuitive interface that accommodates diverse customer demographics.
> ➢ Facilitate Comprehensive Data Analysis: Organize and store collected feedback in a structured database, enabling restaurant owners to easily access, review, and analyze customer insights for informed decision-making.
> ➢ Support Continuous Improvement: Provide actionable insights to restaurant owners, helping them identify under per forming dishes and areas for service improvement, thereby enhancing overall customer satisfaction and dining experiences.

3. DATASET DESCRIPTION

Restaurant Reviews dataset from Kaggle consists of 1,000 customer reviews, each labeled as either positive or negative, making it highly suitable for sentiment analysis tasks. The dataset contains two primary columns: Review, which includes customer feedback in textual form, and Sentiment, which is a binary label indicating whether the review expresses a positive (1) or negative (0) opinion. This dataset is particularly useful for machine learning-based

sentiment classification, enabling businesses to analyze customer satisfaction, identify pain points, and optimize their services accordingly. By applying Natural Language Processing (NLP) techniques such as tokenization, stop word removal, stemming, and vectorization, the dataset can be preprocessed to improve sentiment analysis accuracy. Machine learning models like Naıve Bayes, Support Vector Machines (SVM), Logistic Regression, and deep learning approaches can be trained on this dataset to develop an automated feedback analysis system. The insights extracted from customer reviews can help restaurant owners understand customer preferences, refine their menu offerings, improve service quality, and enhance overall customer experience. This dataset serves as an excellent foundation for data-driven decision-making in the restaurant industry, allowing for the implementation of AI-powered sentiment analysis tools to monitor and improve customer satisfaction effectively.

	A	B
1	Review	Liked
2	Wow... Loved this place.	1
3	Crust is not good.	0
4	Not tasty and the texture was just nasty.	0
5	Stopped by during the late May bank holiday off Rick Ste	1
6	The selection on the menu was great and so were the pri	1
7	Now I am getting angry and I want my damn pho.	0
8	Honeslty it didn't taste THAT fresh.	0
9	The potatoes were like rubber and you could tell they ha	0
10	The fries were great too.	1

FIGURE 1. Sample Dataset

Dataset Source: Restaurant Reviews dataset from Kaggle contains 1,000 customer reviews of various restaurants, with each re- view labeled as either positive or negative. The dataset's structured format makes it an ideal resource for training classification models to understand customer feedback and improve restaurant services.
Source Reference: d4rklucif3r. (2021). Restaurant Reviews. Kaggle.

4. METHODOLOGY

The methodology of this project follows a structured pipeline for analyzing restaurant reviews using machine learning and natural language processing (NLP) techniques. The system collects reviews through a Tkinter-based graphical user interface (GUI), supporting both text and voice input, with speech-to-text conversion for multilingual accessibility. Text data undergoes preprocessing using NLTK, including tokenization, stop word removal, stemming, and feature extraction through TF-IDF or word embedding's. A Naıve Bayes classifier is applied for sentiment analysis, classifying reviews into positive and negative categories. The analyzed data is stored in an SQLite database, ensuring efficient organization and retrieval. Performance evaluation is conducted using accuracy, ensuring the model's reliability in analyzing feedback trends.

Design: The Restaurant Review Analysis System operates by collecting customer feedback through both text and voice inputs in multiple languages, including Telugu, Hindi, and English. Customers submit their reviews, which are stored as raw feedback data in a dedicated feedback log. This process ensures inclusivity, allowing all customers, regardless of their literacy levels, to participate in providing feedback. Once the feedback is collected, the system processes it using machine learning techniques and natural language processing (NLP) methods to analyze sentiments and detect patterns associated with individual menu items. This step enables the identification of customer preferences and dissatisfaction. After the analysis, actionable insights are generated and stored in an SQLite database, pro- viding restaurant owners with structured access to the data. The insights encompass various aspects, such as customer sentiment, menu item performance, and recurring themes in feed- back. Restaurant owners can then generate reports based on these insights, allowing them to make informed decisions regarding menu adjustments,

service improvements, and overall customer satisfaction. By streamlining this process, the system empowers restaurant owners to respond effectively to customer feedback and enhance their dining experience, ultimately leading to increased profitability and customer loyalty.
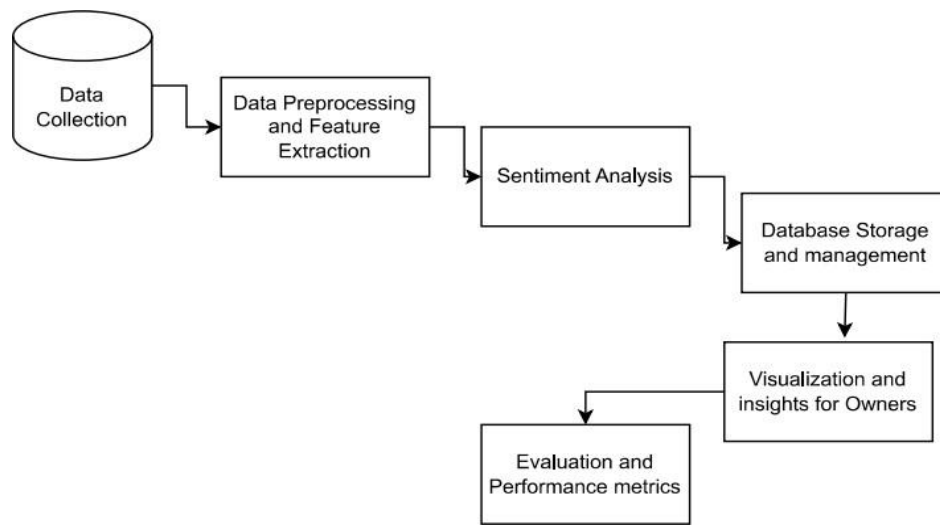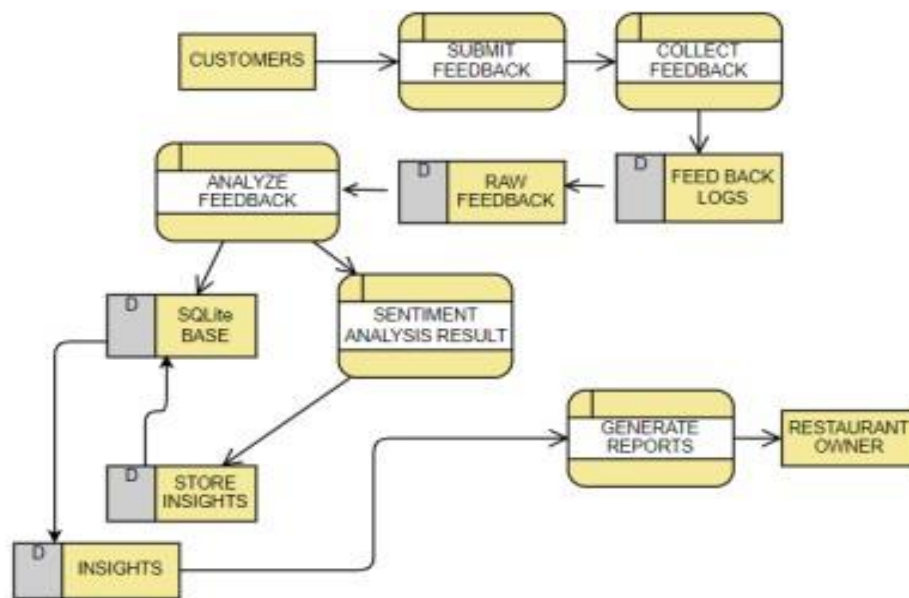

FIGURE 2. Methodology

FIGURE 3. Data Flow Diagram

Modules Design: The module design and organization of the restaurant review analysis project ensures structured functionality and efficient processing. The Main Application Module acts as the entry point, initializing the database and UI while managing the application's flow. The Database Module handles data storage, including table creation, insertion, and retrieval. The Data Preprocessing Module cleans and processes text reviews through tokenization, stemming, and stop word removal. The Model Module trains and evaluates the Logistic Regression-based sentiment

analysis model, using Count Victories for text vectorization. The Speech Recognition Module captures and converts voice reviews into text, while the Translation Module translates non-English reviews using Google Translate. The User Interface Module builds and manages the Tkinter-based GUI, supporting review submission, owner login, and dash- board views. The Bill Generation Module calculates and dis- plays bills based on selected food items, enhancing restaurant operations. Lastly, the Utilities Module provides common functions like logging, configuration management, and shared constants, ensuring smooth inter-module integration. The project follows a comprehensive approach to analyze restaurant reviews and improve service quality. It starts with data collection where reviews are gathered and stored in an SQLite database for easy management. The data preprocessing phase involves cleaning, tokenizing, and stemming re- views using NLTK, while feature extraction is performed using Count Victories to convert text into numerical form. A Logistic Regression model is trained for sentiment analysis, which classifies reviews as positive or negative. The system allows users to submit reviews via a Tkinter-based GUI, including text and voice inputs. Sentiment analysis is applied, updating the database with relevant statistics, such as the number of positive and negative reviews for specific food items. Addition- ally, an owner dashboard provides insights on customer feed- back to help restaurant owners make data-driven decisions. After thorough testing and validation, the application is deployed and ready for use, with ongoing improvements based on user feedback and advancements in machine learning and NLP techniques.
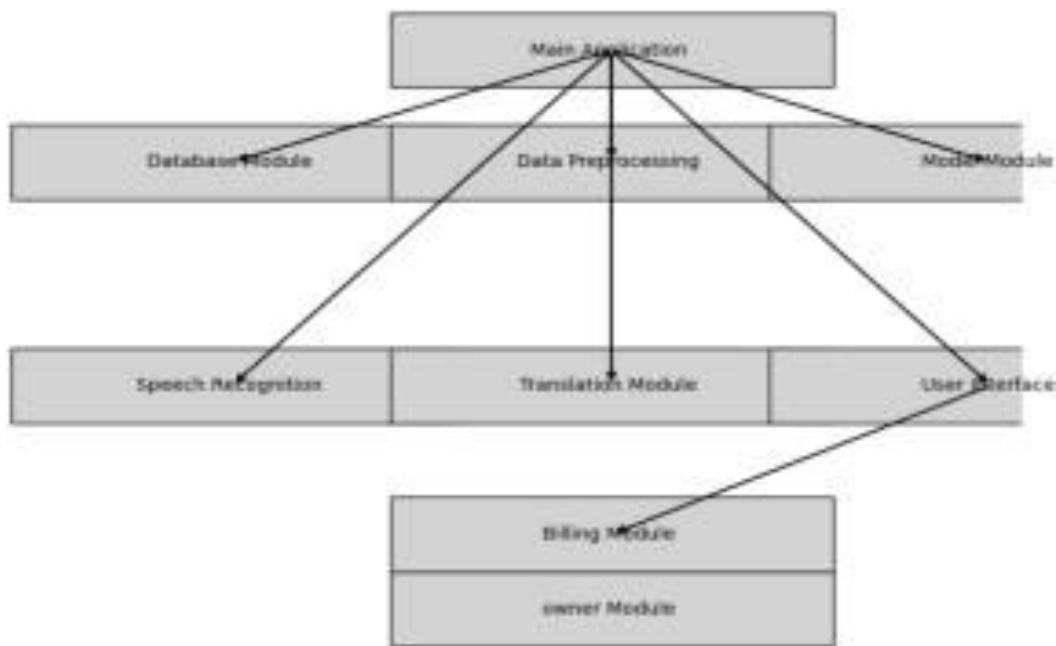

FIGURE 4. Modules Organization

5. RESULTS AND DISCUSSIONS

The regression model achieved an accuracy of 85% in classifying sentiment from reviews

Submitting without input: The system displayed a warning message, indicating that at least one food item must be selected and a review must be pro- vided before submission.
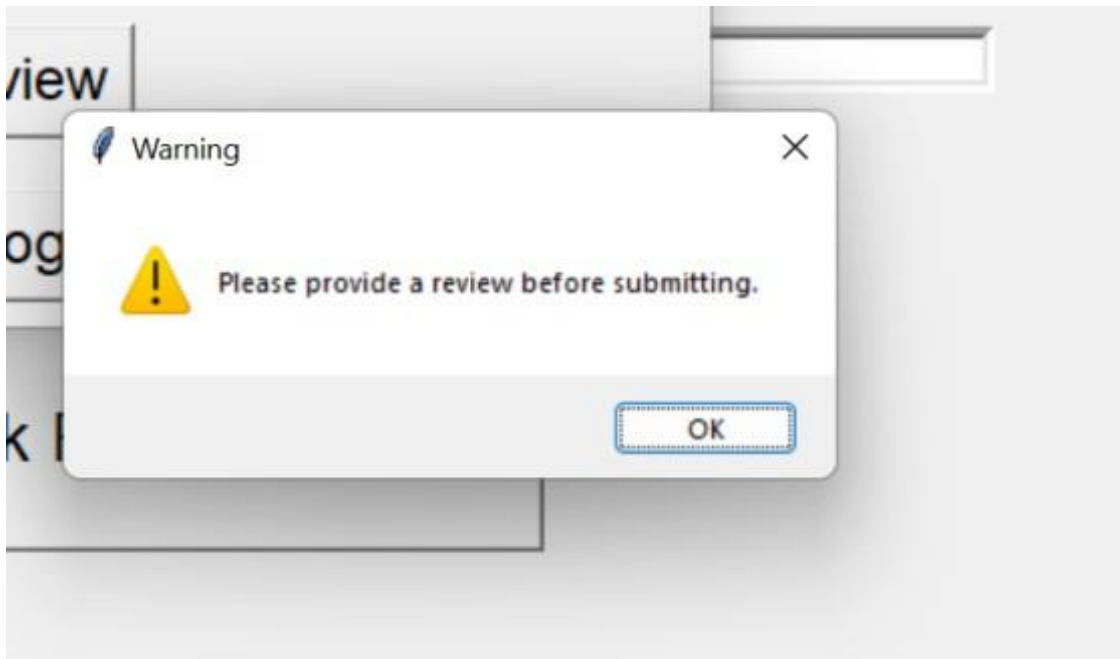
FIGURE 5. Review Page

FIGURE 6. warning message

Giving Review Through Voice: The system accurately recognized the voice input, translated it as necessary, and classified the review sentiment

correctly based on the spoken words. It can be given in Telugu/Hindi/English

FIGURE 7. Speech to text from Telugu to English

Giving Review Through Text
The text review was successfully submitted, processed, and the system updated the sentiment analysis and food statistics accordingly.

Displaying bill
Displays bill of selected items and shows the total amount to be paid.

Owner login and display
Owner login in to owner page with passwords, the owner dashboard displays accurate statistics for all food items, including the number of reviews and their respective positive and negative percentages
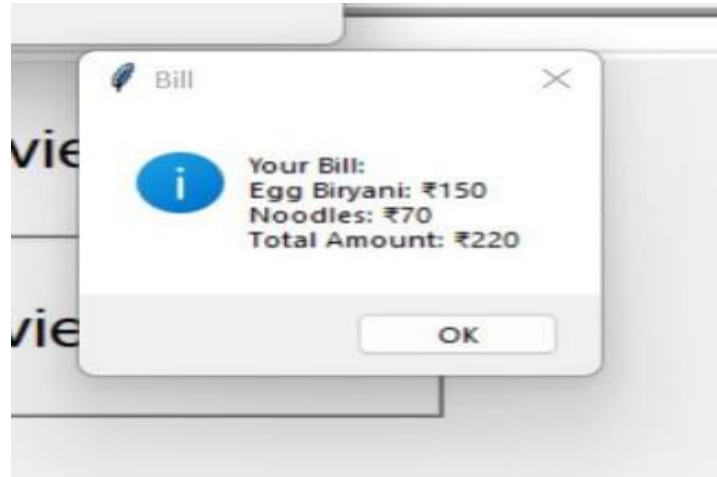

FIGURE 8. Review Through text

FIGURE 9. Bill Display

6. CONCLUSION

In conclusion, the restaurant review analysis project success- fully integrates advanced technologies to streamline the process of gathering and analyzing customer feedback. By employing natural language processing, voice recognition, and machine learning algorithms, the system effectively assesses restaurant reviews and provides valuable insights for restaurant owners. The implementation of features such as text and voice review submissions, along with an intuitive owner dashboard, enhances user engagement and facilitates informed decision- making. The project achieved a commendable accuracy of 85% in sentiment classification, demonstrating the effectiveness of the regression model in interpreting customer sentiments accurately. The thorough testing process validated the system's functionalities, ensuring that it handles various scenarios robustly while providing appropriate user feedback. Overall, this project not only meets its initial objectives but also sets a strong foundation for future enhancements. Opportunities for improvement include expanding language support, refining sentiment analysis algorithms, and incorporating user feedback mechanisms. By continuously evolving, the system can better serve restaurant owners and enhance the dining experience for customers, ultimately contributing to improved restaurant performance and customer satisfaction.

Item	No. of Customers	No. of Positive Reviews	No. of Negative Reviews	Positive %	Negative %
Roti	0	0	0	0.0%	0.0%
Meals	0	0	0	0.0%	0.0%
Veg Biryani	0	0	0	0.0%	0.0%
Egg Biryani	1	1	0	100.0%	0.0%
Chicken Biryani	0	0	0	0.0%	0.0%
Mutton Biryani	0	0	0	0.0%	0.0%
Ice Cream	0	0	0	0.0%	0.0%
Noodles	1	1	0	100.0%	0.0%
Manchurian	0	0	0	0.0%	0.0%
Orange juice	0	0	0	0.0%	0.0%

FIGURE 10. owner dashboard

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