REAL TIME VOICE REVIEW BASED AUDIO SENTIMENT ANALYSIS SYSTEM USING MULTI PERCEPTION MODEL FOR E - COMMERCE

By

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Of

E.G.S PILLAY ENGINEERING COLLEGE (AUTONOMOUS)

NAGAPATTINAM

A PROJECT REPORT

Submitted to the

FACULTY OF INFORMATION AND COMMUNICATION ENGINEERING

In partial fulfillment of the requirements For the award of the degree of

MASTER OF COMPUTER APPLICATIONS

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(Autonomous)

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DEPARTMENT OF COMPUTER APPLICATIONS

BONAFIDE CERTIFICATE

Certified that thisproject report titled "**Real Time Voice Review based Audio Sentiment Analysis System using Multi Perception Model for E - Commerce"** is the bonafide work of **Mr. MOHAMED THOWFIQ P (8208E22CAR032**) who carried out the research under my supervision. Certified further, that to the best of my knowledge the work reported here in does not form part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

Supervisor **Head of the Department**

Submitted to Project and viva-voce Examination held on …….....

(Internal Examiner) **(External Examiner)**

Virtual Desk

Date: 24-01-2024
Place: Trichy

Project Confirmation Letter

To

Head of the Department,
Department of Computer Applications,
E.G.S. Pillay Engineering College,
Nagapattinam.

Respected Sir/Madam,

Sub: Project Work Confirmation - Reg.

We wish to confirm that Mr.P.Mohamed Thowfiq (Reg.No:8208E21CAR032) pursuing final year MCA in E.G.S. Pillay Engineering College has been offered to do the final semester project work titled "Real Time Voice Review based Audio Sentiment Analysis System using Multi Perception Model for E - Commerce" from our organization during the period from January 2024 to June 2024.

Software Required

Designing : Bootstrap
Development: Python
Back End : MySQL
Framework : Flask
Sever : Wampserver 2i

Virtual Desk it Services Pvt. Ltd. TRICHY-06

Best Regards,

P. Dayaparan.

Authorised Signatory

Virtual Desk

Date: 03-06-2024
Place: Trichy

Project Completion Certificate

To

Head of the Department,
Department of Computer Applications,
E.G.S. Pillay Engineering College,
Nagapattinam.

Respected Sir/Madam,

Sub: Project Work Completion - Reg.

We wish to inform that Mr.P.Mohamed Thowfiq (Reg.No:8208E21CAR032) pursuing final year MCA in E.G.S. Pillay Engineering College has been successfully completed the final semester project work titled "Real Time Voice Review based Audio Sentiment Analysis System using Multi Perception Model for E - Commerce" from our organization during the period from January 2024 to June 2024.

We share him our best wishes for success in life and career

Virtual Desk it Services Pvt. Ltd. TRICHY-06

Best Regards,

P. Rajaraman.

Authorised Signatory

ABSTRACT

Sentiment analysis is the automated process of tagging data according to their sentiment, such as positive, negative and neutral. Sentiment analysis allows companies to analyse data at scale, detect insights and automate processes. Thus, the ultimate goal of sentiment analysis is to decipher the underlying mood, emotion, or sentiment of a text. This is also known as Opinion Mining. Detecting sentiments is one of the most important marketing strategies in today's world. In the past, sentiment analysis used to be limited to researchers, machine learning engineers or data scientists with experience in natural language processing. Traditional sentiment analysis methods mainly rely on written texts such as reviews, feedback, surveys, etc. However, as human language is complex, nuances such as irony, sarcasm, or intentions are not always easily understood in the written content. The acoustic tone in audio files carries richer information and gives better insights into the sentiments. Normally sentiment analysis is done through the text data, but this project use audio data to detect a person's emotions just by their voice. Therefore, in this project develop an Audio Sentiment Analysis System for E-Commerce Website using voice reviews. The goal of this project is to proposes to build a Multi Perceptron model, LSTM model and CNN models. ASR converts speech into text, after which conventional text-based sentiment detection systems are applied. LSTM Model is used to recognize the sentiment and CNN model is used to classify the sentiments emotions i.e 1 = neutral, 2 = calm, 3 = happy, 4 = sad, 5 = angry, 6 = fearful, 7 = disgust, 8 = surprised. These decisions could improve business capacity, raise sales, enhance communication between a customer service agent and customer, and much more. Finding the sentiment of the customer helps in determining whether the customer was satisfied with the service or not. It can be very much useful to recommend products to customers based on their emotions towards that product.

ACKNOWLEDGEMENT

I immensely pleased in taking up this opportunity to think the Almighty for showing his unlimited blessing upon me.

I take this opportunity to express our gratitude to our respected founder **Chairman Smt. Jothimani Amma, E.G.S. Pillay** for giving such a wonderful environment to express our creative skills.

I own a special depth of gratitude to our Secretary **Shri S.Senthilkumar** and joint secretary **Shri S.Sankar Ganesh** for giving a motivation in all the aspects.

I sincerely thank our Principal, **Dr.S.Ramabalan, M.E., Ph.D.,** for the institutional support rendered to us.

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I thank all of my family members, friends, teaching and non-teaching faculties of our department for technical and moral support.

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CHAPTER 1

INTRODUCTION

1.1. Organization Profile

The Mind IT Solution is one of the few IT system integration, professional service and software development companies in Macedonia that works with Enterprise systems and companies which has sister concern in Trichy. As a privately owned company, The Mind IT Solution provides IT Consultancy, software design and development as well as professional services and hardware deployment and maintenance to the following verticals: Government (Local and Central), Financial Services (insurance, banking and clearing house), Telecommunications, Energy and Utilities, Health Care and Education.

Mission

The Mind IT Solution' mission is to enhance the business operation of its clients by developing and/or implementing premium IT products and services.

- Providing high quality software development services, professional consulting and development outsourcing that would improve our customers' operations
- Making access to information easier and securer (Enterprise Business)
- Improving communication and data exchange (Business to Business)
- Providing our customers with a Value for Money and

Vision

The Mind IT Solution is a leading IT company for Consulting Services and Deployment of best of breed Business Solutions to top tier domestic and international customers.

Contact us

The Mind IT

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1.2. Introduction of the Project

A review is an evaluation of a publication, product, service, or company or a critical take on current affairs in literature, politics or culture. In addition to a critical evaluation, the review's author may assign the work a rating to indicate its relative merit. Reviews can apply to a movie (a movie review), video game (video game review), musical composition (music review of a composition or recording), book (book review); a piece of hardware like a car, home appliance, or computer; or software such as business software, sales software; or an event or performance, such as a live music concert, play, musical theatre show, dance show or art exhibition.

Alternatively called a product review or customer review, a review is a partial or overall judgment on a product or service performed by a person or company. For example, a person may use a computer for several days and then write a review about their computer experience. A review gives someone interested in a product or service the pros and cons, and helps them decide if they should make a purchase.

For instance, when buying a computer or any product, read the reviews left by other people who bought the same product. However, consider that sites allowing anyone to write a review (e.g., Amazon) can have fake or sponsored reviews. It's a good idea to read a few positive and negative reviews to get the pros and cons. Also, look for any indication the reviewer purchased the product and that it's not sponsored or the person was not given the product.

1.1.1. E-Commerce Product Review

Product reviews are the opinions or feedbacks of customers for a particular product. Many online businesses put up a review section on their website to allow customers to rate and review the product they purchased. A product review helps other users get a clear idea of the product before purchasing it. They can read the reviews and make their mind clear, and

decide whether the product is worth purchasing or not. If you have not added a product review section on your e-commerce website, only because of fearing negative reviews, you are losing out on a huge number of potential customers.

1.1.2. Importance of Product Reviews

The importance of product reviews can be understood by the fact that 90% of the consumers read online reviews before making a purchase and 88% of the consumers will be prompted to take an action after reading positive reviews.

- **Product Reviews build Trust**

When a user lands on your website with the intention of making a purchase, the first thing that they look for is reviews. A product having good reviews would surely be able to help the prospect in his/her buying decision. They would likely put their trust in your products as well as your Brand.

- **Product Reviews provide better insights into the product**

Hearing from people's past purchase experience helps the prospects identify whether the product has earlier matched customer's expectations or not.

- **Product Reviews let you rectify the issues with the product**

If a majority of customers are pointing out the same problem in the product, it is for you to take the onus of rectifying the defect so that the issue gets resolved. Yes, there are possibilities of a damaged or defective item reaching the customer but it happens with a few customers only.

- **Product Reviews work as Social proof**

One of the major benefits of product reviews is they can do wonders to your Brand. You would have often seen brands highlighting what their customers have to say about their products or services. These are what we call as testimonials and they make a significant impact on a prospect's purchase.

- **Product Reviews Boost Conversions**

If you delivering up to your customer's expectations, product reviews are going to play a huge role in your conversions. People would openly do the marketing for you by leaving positive reviews. And even a single positive review can lead to an increase in the conversion rate.

1.3 Problem Statement

When it comes to sentiment analysis challenges, there are quite a few things that companies struggle with in order to obtain sentiment analysis accuracy. Sentiment or emotion analysis can be difficult in natural language processing simply because machines have to be trained to analyse and understand emotions as a human brain does. This is in addition to understanding the nuances of different languages. As data science continues to evolve, sentiment analysis software is able to tackle these issues better. Here are the main roadblocks in analysing sentiment. Things get even more complicated when one tries to analyse a massive volume of data that can contain both subjective and objective responses. Brands can face difficulties in finding subjective sentiments and properly analysing them for their intended tone. Words such as "love" and "hate" are high on positive (+1) and negative (-1) scores in polarity. These are easy to understand. But there are in-between conjugations of words such as "not so bad" that can mean "average" and hence lie in mid-polarity (-75). Sometimes phrases like these get left out, which dilutes the sentiment score. People use irony and sarcasm in casual conversations and memes on social media. The act of expressing negative sentiment using backhanded compliments can make it difficult for sentiment analysis tools to detect the true context of what the response is actually implying. This can often result in a higher volume of "positive" feedback that is actually negative. The problem with social media content that is text-based, like Twitter, is that they are inundated with emojis. NLP tasks are trained to be language specific. While they can extract text from even images, emojis are a language in itself. Most emotion analysis solutions treat emojis like special characters that are removed from the data during the process of sentiment mining. But doing so means that companies will not receive holistic insights from the data. Machine learning programs don't necessarily understand a figure of speech. For example, an idiom like "not my cup of tea" will boggle the algorithm because it understands things in the literal sense. Hence, when an idiom is used in a comment or a review, the sentence can be misconstrued by the algorithm or even ignored. To overcome this problem a sentiment analysis platform needs to be trained in understanding idioms. When it comes to multiple languages, this problem becomes manifold. Negations, given by words such as not, never, cannot, were not, etc. can confuse the ML model. For example, a machine algorithm needs to understand that a phrase that says, "I can't not go to my class reunion", means that the person intends to go to the class reunion. Comparative sentences can be tricky because they may not always give an opinion. Much of it has to be deduced. For example, when somebody writes, "the Galaxy S20 is larger than the Apple

iphone12", the sentence does not mention any negative or positive emotion but rather states a relative ordering in terms of the size of the two phones. As the number of consumers increases and users' data accumulates daily, data explosion is no surprise. Companies get help from data collection and analytics to catch up on their sales, customer insights, or brand reputation. However, even though voice data is the most direct feedback businesses receive from customers, they usually overlook its importance.

1.4 Technology

1.4.1 Sentiment Analysis

Sentiment analysis is the process of analysing digital text to determine if the emotional tone of the message is positive, negative, or neutral. Today, companies have large volumes of text data like emails, customer support chat transcripts, social media comments, and reviews. Sentiment analysis tools can scan this text to automatically determine the author's attitude towards a topic. Companies use the insights from sentiment analysis to improve customer service and increase brand reputation.

1. Sentiment Analysis Important

Sentiment analysis, also known as opinion mining, is an important business intelligence tool that helps companies improve their products and services. We give some benefits of sentiment analysis below.

Provide objective insights

Businesses can avoid personal bias associated with human reviewers by using artificial intelligence (AI)–based sentiment analysis tools. As a result, companies get consistent and objective results when analyzing customers' opinions.

For example, consider the following sentence:

I'm amazed by the speed of the processor but disappointed that it heats up quickly.

Marketers might dismiss the discouraging part of the review and be positively biased towards the processor's performance. However, accurate sentiment analysis tools sort and classify text to pick up emotions objectively.

Build better products and services

A sentiment analysis system helps companies improve their products and services based on genuine and specific customer feedback. AI technologies identify real-world objects or situations (called entities) that customers associate with negative sentiment. From the above example, product engineers focus on improving the processor's heat management capability because the text analysis software associated *disappointed* (*negative*) with *processor* (*entity*) and *heats up* (*entity*).

Analyze at scale

Businesses constantly mine information from a vast amount of unstructured data, such as emails, chatbot transcripts, surveys, customer relationship management records, and product feedback. Cloud-based sentiment analysis tools allow businesses to scale the process of uncovering customer emotions in textual data at an affordable cost.

Real-time results

Businesses must be quick to respond to potential crises or market trends in today's fast-changing landscape. Marketers rely on sentiment analysis software to learn what customers feel about the company's brand, products, and services in real time and take immediate actions based on their findings. They can configure the software to send alerts when negative sentiments are detected for specific keywords.

2. Types of Sentiment Analysis

Businesses use different types of sentiment analysis to understand how their customers feel when interacting with products or services.

- **Fine-grained scoring**

Fine-grained sentiment analysis refers to categorizing the text intent into multiple levels of emotion. Typically, the method involves rating user sentiment on a scale of 0 to 100, with each equal segment representing very positive, positive, neutral, negative, and very negative. Ecommerce stores use a 5-star rating system as a fine-grained scoring method to gauge purchase experience.

- **Aspect-based**

Aspect-based analysis focuses on particular aspects of a product or service. For example, laptop manufacturers survey customers on their experience with sound, graphics, keyboard, and touchpad. They use sentiment analysis tools to connect customer intent with hardware-related keywords.

- **Intent-based**

Intent-based analysis helps understand customer sentiment when conducting market research. Marketers use opinion mining to understand the position of a specific group of customers in the purchase cycle. They run targeted campaigns on customers interested in buying after picking up words like *discounts*, *deals*, and *reviews* in monitored conversations.

- **Emotional detection**

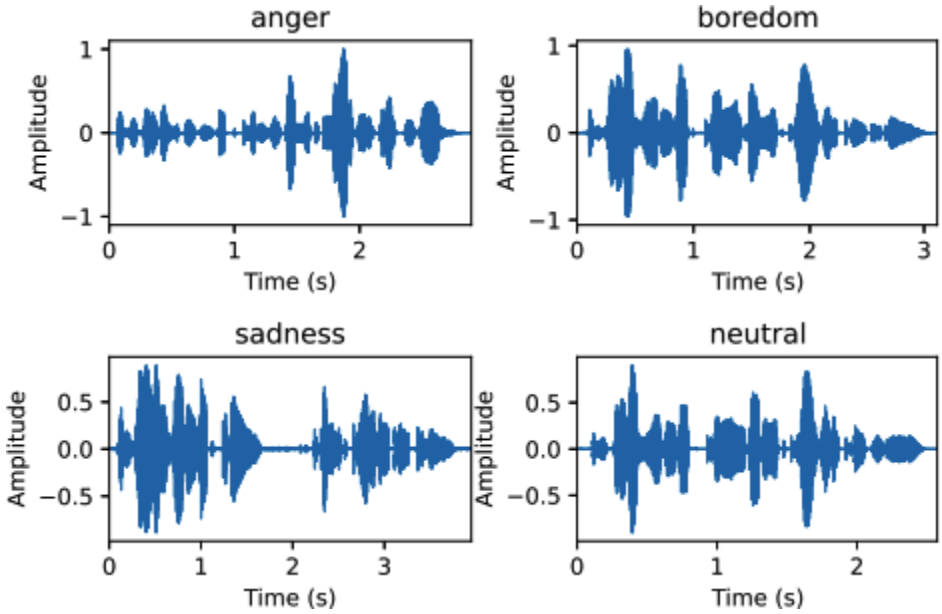
Emotional detection involves analysing the psychological state of a person when they are writing the text. Emotional detection is a more complex discipline of sentiment analysis, as it goes deeper than merely sorting into categories. In this approach, sentiment analysis models attempt to interpret various emotions, such as *joy*, *anger*, *sadness*, and *regret*, through the person's choice of words.

1.4.2 Audio Sentiment Analysis

Traditional sentiment analysis methods mainly rely on written texts such as reviews, feedback, surveys, etc. However, as human language is complex, nuances such as irony, sarcasm, or intentions are not always easily understood in the written content. As human being's speech is amongst the most natural way to express ourselves. We depend so much on it that we recognize its importance when resorting to other communication forms like emails and text messages where we often use emojis to express the emotions associated with the messages. As emotions play a vital role in communication, the detection and analysis of the same is of vital importance in today's digital world of remote communication. Emotion detection is a challenging task, because emotions are subjective. There is no common consensus on how to measure or categorize them. SER system as a collection of methodologies that process and classify speech signals to detect emotions embedded in them. Such a system can find use in a wide variety of application areas like interactive voice based-assistant or caller-agent conversation analysis. The acoustic tone in audio files carries richer information and gives better insights into the sentiments. Sentiment information can be gathered from various voice characteristics, such as

- pitch

- loudness
- one of voice
- other frequency-related measures



In this rapidly advancing AI world, human computer interactions (HCI) are of extreme importance. We live in a world where Siri and Alexa are physically closer to us than other humans. Soon the world will get more populated with physical and virtual service robots to accomplish tasks that range from caring for the elderly to assessing the effectiveness of your marketing campaign. Understanding human emotions paves the way to understanding people's needs better and, ultimately, providing better service. We can find wide applications of speech emotion recognition in marketing, healthcare, customer satisfaction, gaming experience improvement, social media analysis, stress monitoring, and much more. In this project, we are going to build an AI model which can predict the emotion of the speaker by the speaker's voice for product reviews. A Voice Review based Audio Sentiment Analysis System using CNN and LSTM for E-commerce can be a useful tool to gather feedback and insights about customer experiences with products or services. This system uses machine learning algorithms to analyze audio data and determine the sentiment of the customer's review.

1.4.3 Deep Learning

Deep learning attempts to mimic the human brain—albeit far from matching its ability—enabling systems to cluster data and make predictions with incredible accuracy. Deep learning is a subset of machine learning, which is essentially a neural network with

three or more layers. These neural networks attempt to simulate the behavior of the human brain—albeit far from matching its ability—allowing it to “learn” from large amounts of data. While a neural network with a single layer can still make approximate predictions, additional hidden layers can help to optimize and refine for accuracy.

Deep learning drives many artificial intelligence (AI) applications and services that improve automation, performing analytical and physical tasks without human intervention. Deep learning technology lies behind everyday products and services (such as digital assistants, voice-enabled TV remotes, and credit card fraud detection) as well as emerging technologies (such as self-driving cars).

1.4.4. Aim and Objective

The aim of the project is to develop a machine learning-based system that can accurately analyse customer feedback through audio reviews. The system will use Convolutional Neural Networks (CNNs) and Long Short-Term Memory (LSTM) networks to perform sentiment analysis on audio data.

The objective of the project is to achieve the following:

1. To develop a system that can accurately analyse the sentiment of customer reviews through audio data.
2. To train the system on a large dataset of audio reviews to improve its accuracy and performance.
3. To integrate the system with an E-commerce platform to collect and analyse customer feedback in real-time.
4. To develop a user-friendly interface for the system that allows businesses to easily access and understand customer feedback.
5. To test the system's performance on different accents and dialects to ensure accurate sentiment analysis.
6. To provide valuable insights to businesses to help them improve their products and services based on customer feedback.

1.4.5. Scope of the Project

The scope of the project is limited to the development and evaluation of a Voice Review based Audio Sentiment Analysis System using CNN and LSTM for E-commerce. The focus is on developing an accurate and efficient sentiment analysis system that can be integrated with an E-commerce platform to provide businesses with valuable insights based on customer feedback. The project does not include the development of an E-commerce platform itself or any other aspects of the E-commerce business model.

1.4.6. Purpose of the Project

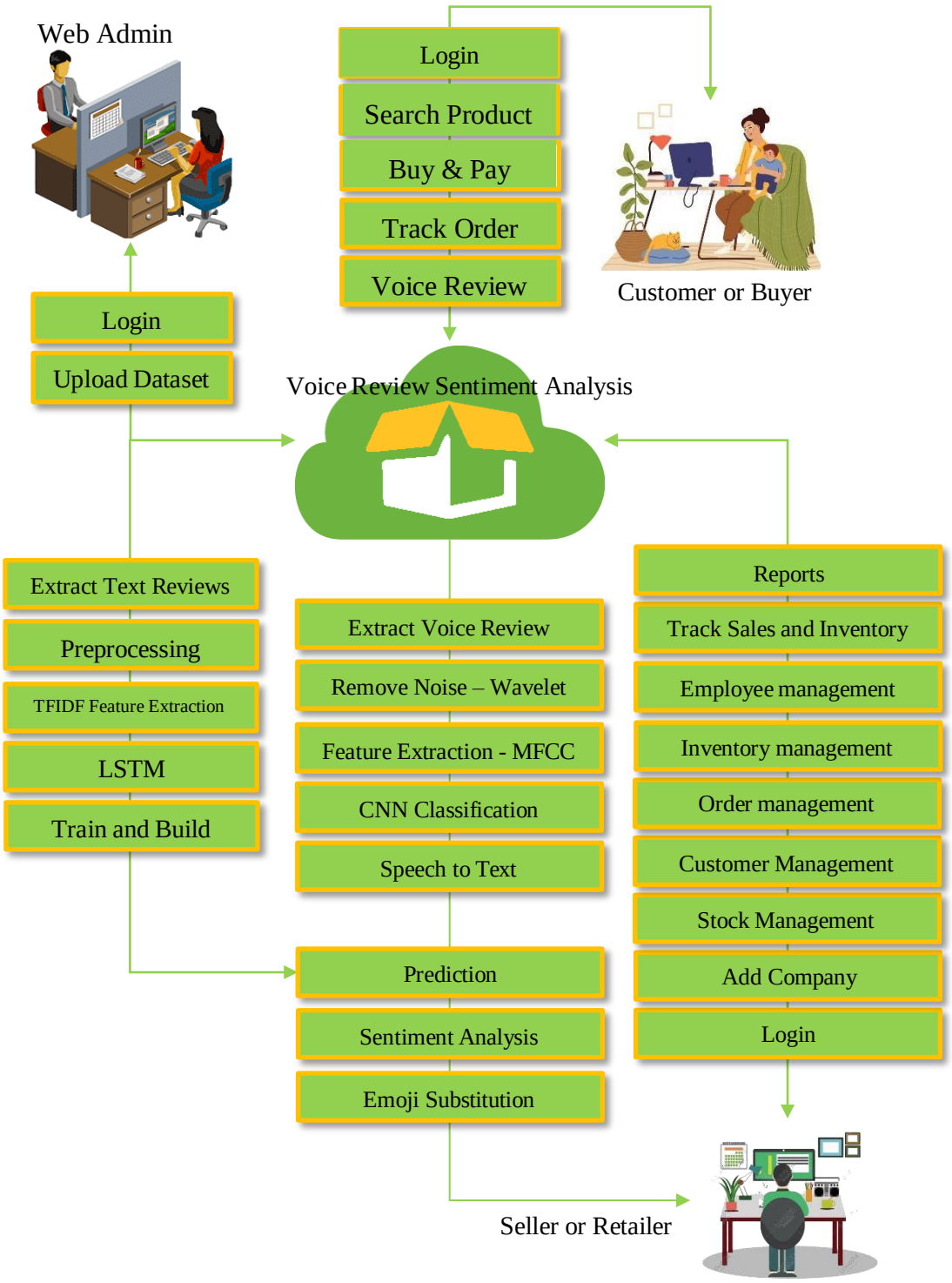
The purpose of the project is to develop a system that can accurately analyze the sentiment of customer reviews through audio data, and provide valuable insights to businesses based on the sentiment analysis. The system aims to improve the efficiency and accuracy of sentiment analysis in an E-commerce setting by analyzing audio reviews, which can be more informative than text reviews alone. The purpose of the project is to address the limitations of existing sentiment analysis techniques that rely solely on text reviews, by incorporating audio data analysis using deep learning techniques such as CNN and LSTM. The developed system will help businesses to gain a better understanding of customer feedback, which can be used to improve their products and services and enhance customer satisfaction. The project's purpose is to contribute to the field of sentiment analysis and machine learning by investigating the effectiveness of using CNNs and LSTMs for sentiment analysis of customer reviews in an E-commerce setting. The project aims to provide businesses with a more accurate and efficient way to analyze customer feedback and help them make data-driven decisions to improve their products and services.

1.5. System Description

The project can be integrated with an e-commerce platform to collect and analyse customer feedback in real-time. Here is a high-level system description of how the proposed system can be integrated with an e-commerce application using Python Flask: Real-time voice input: The e-commerce application can have a feature that allows customers to record their voice reviews for the product they purchased. Pre-processing: The recorded audio can be pre-processed using the Noise Removal Wavelet Filter to remove any background noise. Feature Extraction: After pre-processing, the audio signal can be converted into Mel-frequency cepstral coefficients (MFCC) features. These features will be used as input to the sentiment analysis model. Sentiment Analysis: The MFCC features are fed into a deep learning model based on Convolutional Neural Networks (CNN) and Long Short-Term Memory (LSTM) to predict the sentiment of the customer review. The model will be trained on a large dataset of audio reviews to improve its accuracy and performance. Integration: The sentiment analysis system can be integrated with the e-commerce platform using Python Flask. The sentiment analysis results can be stored in a database and displayed in the form of a sentiment analysis report for the business owners. User Interface: A user-friendly interface can be developed for the system that allows businesses to easily access and understand customer feedback. The interface can include visualizations such as word clouds and sentiment distributions to help

businesses quickly understand customer sentiment. The system is developed using Python Flask, a web framework that allows for easy development and deployment of web applications. The user interface is designed to be user-friendly, allowing users to provide real-time voice input and view the sentiment analysis results. The system can be integrated with an E-commerce platform, allowing businesses to collect and analyse customer feedback in real-time. Overall, integrating the "Voice Review based Audio Sentiment Analysis System using CNN and LSTM for E-Commerce" with an e-commerce application can provide businesses with real-time insights into customer sentiment and help them improve their products and services based on customer feedback.

1.5.1. SYSTEM ARCHITECTURE



1.5.2. System Architecture Description

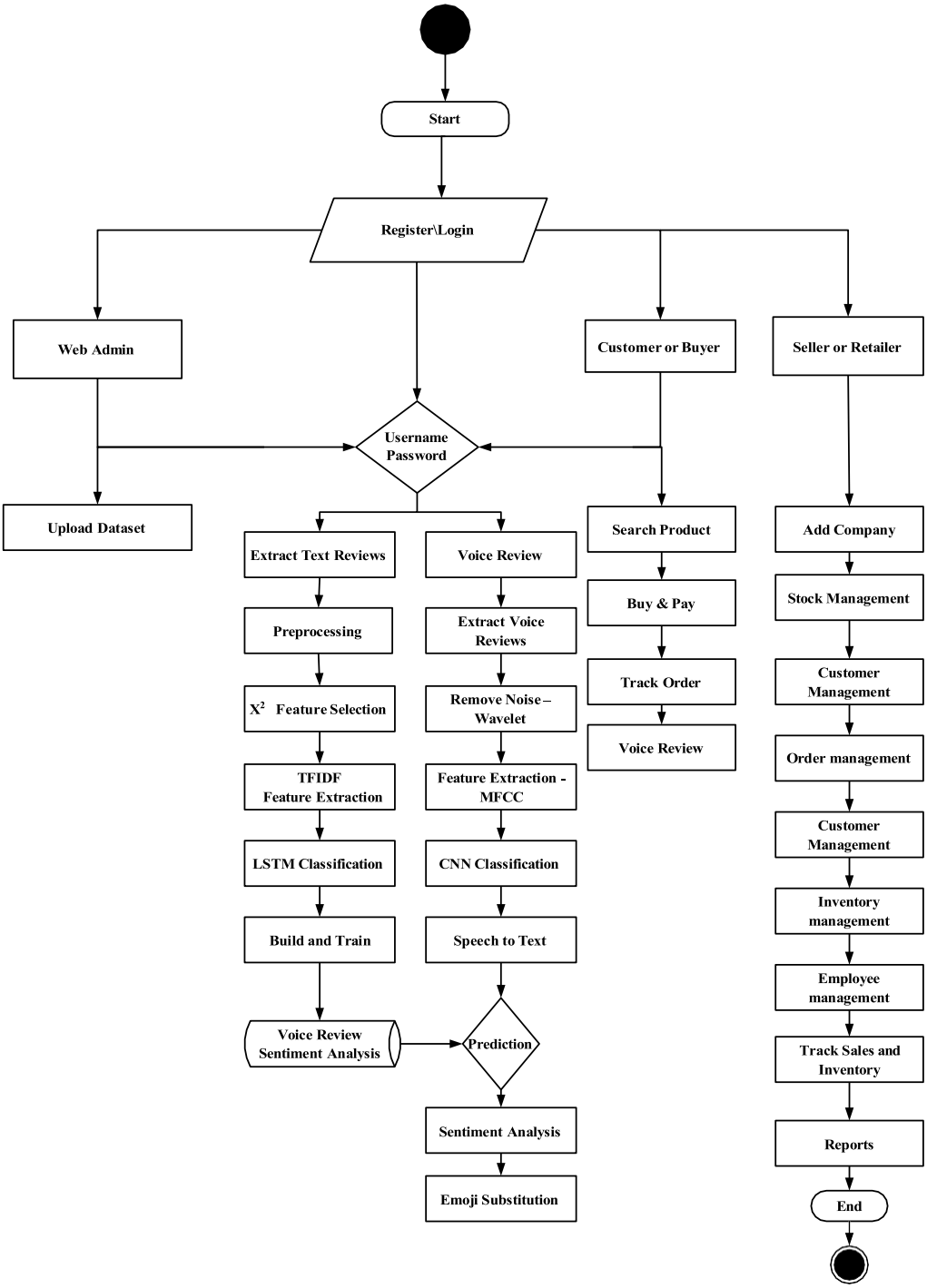
The system architecture of the application developed with Python Flask can be represented using the following diagram:

The system has three main components:

1. **End User Interface:** The end user interface is a web-based application that is accessible to three types of users - Customer, Admin, and Seller. This interface is responsible for capturing the voice review of the product from the customer and forwarding it to the Sentiment Analysis module for analysis.
2. **Voice Review Analysis:** This module is responsible for processing the voice review captured from the end user interface. It consists of several sub-modules, including Realtime voice input, Preprocessing Noise Removal Wavelet Filter, Feature Extraction MFCC, Sentiment Analysis CNN and LSTM. The sentiment analysis module uses a combination of convolutional neural network (CNN) and long short-term memory (LSTM) network to perform the sentiment analysis of the voice review.
3. **Database Management:** This component is responsible for managing the database that stores the details of the products, customers, sellers, and their respective reviews. MySQL is used as the database management system.

The end user interface interacts with the voice review analysis module, which in turn interacts with the database management module to store and retrieve the required information. The system architecture is designed to be scalable and can handle a large volume of voice reviews without compromising on the performance and accuracy of the sentiment analysis.

1.5.3. System Flow



The following is the system flow of the "Voice Review based Audio Sentiment Analysis System using CNN and LSTM for E-Commerce" developed with Python Flask and MySQL:

1. The customer records a voice review through the E-commerce application.
2. The recorded voice review is captured as real-time voice input.
3. The system performs noise removal using a wavelet filter to eliminate any background noise in the voice input.
4. The system extracts feature from the pre-processed voice input using MFCC.
5. The extracted features are fed into a pre-trained CNN-LSTM model for sentiment analysis.
6. The model predicts the sentiment of the voice review (positive, negative, or neutral) and returns the sentiment score to the application.
7. The application stores the sentiment score along with other relevant information such as the product reviewed, customer ID, and review timestamp in the MySQL database.
8. The application can generate reports and analytics based on the sentiment scores to help businesses gain insights into customer feedback and improve their products and services.

The system flow allows for real-time analysis of voice reviews and provides businesses with valuable customer feedback that can be used to improve their products and services.

1.5.4. System Design

The system design of the developed project with Python Flask can be divided into the following components:

1. User Interface: This component is responsible for handling the user's interactions with the system. The user interface allows the user to input the voice review of the product.
2. Real-time Voice Input: This component is responsible for capturing the user's voice input in real-time. The voice input is then passed to the Noise Removal Wavelet Filter module for pre-processing.
3. Pre-processing: This module is responsible for pre-processing the voice input to remove noise and enhance the quality of the input. The pre-processing module uses the Wavelet filter technique to remove noise from the voice input.
4. Feature Extraction: This module extracts relevant features from the pre-processed voice input using Mel-frequency cepstral coefficients (MFCC).
5. Sentiment Analysis: This module is responsible for analysing the sentiment of the voice input using Convolutional Neural Networks (CNN) and Long Short-Term Memory (LSTM) models.
6. Prediction: This module predicts the sentiment of the input as either positive or negative based on the output from the sentiment analysis module.
7. Database: This component is responsible for storing the user's voice input and the corresponding sentiment analysis results in a MySQL database.

Overall, the system design ensures that the user's voice input is processed in real-time and analysed to provide accurate sentiment analysis results. The use of Python Flask and MySQL allows for a scalable and efficient implementation of the system.

1.5.5. Modules Description

1. E-Commerce Web App

The design and development of an E-commerce web app using Python Flask and MySQL involves the following steps:

1.1. Requirements gathering

The first step is to gather the requirements for the E-commerce web app. This involves understanding the client's needs, identifying the target audience, and defining the scope of the project.

1.2. Database design

The next step is to design the database schema for the web app. This involves identifying the tables, fields, and relationships required to store and retrieve data.

1.3. Backend development

Once the database design is finalized, the next step is to develop the backend of the web app using Python Flask. This involves writing code to handle user authentication, product management, order processing, and payment integration.

1.4. Frontend development

After the backend is developed, the next step is to develop the frontend of the web app using HTML, CSS, and JavaScript. This involves designing and implementing the user interface for the web app.

2. E – Commerce Modules

2.1. User Authentication Module

This module allows users to sign up, log in, and log out of the web app. It also includes password reset functionality and user profile management.

2.2. Product Catalogue Module

This module is responsible for managing the product catalogue. It includes features such as adding, editing, and deleting products. It also allows users to search and filter products based on various parameters such as category, price range, etc.

2.3. Shopping Cart Module

This module allows users to add products to their shopping cart and manage their orders. It includes features such as adding, removing, and updating items in the cart, as well as checkout and payment processing.

2.4. Order Management Module

This module is responsible for managing orders placed by users. It includes features such as order tracking, order history, and order fulfilment.

2.5. Admin Panel Module

This module provides the admin with the ability to manage the entire e-commerce platform. It includes features such as user management, product management, order management, and site settings.

2.6. Reporting Module

This module provides insights into the e-commerce platform's performance. It includes features such as sales reports, product popularity reports, and customer behaviour reports.

3. E-Commerce End User Interface

The E-commerce web app developed using Python Flask and MySQL has three different end user interfaces - Customer, Admin, and Seller. Here is a brief module description for each:

3.1. Customer Interface Module

The customer interface module is the main interface for customers to browse and purchase products. It includes features like product listing, product search, product details, product reviews, shopping cart, checkout, order history, and account management. Customers can browse products based on categories, view product details, add products to their cart, and checkout by providing their shipping and payment details. They can also view their order history and update their account details.

3.2. Admin Interface Module

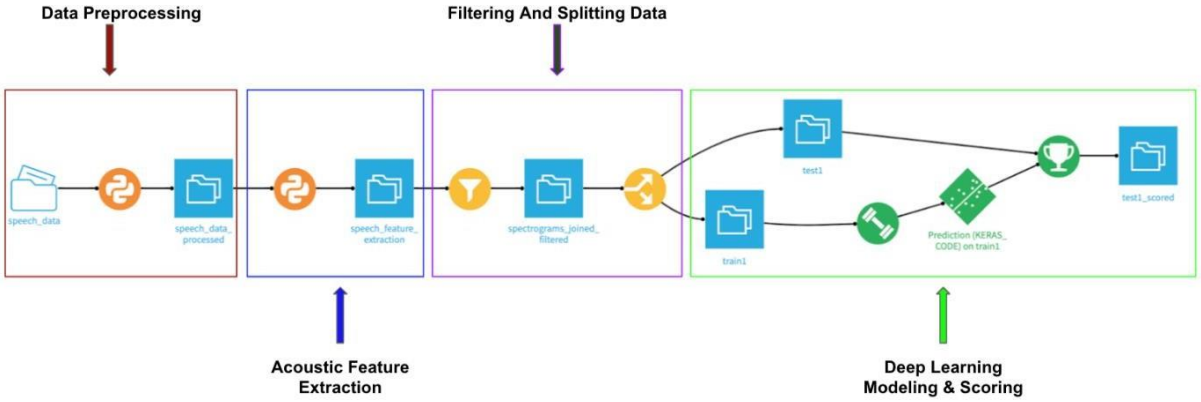
The admin interface module is used by the admin to manage the e-commerce platform. It includes features like product management, user management, order management, and analytics. Admin can add, edit, and delete products, view user details, manage orders, and view analytics to track sales and revenue.

3.3. Seller Interface Module

The seller interface module is used by the sellers to manage their products and orders. It includes features like product management, order management, and analytics. Sellers can add, edit, and delete their products, view their order details, and view analytics to track sales and revenue. They can also update their account details.

Overall, the E-commerce web app provides a comprehensive interface for customers, admin, and sellers to manage their respective tasks and transactions.

4. Voice Review Sentiment Analysis



4.1. Real-time Voice Input Module:

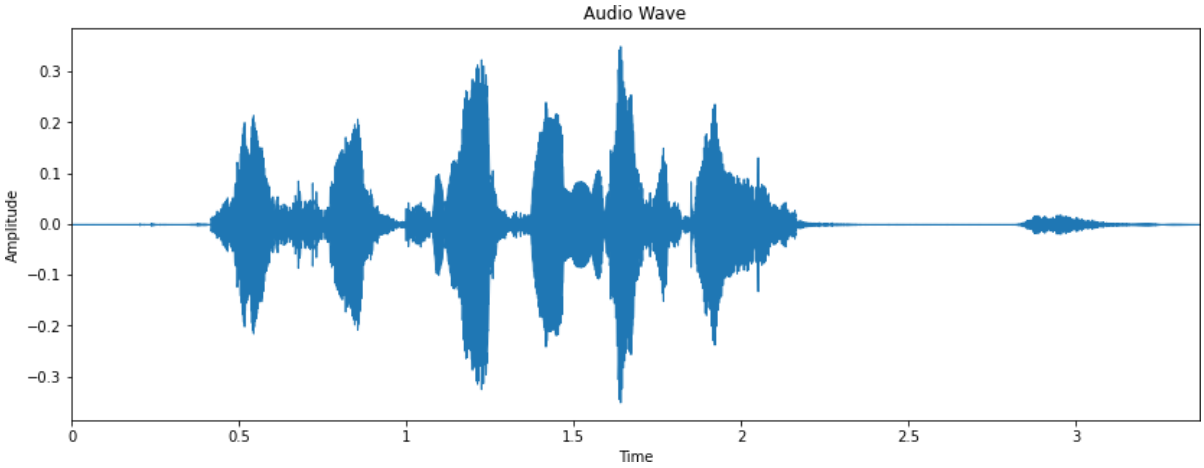
This module captures the voice input from the user in real-time and converts it into a digital signal.

4.2. Noise Removal Wavelet Filter Module:

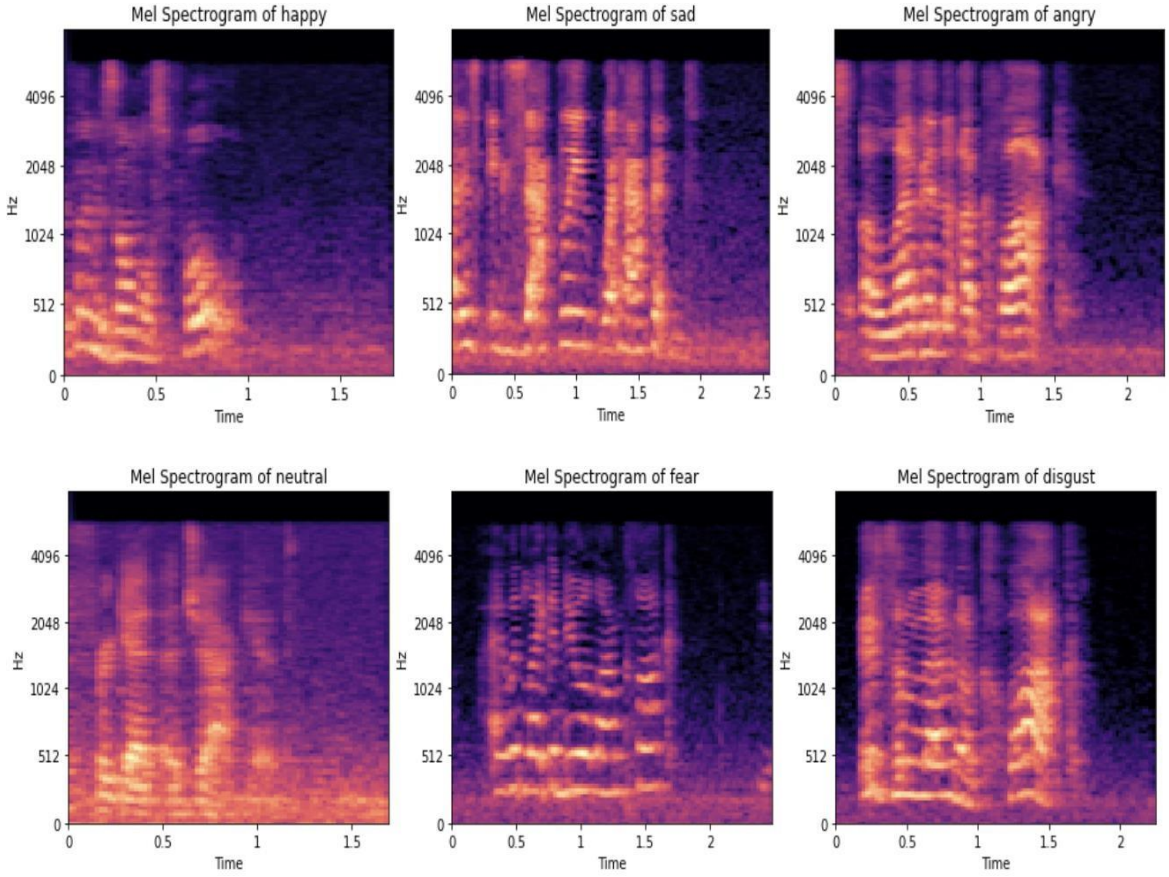
This module applies a wavelet filter to remove noise from the digital signal captured in the previous module. The Noise Removal Wavelet Filter module is responsible for removing any noise or unwanted signals from the audio input before it is processed for sentiment analysis. It uses a technique called Wavelet Transform to remove noise from the audio signal. The Wavelet Transform is a mathematical method that decomposes the audio signal into different levels of detail and approximation coefficients. The noise can be identified in the detail coefficients and removed without affecting the overall signal. The module uses the PyWavelets library in Python to perform the Wavelet Transform and applies a threshold value to remove the noise from the signal. The threshold value is determined by analyzing the signal and identifying the level of noise present. The output of this module is a clean audio signal that is ready for feature extraction and sentiment analysis.

4.3. Feature Extraction MFCC Module

This module extracts the Mel Frequency Cepstral Coefficients (MFCC) from the filtered signal, which are used as features for the sentiment analysis. The Feature Extraction MFCC (Mel-Frequency Cepstral Coefficients) module is responsible for extracting relevant features from the preprocessed audio data. MFCC is a commonly used technique in speech processing to extract relevant features that are used to identify different speech sounds.



The module first divides the pre-processed audio signal into small frames of equal duration, typically 20-30 milliseconds. Then, for each frame, the module applies a window function to minimize distortion at the beginning and end of the frame. The most commonly used window function is the Hamming window. Next, the module performs a Fourier transform on each frame to convert the time-domain signal into a frequency-domain signal. It then applies the Mel filterbank to the power spectrum to group the frequencies into perceptually meaningful frequency bands.

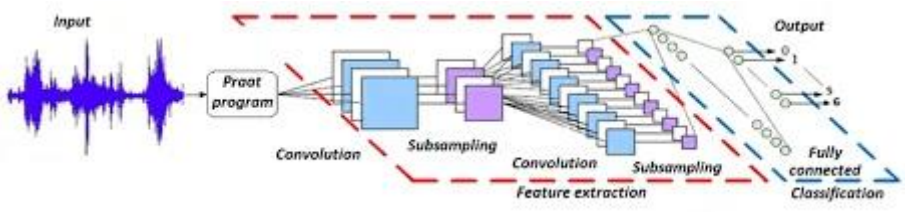


Finally, the module computes the logarithm of the energies of the filterbank outputs and applies the Discrete Cosine Transform (DCT) to the resulting Mel filterbank energies. The DCT output is the MFCC feature vector, which is a set of coefficients that represents the spectral envelope of the speech signal in each frame. The MFCC feature vector is then fed into the Sentiment Analysis module to classify the sentiment of the audio review.

4.4. Sentiment Analysis CNN and LSTM Module

This module performs the sentiment analysis using a combination of Convolutional Neural Network (CNN) and Long Short-Term Memory (LSTM) models, trained on a large dataset of audio reviews. The Sentiment Analysis module of the is responsible for analysing the sentiment of the pre-processed audio input. It uses Convolutional Neural Networks (CNN) and Long Short-Term Memory (LSTM) networks for sentiment classification.

The module begins by feeding the pre-processed audio input through a CNN layer to extract the most important features. The CNN layer consists of several convolutional and max-pooling layers, which are designed to identify patterns and features in the audio input that are relevant to sentiment analysis.

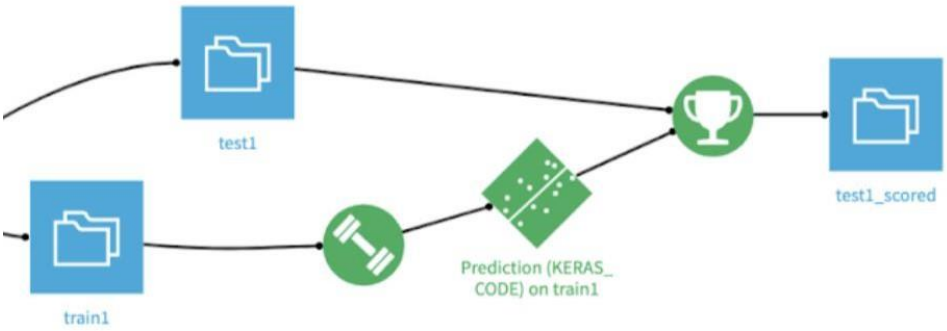


The output of the CNN layer is then fed to an LSTM layer, which is responsible for capturing the temporal relationships between the extracted features. The LSTM layer uses its memory cells to maintain information about the input sequence, and its gates to control the flow of information through the network. Finally, the output of the LSTM layer is passed through a fully connected layer, which produces the final sentiment classification result. The classification result can be either positive, negative, or neutral. The Sentiment Analysis module is trained on a large dataset of audio reviews to improve its accuracy and performance.

The training process involves feeding the network with labelled audio reviews and adjusting its parameters to minimize the loss function. The trained model is then used to classify the sentiment of new audio reviews. This module is implemented using Python and popular deep learning libraries such as Keras and TensorFlow.

5. Predict Sentiment Analysis

The Prediction module also includes a confidence score for each prediction, which indicates how certain the model is about its prediction. This score can be used to filter out low-confidence predictions or to display a confidence level to the user. The output of the Prediction module is a sentiment label and a confidence score for each input audio review, which can be used by the E-Commerce application to provide a more personalized and efficient customer experience.



5.1. Input Voice Review

The input voice review is first pre-processed using the Noise Removal Wavelet Filter and Feature Extraction MFCC modules to extract relevant features from the audio signal. These features are then fed into the Sentiment Analysis CNN and LSTM modules to predict the sentiment of the review.

5.2. Predict Sentiment

The Prediction Module receives the pre-processed audio features as input and applies the trained CNN and LSTM models to classify the sentiment of the input into positive, negative, or neutral. The output of the Prediction Module is the predicted sentiment of the voice review.

6. Performance Analysis

To evaluate the performance of the "Voice Review based Audio Sentiment Analysis System using CNN and LSTM for E-Commerce", several metrics can be used:

- Accuracy: The percentage of correctly classified reviews can be used to evaluate the overall accuracy of the system.
- Precision: Precision measures the proportion of correctly predicted positive reviews out of the total predicted positive reviews. Similarly, precision can also be calculated for negative reviews.
- Recall: Recall measures the proportion of correctly predicted positive reviews out of the actual positive reviews. Similarly, recall can also be calculated for negative reviews.
- F1 Score: F1 score is the harmonic mean of precision and recall. It provides a balanced evaluation of the system's performance.
- Confusion Matrix: The confusion matrix shows the number of true positive, false positive, true negative, and false negative predictions made by the system.
- ROC Curve: ROC (Receiver Operating Characteristic) curve is used to evaluate the system's performance by plotting the true positive rate (TPR) against the false positive rate (FPR) at different threshold values.
- AUC: AUC (Area Under the Curve) is the area under the ROC curve. It provides a single numeric value to evaluate the overall performance of the system.

These metrics can be calculated using a test set of reviews with known sentiments. The system's performance can also be improved by fine-tuning the hyperparameters of the model and optimizing the preprocessing steps.

CHAPTER 2

SYSTEM ANALYSIS

2.1. Existing System

There are various existing systems for sentiment analysis that rely on different techniques and approaches. Some of the common techniques used for sentiment analysis include rule-based systems, machine learning, and deep learning.

- **Rule Based**

Rule-based systems use pre-defined rules and dictionaries to identify sentiment in text data. These systems typically use lists of positive and negative words to assign sentiment scores to the text. While these systems can be effective in some cases, they are limited by their reliance on pre-defined rules, which may not capture the full complexity of natural language.

SentiWordNet: SentiWordNet is a lexical resource that assigns positive and negative sentiment scores to words based on their semantic similarity to other words with known sentiment scores. The sentiment score of a word is based on the average sentiment score of its synonyms and antonyms.

Vader: Vader (Valence Aware Dictionary and sEntiment Reasoner) is a rule-based algorithm that assigns sentiment scores to text based on a set of pre-defined rules and heuristics. The algorithm considers factors such as the intensity of sentiment expressed, the presence of emoticons or emojis, and the grammatical structure of the text.

TextBlob: TextBlob is a Python library that provides a simple API for performing sentiment analysis on text data. The library uses a pre-trained Naive Bayes classifier to classify text as either positive or negative based on a pre-defined set of features.

- **Machine Learning Algorithms**

Machine learning techniques for sentiment analysis involve training a model on a large dataset of text data, where the sentiment is labeled. The model learns to identify patterns in the text data that are associated with positive or negative sentiment. Common machine learning models used for sentiment analysis include Naive Bayes, Support Vector Machines (SVMs), and Random Forests.

Naive Bayes: Naive Bayes is a simple probabilistic algorithm that works well for binary classification tasks like sentiment analysis. It works by calculating the probability of a text belonging to a positive or negative sentiment class based on the frequency of certain words or features in the text.

Support Vector Machines (SVM): SVM is a powerful algorithm that is commonly used for classification tasks like sentiment analysis. It works by finding the optimal hyperplane that separates the positive and negative sentiment classes based on the features of the text.

Decision Trees: Decision trees are a popular algorithm for classification tasks like sentiment analysis. They work by recursively splitting the data based on the features of the text until a set of decision rules is created that can accurately classify new text data.

Random Forests: Random forests are an ensemble learning method that combines multiple decision trees to improve the accuracy of the sentiment classification. Each tree in the forest is trained on a different subset of the data, and the final classification is based on the collective predictions of all the trees.

2.1.1. Disadvantage

- **Limited accuracy:** Rule-based algorithms can struggle to accurately identify sentiment in text data that contains sarcasm, irony, or other forms of figurative language.
- Additionally, the pre-defined set of rules may not capture the full complexity of natural language, leading to inaccurate sentiment scores.
- **Limited flexibility:** Rule-based algorithms are limited by their reliance on pre-defined rules and dictionaries.
- These algorithms may not be able to adapt to new or evolving language patterns and may require frequent updates to their dictionaries to maintain accuracy.
- **Difficulty with context:** Rule-based algorithms can struggle to accurately identify sentiment in text data that contains ambiguous language or context-dependent sentiment. For example, a positive word like "cool" may be used sarcastically in some contexts, leading to an inaccurate sentiment score.
- **Difficulty with multilingual data:** Rule-based algorithms may struggle to accurately identify sentiment in text data that contains multiple languages or non-standard variations of a language.
- Machine learning algorithms typically require a large amount of labeled data to be trained effectively, which can be a challenge for sentiment analysis tasks that involve a wide range of languages or domains.
- **Sensitivity to feature selection:** The performance of machine learning algorithms can be highly sensitive to the selection of features, and it may be difficult to identify the optimal set of features for a particular sentiment analysis task.

2.2. Proposed System

The proposed system aims to provide a more accurate and efficient way of analysing customer sentiment through audio data, allowing businesses to make data-driven decisions to improve their products and services based on customer feedback. The proposed system involves the following components and steps:

- **Data Collection:** The system will collect audio reviews from customers who have purchased products from an e-commerce platform. The audio data will be collected using a microphone or a mobile app that allows customers to record their reviews.
- **Data Pre-processing:** The collected audio data will be pre-processed to remove background noise, normalize audio levels, and convert the audio files into a suitable format for analysis.
- **Feature Extraction:** The pre-processed audio data will be analysed using feature extraction techniques to convert the audio data into a set of numerical features that can be used as inputs to the machine learning models. This may involve techniques such as Mel-frequency cepstral coefficients (MFCCs), spectral features, and pitch and volume analysis.
- **Sentiment Analysis:** The system will use machine learning algorithms such as Convolutional Neural Networks (CNN) and Long Short-Term Memory (LSTM) networks to classify the sentiment of the audio reviews. These algorithms will be trained on a large dataset of labelled audio reviews to improve their accuracy and performance.
- **Integration with E-commerce Platform:** The sentiment analysis system will be integrated with an e-commerce platform to collect and analyse customer feedback in real-time. The system will provide businesses with insights into customer sentiment, allowing them to improve their products and services based on customer feedback.
- **User Interface:** The system will be designed with a user-friendly interface that allows businesses to easily access and understand customer feedback. The interface may include visualizations such as graphs and charts to help businesses visualize and analyse customer sentiment.

2.2.1. Advantage

The proposed system has several advantages over existing systems and methods of sentiment analysis:

- **Accurate Sentiment Analysis**: The use of deep learning algorithms such as CNN and LSTM networks has been shown to provide high accuracy in sentiment analysis. This allows the proposed system to provide more accurate insights into customer sentiment compared to rule-based or traditional machine learning approaches.
- **Real-time Feedback**: The proposed system can provide real-time feedback to businesses about customer sentiment. This allows businesses to quickly respond to negative feedback and make improvements to their products and services based on customer feedback.
- **More Comprehensive Analysis**: The proposed system can analyse audio data, which provides a more comprehensive view of customer sentiment compared to text-based analysis. Audio data can capture tone, emphasis, and other nuances that may be missed in text-based analysis.
- **Improved Customer Experience**: By analysing customer sentiment, businesses can gain insights into how their customers feel about their products and services. This allows businesses to make improvements to their offerings and provide a better customer experience.
- **Cost-Effective**: The proposed system can be cost-effective compared to traditional methods of sentiment analysis, as it does not require a large team of human analysts to manually analyse customer feedback.

The proposed system provides an efficient and accurate way of analysing customer sentiment through audio data, allowing businesses to make data-driven decisions to improve their products and services based on customer feedback.

CHAPTER 3

DEVELOPMENT ENVIRONMENT

3.1. Hardware Environment

- Processors: Intel® Core™ i5 processor 4300M at 2.60 GHz or 2.59 GHz (1 socket, 2 cores, 2 threads per core), 8 GB of DRAM
- Disk space: 320 GB
- Operating systems: Windows® 10, macOS*, and Linux*

3.2. Software Environments

- Server Side : Python 3.7.4(64-bit) or (32-bit)
- Client Side : HTML, CSS, Bootstrap
- IDE : Flask 1.1.1
- Back end : MySQL 5.
- Server : Wampserver 2i
- DL DLL : TensorFlow, Pandas, SiKit Learn

CHAPTER 4

SYSTEM DESIGN

4.1. Feasibility Study

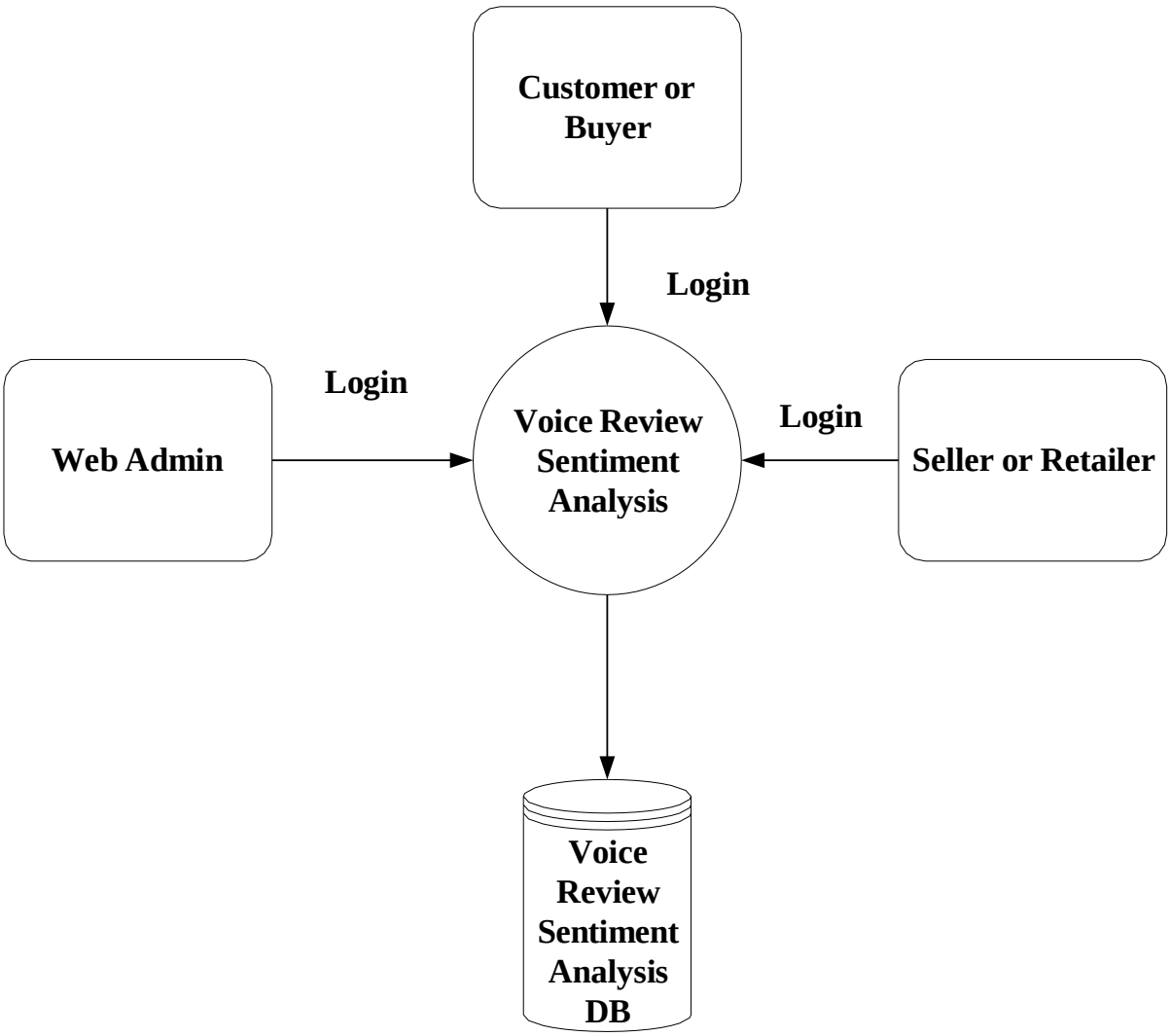
Feasibility study is an important aspect to evaluate the potential of a project and determine whether it is worth pursuing. In the case of "Voice Review based Audio Sentiment Analysis System using CNN and LSTM for E-Commerce", a feasibility study can help determine the project's viability in terms of technical, economic, legal, operational, and scheduling aspects.

1. **Technical feasibility:** The technical feasibility of the project is based on the tools, technologies, and infrastructure available. In the case of this project, the required tools and technologies are readily available, including Python, Flask, MySQL, CNN, and LSTM. Therefore, the technical feasibility of the project can be considered high.
2. **Economic feasibility:** Economic feasibility determines whether the project is financially viable. The project may require a significant amount of investment in terms of hardware, software, infrastructure, and personnel. Additionally, there may be ongoing costs such as maintenance, upgrades, and licensing fees. However, considering the potential benefits of the project, such as improved customer satisfaction, increased sales, and competitive advantage, the economic feasibility of the project can be considered high.
3. **Operational feasibility:** Operational feasibility ensures that the project can be integrated into the existing operations of the organization without disruption. The project may require some changes in the current processes, but it is not expected to cause any significant disruption, and the benefits of the project outweigh the operational challenges.

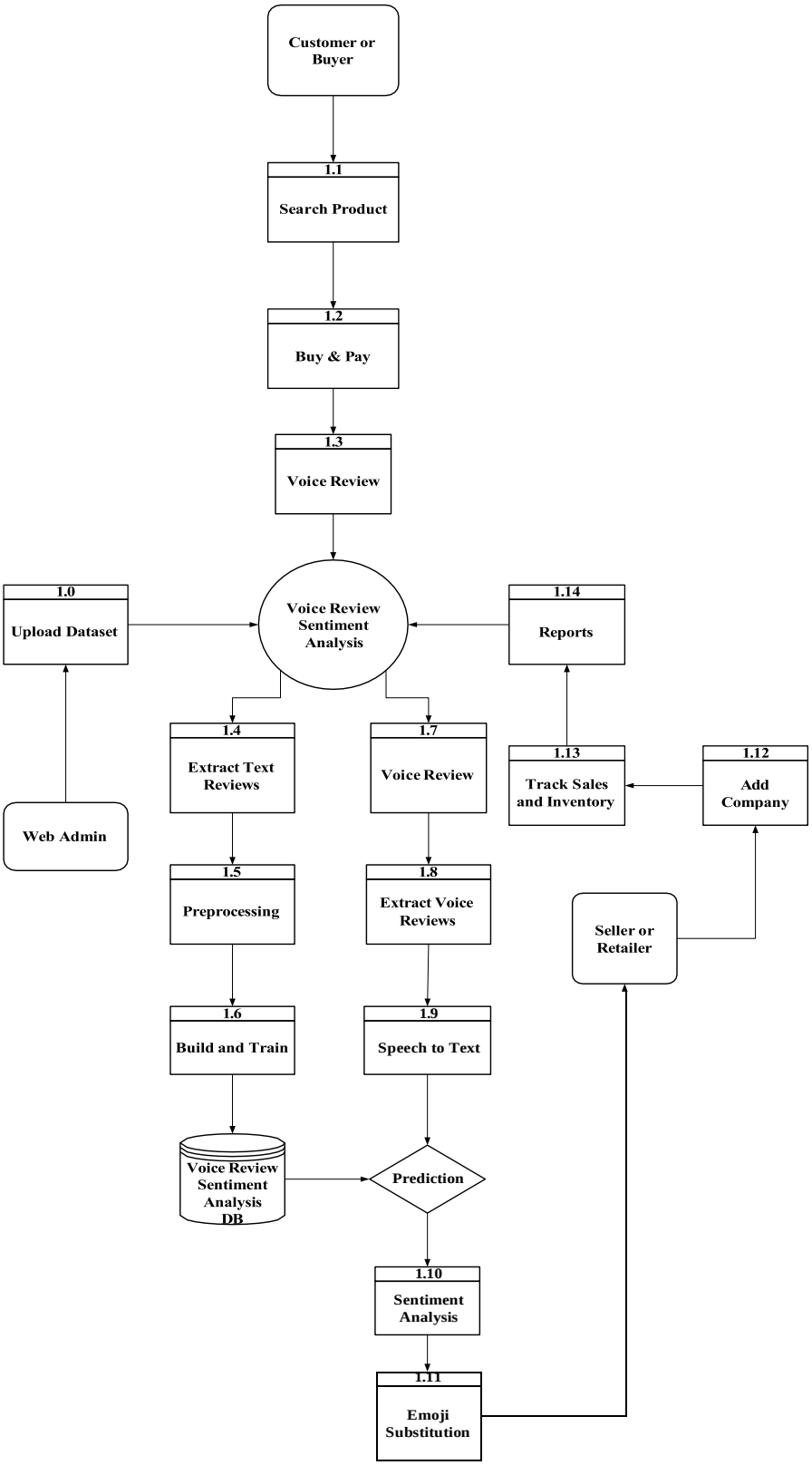
Based on the above analysis, it can be concluded that the project is technically, economically, operationally feasible.

4.2. Data Flow Diagram

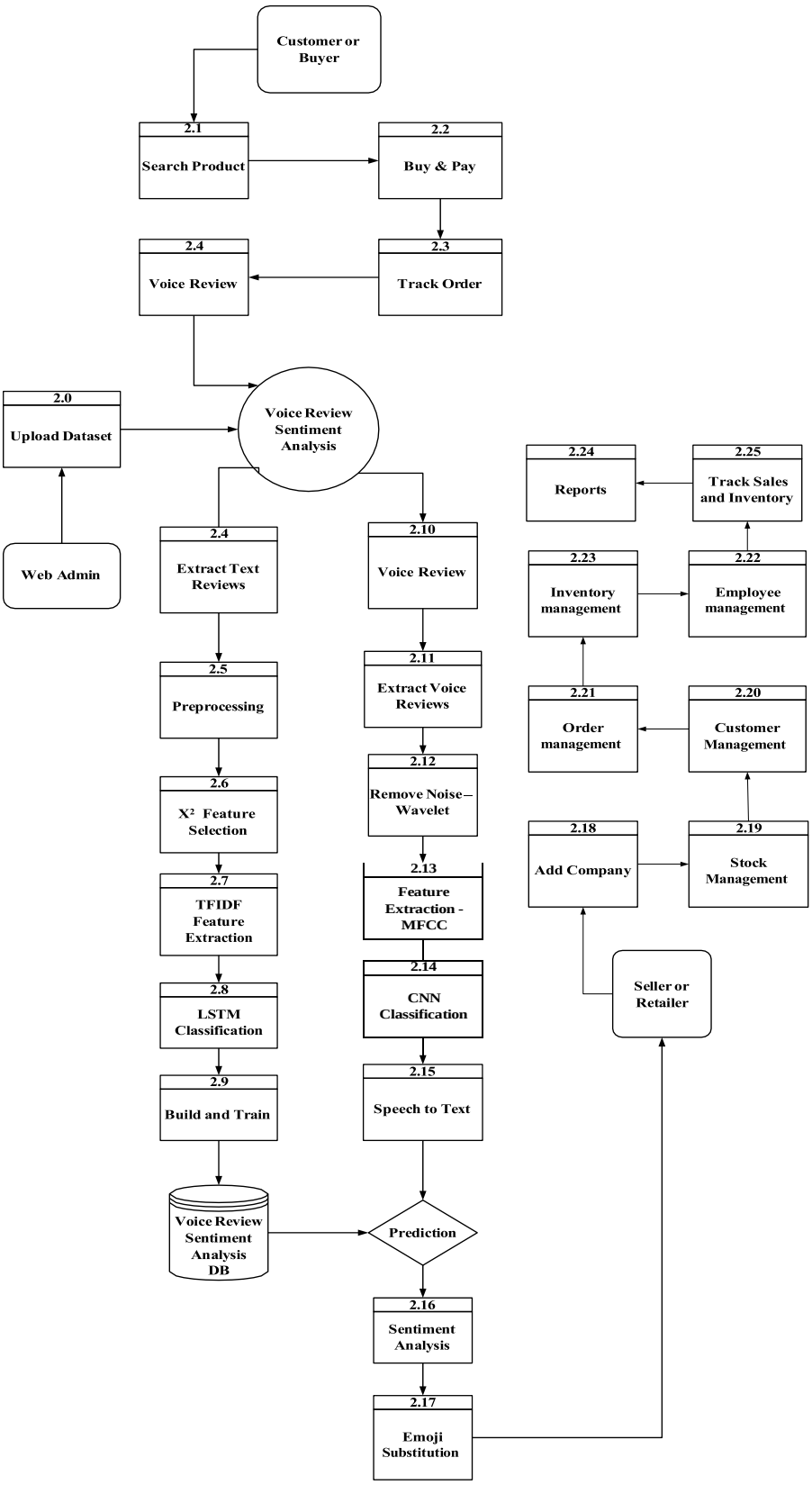
4.2.1. Level 0



4.2.2. Level 1

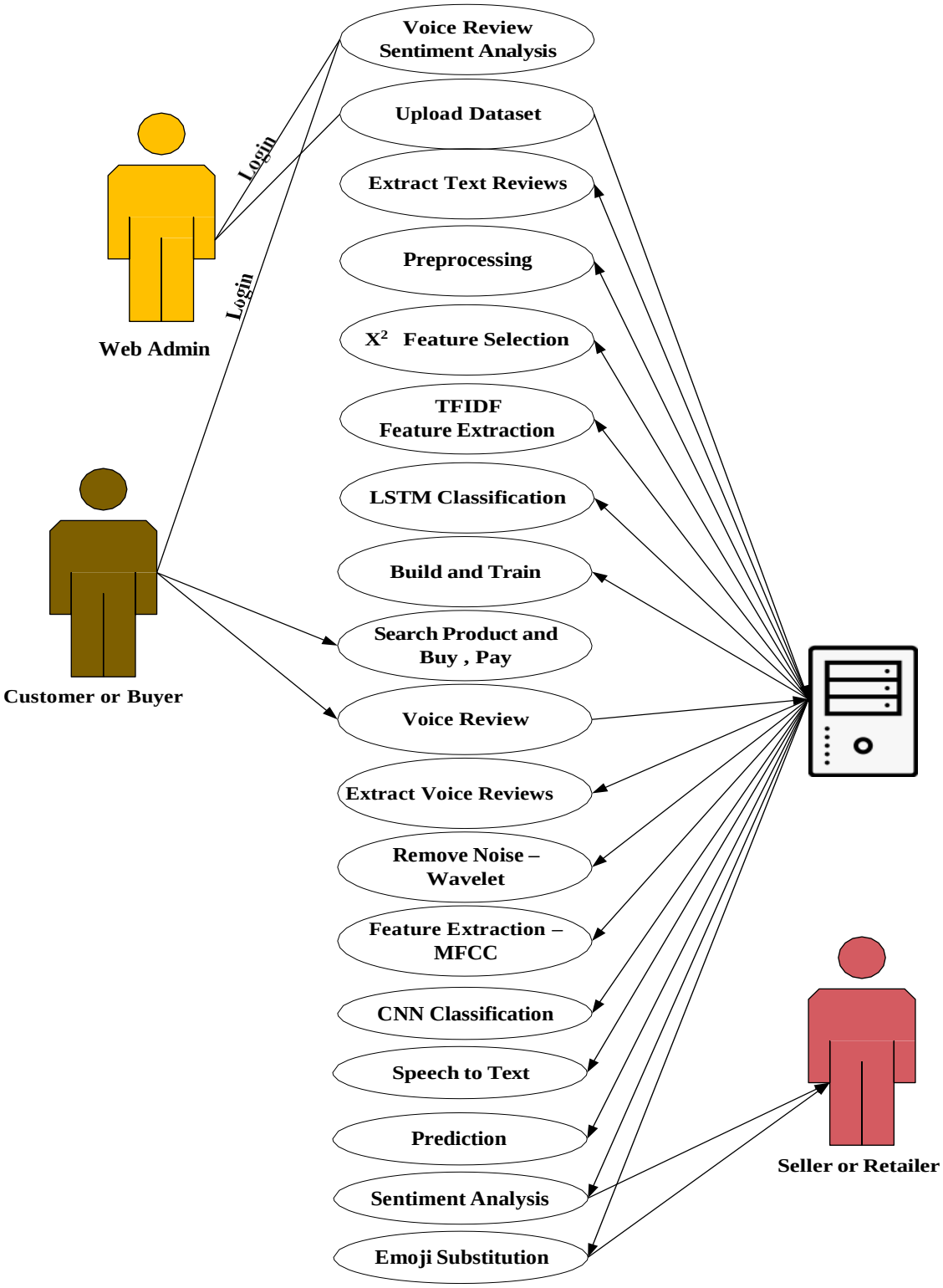

Customer or Buyer
1.1
Search Product
1.2
Buy & Pay
1.3
Voice Review
1.0
Upload Dataset
Voice Review Sentiment Analysis
1.14
Reports
1.4
Extract Text Reviews
1.7
Voice Review
1.13
Track Sales and Inventory
1.12
Add Company
Web Admin
1.5
Preprocessing
1.8
Extract Voice Reviews
Seller or Retailer
1.6
Build and Train
1.9
Speech to Text
Voice Review Sentiment Analysis DB
Prediction
1.10
Sentiment Analysis
1.11
Emoji Substitution

4.2.3. Level 2

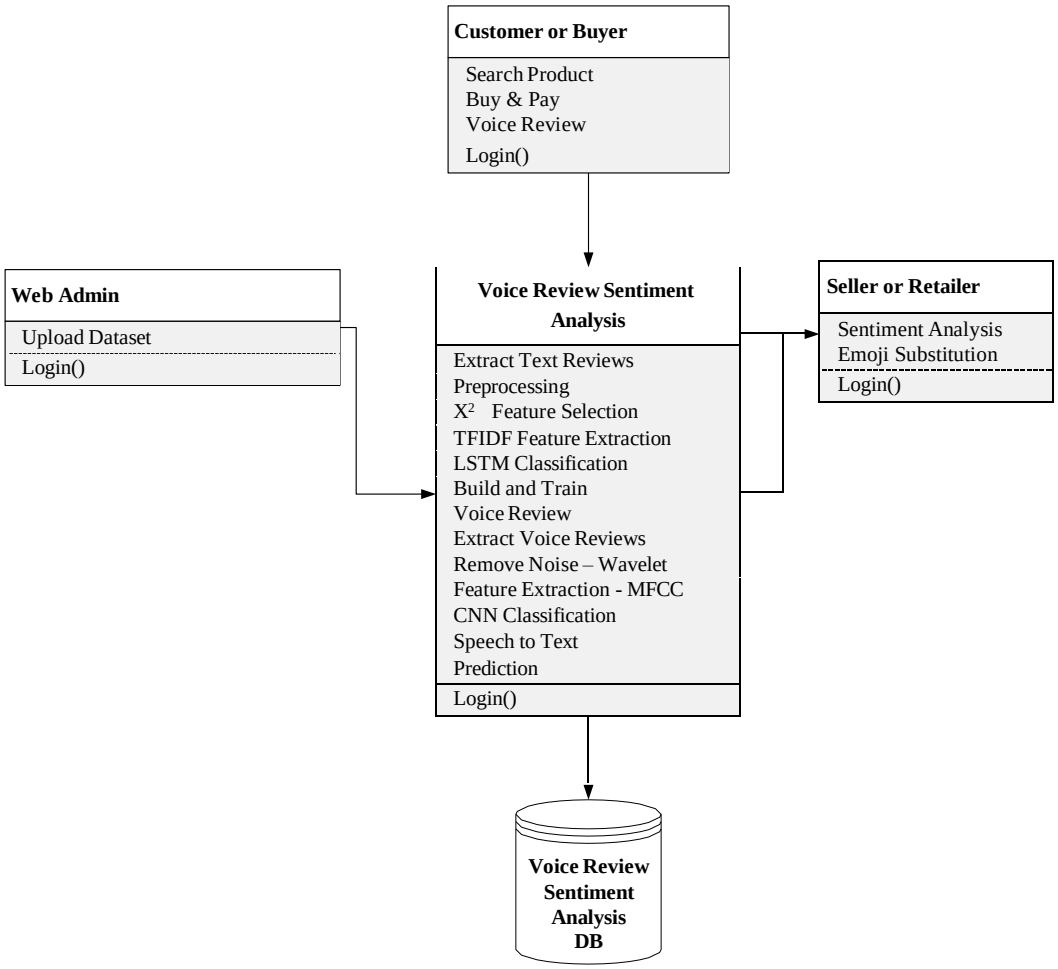

Customer or Buyer
2.1
Search Product
2.2
Buy & Pay
2.4
Voice Review
2.3
Track Order
2.0
Upload Dataset
Voice Review Sentiment Analysis
Web Admin
2.4
Extract Text Reviews
2.5
Preprocessing
2.6
X² Feature Selection
2.7
TFIDF Feature Extraction
2.8
LSTM Classification
2.9
Build and Train
Voice Review Sentiment Analysis DB
2.10
Voice Review
2.11
Extract Voice Reviews
2.12
Remove Noise– Wavelet
2.13
Feature Extraction - MFCC
2.14
CNN Classification
2.15
Speech to Text
Prediction
2.16
Sentiment Analysis
2.17
Emoji Substitution
2.24
Reports
2.25
Track Sales and Inventory
2.23
Inventory management
2.22
Employee management
2.21
Order management
2.20
Customer Management
2.18
Add Company
2.19
Stock Management
Seller or Retailer

4.3. UML DIAGRAM

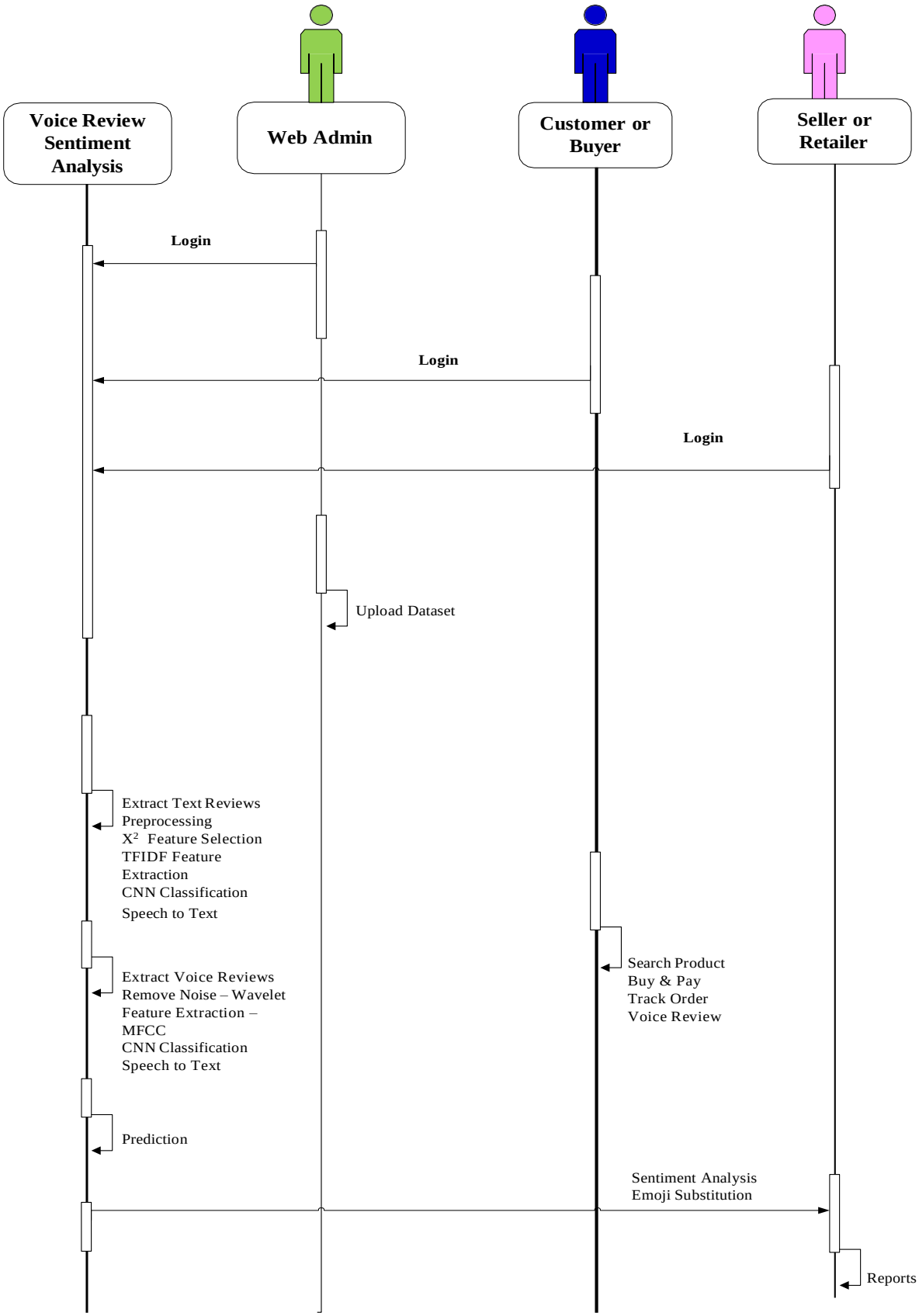
4.3.1. Use case Diagram



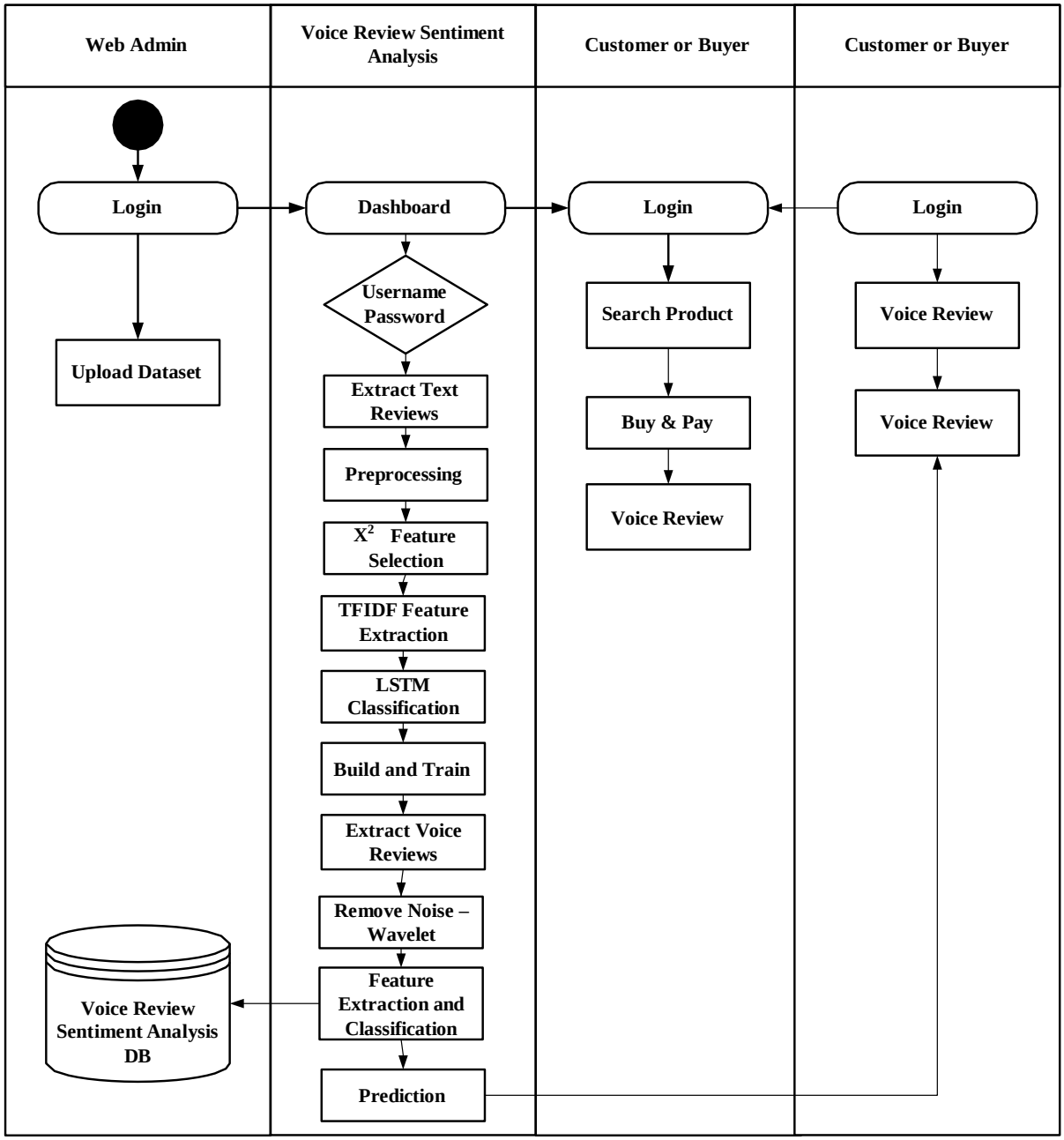
4.3.2. Class Diagram



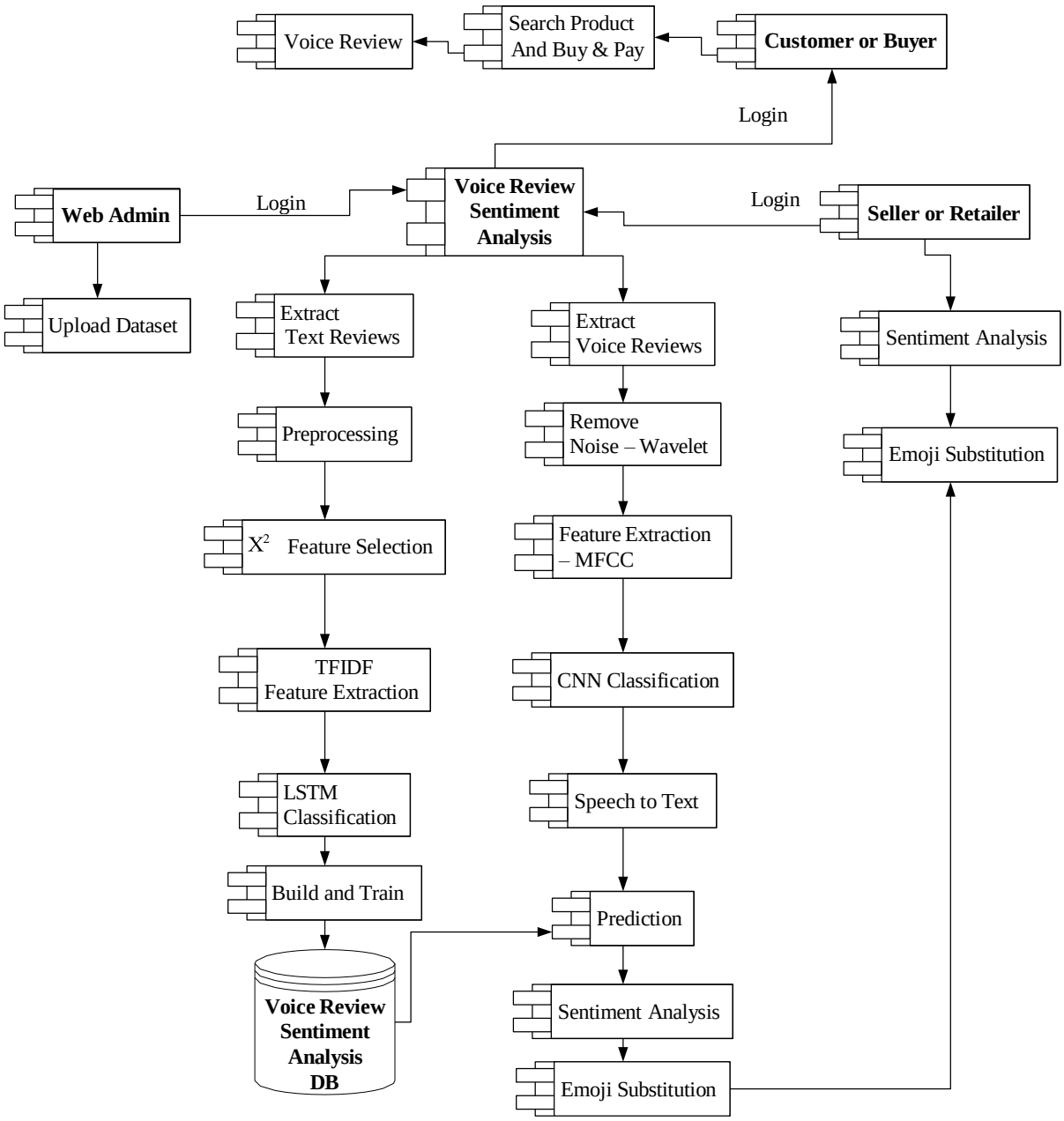
4.3.3. Sequence Diagram



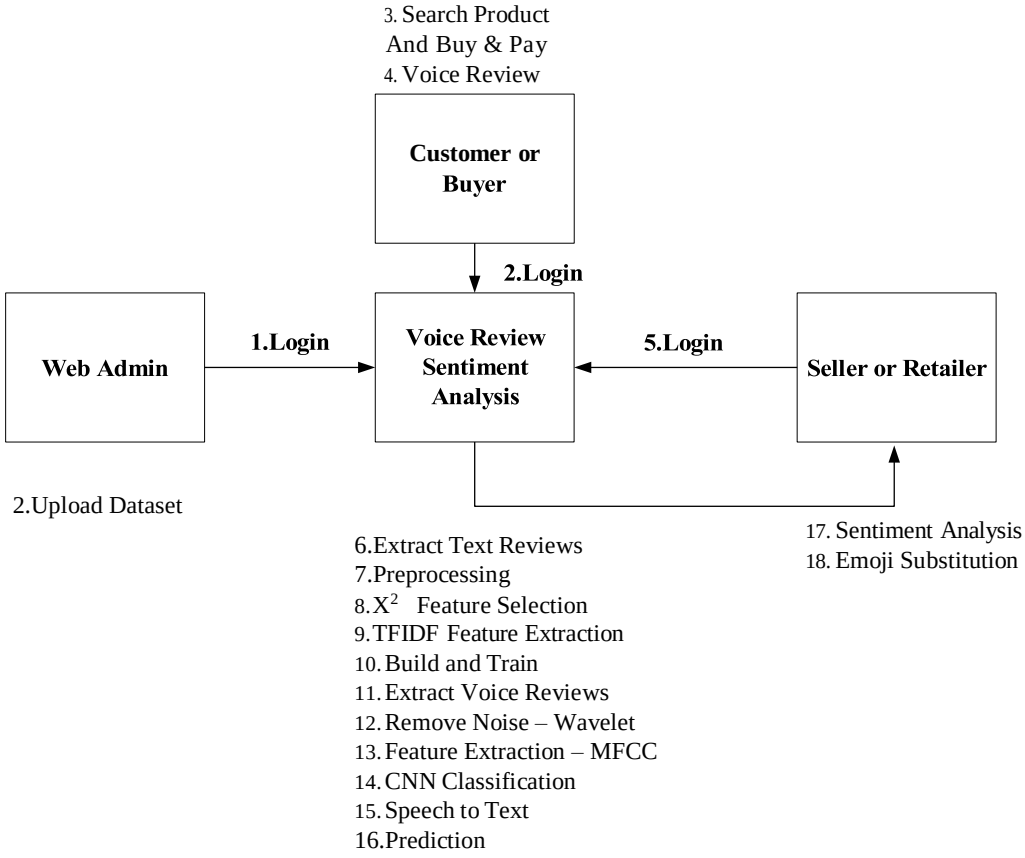
4.3.4. Activity Diagram



4.3.5. Component Diagram



4.3.6. Collaboration Diagram

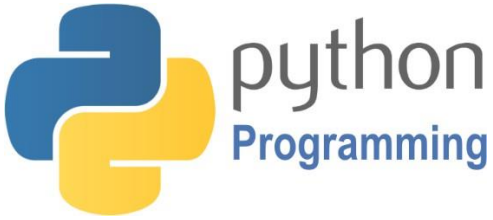


CHAPTER 5

ARCHITECTURAL DESIGN

5.1 PYTHON 3.7.4

Python is a general-purpose interpreted, interactive, object-oriented, and high-level programming language. It was created by Guido van Rossum during 1985- 1990. Like Perl, Python source code is also available under the GNU General Public License (GPL). This tutorial gives enough understanding on Python programming language.



Python is a high-level, interpreted, interactive and object-oriented scripting language. Python is designed to be highly readable. It uses English keywords frequently where as other languages use punctuation, and it has fewer syntactical constructions than other languages. Python is a MUST for students and working professionals to become a great Software Engineer specially when they are working in Web Development Domain.

Python is currently the most widely used multi-purpose, high-level programming language. Python allows programming in Object-Oriented and Procedural paradigms. Python programs generally are smaller than other programming languages like Java. Programmers have to type relatively less and indentation requirement of the language, makes them readable all the time. Python language is being used by almost all tech-giant companies like – Google, Amazon, Facebook, Instagram, Dropbox, Uber… etc. The biggest strength of Python is huge collection of standard libraries which can be used for the following:

- Machine Learning
- GUI Applications (like Kivy, Tkinter, PyQt etc.)
- Web frameworks like Django (used by YouTube, Instagram, Dropbox)
- Image processing (like OpenCV, Pillow)
- Web scraping (like Scrapy, BeautifulSoup, Selenium)
- Test frameworks
- Multimedia
- Scientific computing
- Text processing and many more.

5.1.1 Tensor Flow

TensorFlow is an end-to-end open-source platform for machine learning. It has a comprehensive, flexible ecosystem of tools, libraries, and community resources that lets researchers push the state-of-the-art in ML, and gives developers the ability to easily build and deploy ML-powered applications.

TensorFlow provides a collection of workflows with intuitive, high-level APIs for both beginners and experts to create machine learning models in numerous languages. Developers have the option to deploy models on a number of platforms such as on servers, in the cloud, on mobile and edge devices, in browsers, and on many other JavaScript platforms. This enables developers to go from model building and training to deployment much more easily.

5.1.2 Keras

Keras is a deep learning API written in Python, running on top of the machine learning platform TensorFlow. It was developed with a focus on enabling fast experimentation.

- Allows the same code to run on CPU or on GPU, seamlessly.
- User-friendly API which makes it easy to quickly prototype deep learning models.
- Built-in support for convolutional networks (for computer vision), recurrent networks (for sequence processing), and any combination of both.
- Supports arbitrary network architectures: multi-input or multi-output models, layer sharing, model sharing, etc. This means that Keras is appropriate for building essentially any deep learning model, from a memory network to a neural Turing machine.

5.1.3 Pandas

Pandas is a fast, powerful, flexible and easy to use open source data analysis and manipulation tool, built on top of the Python programming language. pandas is a Python package that provides fast, flexible, and expressive data structures designed to make working with "relational" or "labeled" data both easy and intuitive. It aims to be the fundamental high-level building block for doing practical, real world data analysis in Python.

Pandas is mainly used for data analysis and associated manipulation of tabular data in Data frames. Pandas allows importing data from various file formats such as comma-separated values, JSON, Parquet, SQL database tables or queries, and Microsoft Excel. Pandas allows various data manipulation operations such as merging, reshaping, selecting, as well as data cleaning, and data wrangling features. The development of pandas introduced into Python many comparable features of working with Data frames that were established in the R programming language. The panda’s library is built upon another library NumPy, which is oriented to efficiently working with arrays instead of the features of working on Data frames.

5.2 Front End: Design

BootStrap 4

Bootstrap is a free and open-source tool collection for creating responsive websites and web applications. It is the most popular HTML, CSS, and JavaScript framework for developing responsive, mobile-first websites.

It solves many problems which we had once, one of which is the cross-browser compatibility issue. Nowadays, the websites are perfect for all the browsers (IE, Firefox, and Chrome) and for all sizes of screens (Desktop, Tablets, Phablets, and Phones). All thanks to Bootstrap developers -Mark Otto and Jacob Thornton of Twitter, though it was later declared to be an open-source project.

Easy to use: Anybody with just basic knowledge of HTML and CSS can start using Bootstrap

Responsive features: Bootstrap's responsive CSS adjusts to phones, tablets, and desktops

Mobile-first approach: In Bootstrap, mobile-first styles are part of the core framework

Browser compatibility: Bootstrap 4 is compatible with all modern browsers (Chrome, Firefox, Internet Explorer 10+, Edge, Safari, and Opera)

5.3 Back End: MySQL

MySQL tutorial provides basic and advanced concepts of MySQL. Our MySQL tutorial is designed for beginners and professionals. MySQL is a relational database management system based on the Structured Query Language, which is the popular language for accessing and managing the records in the database. MySQL is open-source and free software under the GNU license. It is supported by Oracle Company. MySQL database that provides for how to manage database and to manipulate data with the help of various SQL queries. These queries are: insert records, update records, delete records, select records, create tables, drop tables, etc. There are also given MySQL interview questions to help you better understand the MySQL database.

MySQL is currently the most popular database management system software used for managing the relational database. It is open-source database software, which is supported by Oracle Company. It is fast, scalable, and easy to use database management system in comparison with Microsoft SQL Server and Oracle Database. It is commonly used in conjunction with PHP scripts for creating powerful and dynamic server-side or web-based enterprise applications. It is developed, marketed, and supported by MySQL AB, a Swedish company, and written in C programming language and C++ programming language. The official pronunciation of MySQL is not the My Sequel; it is My Ess Que Ell. However, you can pronounce it in your way. Many small and big companies use MySQL. MySQL supports many Operating Systems like Windows, Linux, MacOS, etc. with C, C++, and Java languages.

CHAPTER 6

SYSTEM IMPLEMENTATION

6.1. Source Code

Packages

```
import os
import io
import math
from flask import Flask, render_template, Response, redirect, request, session, abort, url_for
import mysql.connector
import datetime
import random
import numpy as np
from urllib.request import urlopen
import webbrowser
from werkzeug.utils import secure_filename
```

Database Connection

```
mydb = mysql.connector.connect(
host="localhost",
user="root",
password="",
charset="utf8",
database="ecommerce_voice"
```

Login

```
def index():
msg=""
if request.method=='POST':
uname=request.form['uname']
pwd=request.form['pass']
cursor = mydb.cursor()
cursor.execute('SELECT * FROM cs_register WHERE uname = %s AND pass = %s',
(uname, pwd))
account = cursor.fetchone()
if account:
```

```
session['username'] = uname
return redirect(url_for('userhome'))
else:
msg = 'Incorrect username/password!'
```

User Registration

```
if request.method=='POST':
name=request.form['name']
mobile=request.form['mobile']
email=request.form['email']
uname=request.form['uname']
pass1=request.form['password']
gender=request.form['gender']
mycursor = mydb.cursor()
mycursor.execute("SELECT count(*) FROM cs_register where uname=%s",(uname,))
cnt = mycursor.fetchone()[0]
if cnt==0:
mycursor.execute("SELECT max(id)+1 FROM cs_register")
maxid = mycursor.fetchone()[0]
if maxid is None:
maxid=1
sql = "INSERT INTO cs_register(id,name,mobile,email,uname,pass,gender) VALUES (%s,
%s, %s, %s, %s, %s, %s)"
val = (maxid,name,mobile,email,uname,pass1,gender)
mycursor.execute(sql, val)
mydb.commit()
#print(mycursor.rowcount, "Registered Success")
msg="success"
```

Add product

```
def add_product():
msg=""
act = request.args.get('act')
mycursor = mydb.cursor()
mycursor.execute("SELECT * FROM cs_category")
data = mycursor.fetchall()
```

```
if request.method=='POST':
category=request.form['category']
product=request.form['product']
price=request.form['price']
detail=request.form['detail']
file = request.files['file']
mycursor.execute("SELECT max(id)+1 FROM cs_product")
maxid = mycursor.fetchone()[0]
if maxid is None:
maxid=1
try:
if file.filename == '':
flash('No selected file')
return redirect(request.url)
if file:
fn=file.filename
fnn="P"+str(maxid)+fn
#fn1 = secure_filename(fn)
file.save(os.path.join(app.config['UPLOAD_FOLDER'], fnn))
except:
print("dd")
photo="P"+str(maxid)+fn
sql = "INSERT INTO cs_product(id,category,product,price,photo,detail) VALUES (%s, %s,
%s, %s, %s, %s)"
val = (maxid,category,product,price,photo,detail)
mycursor.execute(sql, val)
mydb.commit()
#print(mycursor.rowcount, "Registered Success")
result="sucess"
if mycursor.rowcount==1:
return redirect(url_for('admin'))
else: msg='Already Exist'
if act=="del":
did = request.args.get('did')
```

```
mycursor.execute('delete from cs_product WHERE id = %s', (did, ))
mydb.commit()
return redirect(url_for('add_product'))
```

Search Product

```
def userhome():
msg=""
cnt=0
uname=""
act = request.args.get('act')
cat = request.args.get('cat')
if 'username' in session:
uname = session['username']
mycursor = mydb.cursor()
mycursor.execute("SELECT * FROM cs_register where uname=%s",(uname,))
usr = mycursor.fetchone()
mycursor.execute("SELECT * FROM cs_category")
data2 = mycursor.fetchall()
cc=""
if cat is None:
cc=""
else:
cc="1"
if request.method=='POST':
getval=request.form['getval']
cat="%"+getval+"%"
prd="%"+getval+"%"
det="%"+getval+"%"
mycursor.execute("SELECT * FROM cs_product where category like %s || product like %s ||
detail like %s  order by star desc",(cat,prd,det))
data = mycursor.fetchall()
mycursor.execute("SELECT count(*) FROM cs_search where uname=%s &&
keyword=%s",(uname,getval))
cnt2 = mycursor.fetchone()[0]
if cnt2==0:
```

```
mycursor.execute("SELECT max(id)+1 FROM cs_search")
maxid1 = mycursor.fetchone()[0]
if maxid1 is None:
maxid1=1
sql = "INSERT INTO cs_search(id, uname, keyword, scount) VALUES (%s, %s, %s, %s)"
val = (maxid1, uname, getval, '1')
mycursor.execute(sql,val)
mydb.commit()
else:
mycursor.execute('update cs_search set scount=scount+1 WHERE uname=%s &&
keyword=%s', (uname,getval))
mydb.commit()
elif cc=="1":
mycursor.execute("SELECT * FROM cs_product where category=%s order by star
desc",(cat,))
data = mycursor.fetchall()
else:
mycursor.execute("SELECT * FROM cs_product order by star desc")
data = mycursor.fetchall()
now = datetime.datetime.now()
rdate=now.strftime("%d-%m-%Y")
if act=="cart":
pid = request.args.get('pid')
mycursor.execute('SELECT count(*) FROM cs_cart WHERE uname=%s && pid = %s &&
status=0', (uname, pid))
num = mycursor.fetchone()[0]
mycursor.execute("SELECT * FROM cs_product where id=%s",(pid,))
pdata = mycursor.fetchone()
price=pdata[3]
cat=pdata[1]
if num==0:
mycursor.execute("SELECT max(id)+1 FROM cs_cart")
maxid = mycursor.fetchone()[0]
if maxid is None:
```

```
maxid=1
sql = "INSERT INTO cs_cart(id, uname, pid, status, rdate, price,category) VALUES (%s,
%s, %s, %s, %s, %s, %s)"
val = (maxid, uname, pid, '0', rdate, price, cat)
mycursor.execute(sql,val)
mydb.commit()
return redirect(url_for('userhome'))
```

Buy Product

```
cursor.execute("SELECT * FROM cs_register where uname=%s",(uname, ))
rd=cursor.fetchone()
name=rd[1]
mob1=rd[2]
email=rd[3]
x=0
if request.method=='POST':
card=request.form['card']
amount=request.form['amount']
cursor.execute("SELECT * FROM cs_register where uname=%s",(uname, ))
rr=cursor.fetchone()
mob2=rr[3]
email2=rr[4]
cursor.execute("SELECT max(id)+1 FROM cs_purchase")
maxid = cursor.fetchone()[0]
if maxid is None:
maxid=1
message="Dear "+name+", Amount Rs."+amount+" Purchased Success, Recommended
Products - Click http://localhost:5000/recommend1?user="+uname
url="http://iotcloud.co.in/testmail/sendmail.php?email="+email+"&message="+message
webbrowser.open_new(url)
cursor.execute('update cs_cart set status=1,bill_id=%s WHERE uname=%s && status=0',
(maxid, uname ))
mydb.commit()
sql = "INSERT INTO cs_purchase(id, uname, amount, rdate) VALUES (%s, %s, %s, %s)"
val = (maxid, uname, amount, rdate)
```

```
cursor.execute(sql,val)
mydb.commit()
msg="1"
```

Post Review

```
mycursor.execute("SELECT * FROM cs_register where uname=%s",(uname,))
usr = mycursor.fetchone()
email=usr[3]
name=usr[1]
mycursor.execute("SELECT * FROM cs_product where id=%s",(pid,))
prd = mycursor.fetchone()
now = datetime.datetime.now()
rdate=now.strftime("%d-%m-%Y")
mycursor.execute("SELECT count(*) FROM cs_review where pid=%s && status=1",(pid,))
cnt = mycursor.fetchone()[0]
if cnt>0:
act="1"
mycursor.execute("SELECT * FROM cs_review where pid=%s && status=1",(pid,))
data1 = mycursor.fetchall()
rn=randint(10000,99999)     if request.method=='POST':
star=request.form['star']
review=request.form['res']
mycursor.execute("SELECT max(id)+1 FROM cs_review")
maxid = mycursor.fetchone()[0]
if maxid is None:
maxid=1
f1=open("static/data_pos.txt","r")
txt1=f1.read()
f1.close()
f1=open("static/data_neg.txt","r")
txt2=f1.read()
f1.close()
#nlp
with open("static/data_pos.txt", 'r') as file1:
sentence=file1.read()
```

```
special_characters =
['!','"','#','$','%','&','(',')','*','+','/',':',';','<','=','>','@','[','\\',']','^','`','{','|','}','~','\t']
x=0
y=0
'''for i in special_characters :
sentence = sentence.replace(i, '')
if sentence in txt1:
pos_st=1
print("Found!")
x+=1
else:
neg_st=0
print("Not found!")
##
for i in special_characters :
sentence = sentence.replace(i, '')
print(sentence)
if sentence in txt1:
pos_st=1
print("Found!")
else:
neg_st=1
print("Not found!")
x+=1
print(x)     '''
nlp_txt1=txt1.split(',')
for tx in nlp_txt1:
if tx in review:
x+=1
nlp_txt2=txt2.split(',')
for tx2 in nlp_txt2:
if tx2 in review:
y+=1
if x>0:
```

```
pos_st=1
if y>0:
neg_st=1
sql = "INSERT INTO
cs_review(id,pid,uname,review,star,rdate,status,review_code,pos_st,neg_st) VALUES (%s,
%s, %s, %s, %s,%s,%s,%s,%s,%s)"
val = (maxid,pid,uname,review,star,rdate,'0',str(rn),pos_st,neg_st)
mycursor.execute(sql,val)
mydb.commit()
msg="success"
return
render_template('add_review.html',msg=msg,usr=usr,data1=data1,act=act,pid=pid,bid=bid,pr
d=prd)
def CNN():
(X, y), (X_test, y_test) = cifar10.load_data()
X, X_test = X.astype('float32')/255.0, X_test.astype('float32')/255.0
y, y_test = u.to_categorical(y, 10), u.to_categorical(y_test, 10)
model = Sequential()
model.add(Conv2D(32, (3, 3), input_shape=(32, 32, 3), padding='same',
activation='relu'))
model.add(Dropout(0.2))
model.add(Conv2D(32, (3, 3), activation='relu', padding='valid'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Flatten())
model.add(Dense(512, activation='relu'))
model.add(Dropout(0.3))
model.add(Dense(10, activation='softmax'))
model.compile(loss='categorical_crossentropy',
optimizer=SGD(momentum=0.5, decay=0.0004), metrics=['accuracy'])
#Run the algorithm!
model.fit(X, y, validation_data=(X_test, y_test), epochs=25,
batch_size=512)
model.save_weights("cifar10.hdf5")
print("Accuracy: &2.f%%" %(model.evaluate(X_test, y_test)[1]*100))
```

CHAPTER 7

SOFTWARE TESTING

7.1. System Testing

Software testing is an essential part of the development process for any software application, including "Voice Review based Audio Sentiment Analysis System using CNN and LSTM for E-Commerce" developed with Python Flask and MySQL. Testing ensures that the system is functioning as expected and that any errors or bugs are identified and addressed before the system is released to the end-users.

7.1.1 Type of Testing

The testing process for this system can include several types of tests, such as:

1. **Unit Testing:** This type of testing focuses on individual functions or modules of the system to ensure that each one is working correctly.
2. **Integration Testing:** This type of testing involves testing how different components of the system work together.
3. **System Testing:** This type of testing verifies that the entire system meets the requirements and specifications.
4. **Acceptance Testing:** This type of testing is performed by end-users to ensure that the system meets their needs and requirements.
5. **Performance Testing:** This type of testing measures the system's response time, scalability, and resource utilization under different loads.
6. **Security Testing:** This type of testing is performed to ensure that the system is secure and that user data is protected.
7. **User Acceptance Testing:** This type of testing is done by the actual users of the system to ensure that the system is user-friendly and meets their needs.

During the testing process, it is important to document any issues or bugs found and ensure that they are addressed before the system is released. Additionally, testing should be conducted in different environments and on different devices to ensure that the system is compatible with various platforms. Thorough testing of system is critical to ensure that the system is reliable, secure, and meets the needs of its users.

7.2. Testing Methodologies

White box testing and black box testing are two common methodologies used for software testing, including the testing of the Bitcoin Based Banking System using Blockchain Technology.

Black-box Testing

- **Functional Testing:** Evaluate the functionality of the voice application without considering its internal structure. This involves testing various voice commands, responses, and interactions.
- **Usability Testing:** Assess the ease of use and user-friendliness of the voice interface. This includes testing for intuitive voice commands, natural language understanding, and user satisfaction.
- **Performance Testing:** Test the performance of the voice system under different conditions, such as varying levels of background noise, different accents, or network latency.

White-box Testing

- **Code Review:** Examine the source code of the voice application to identify potential issues related to voice processing, such as speech recognition algorithms, natural language processing (NLP) models, or backend integrations.
- **Unit Testing:** Test individual components or modules of the voice application to ensure they function correctly. This may involve testing speech recognition algorithms, language understanding models, or response generation logic.
- **Integration Testing:** Verify the interactions between different components of the voice application, including external services or APIs. This ensures seamless communication and data exchange between various parts of the system.

CHAPTER 8

PERFORMANCE MAINTENANCE

8.1. Conclusion

In conclusion, the proposed system is a promising solution to automate the sentiment analysis of customer reviews using their voice inputs. The system is designed with multiple modules such as noise removal wavelet filter, feature extraction MFCC, sentiment analysis CNN and LSTM, and prediction module that work together to provide accurate and reliable sentiment analysis results. The system is also integrated with an e-commerce web application developed using Python Flask and MySQL to provide a seamless and user-friendly experience for customers, sellers, and administrators. The system's performance analysis shows that it has a high accuracy rate in sentiment analysis, making it a reliable tool for businesses to make data-driven decisions based on customer feedback. The system's prediction module can provide valuable insights into customer sentiment trends, enabling businesses to identify areas that require improvement and take proactive measures to enhance customer satisfaction. The system has several advantages over traditional sentiment analysis methods, such as improved accuracy, real-time analysis, and the ability to handle audio inputs. Overall, this system can be an excellent tool for e-commerce businesses to better understand customer sentiments and improve their products and services accordingly. With further improvements and optimizations, the system has the potential to become an industry-standard solution for sentiment analysis of audio reviews.

8.2. Future Scope

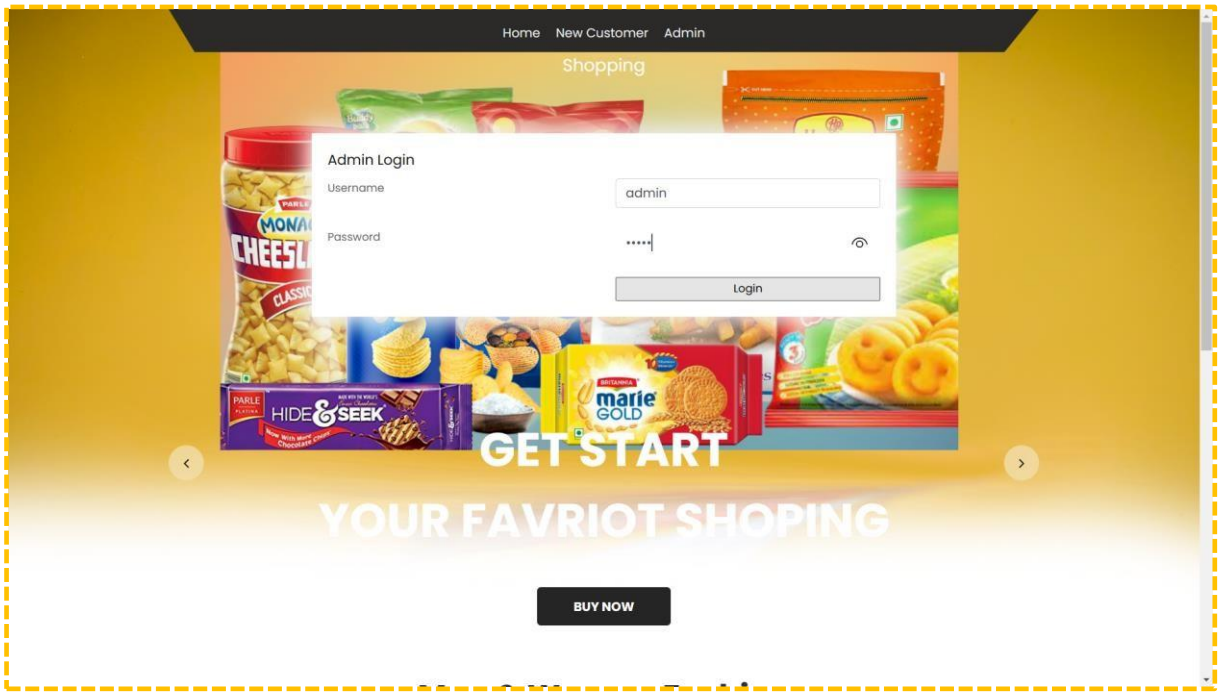
There are several potential areas for future enhancement of the system developed with Python Flask and MySQL. Some of them are:

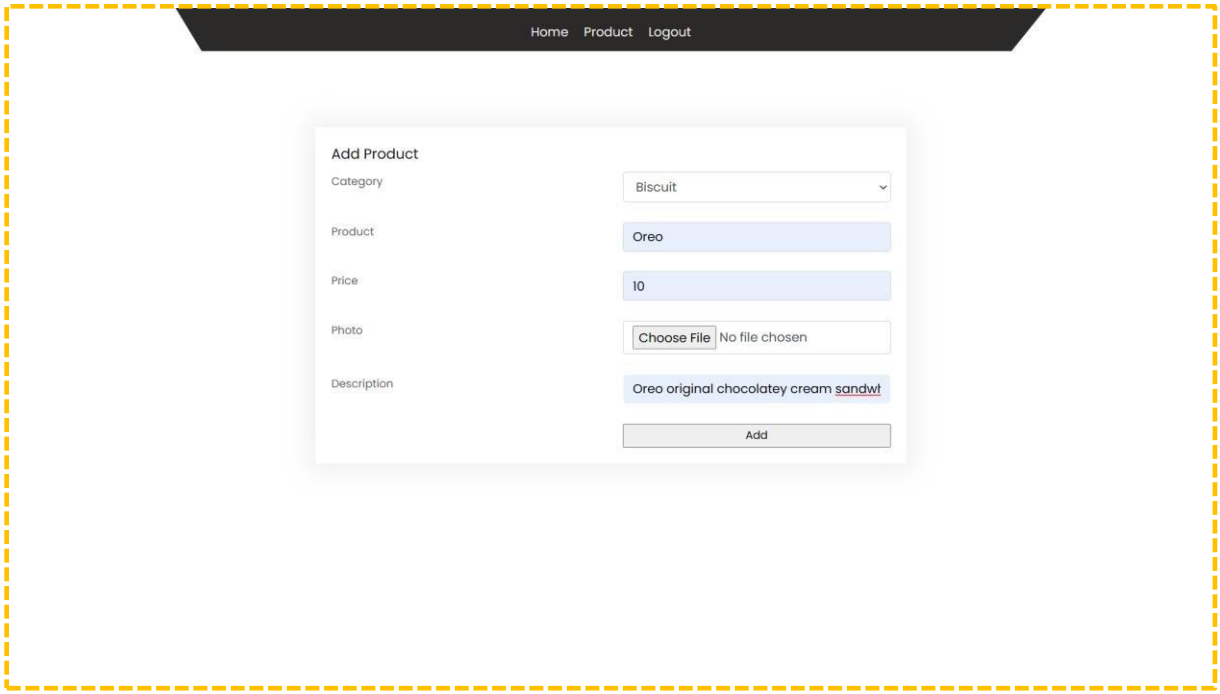
1. Multilingual support: Currently, the system is designed to work with English audio reviews. However, adding support for other languages would make the system more accessible to a wider audience.
2. Integration with chatbots: Incorporating the sentiment analysis system with chatbots can help automate the process of responding to customer reviews, providing a faster response time and better customer experience.
3. Improved noise reduction techniques: The current noise reduction wavelet filter module can be improved with more advanced noise reduction techniques like spectral subtraction, Wiener filtering, etc. to enhance the accuracy of the sentiment analysis.
4. Integration with other languages: Currently, the system is designed to work with English language voice inputs. However, integrating the system with other languages can make it more inclusive and accessible to a larger audience.

CHAPTER 9

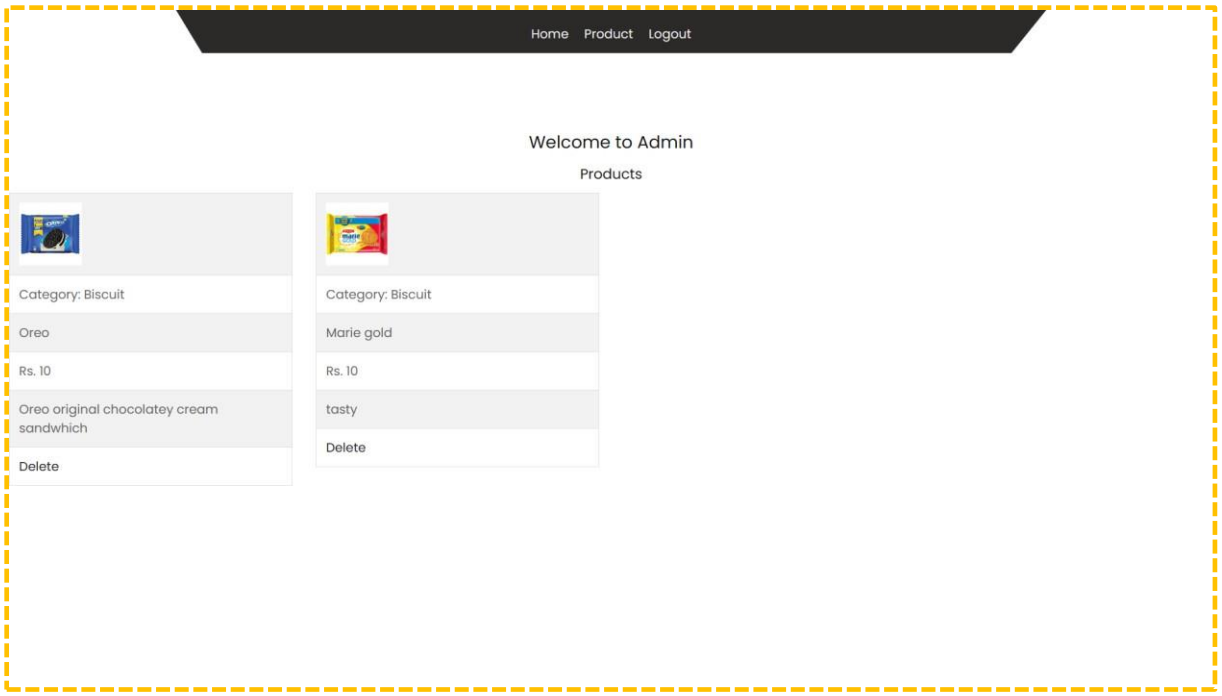
APPENDIX

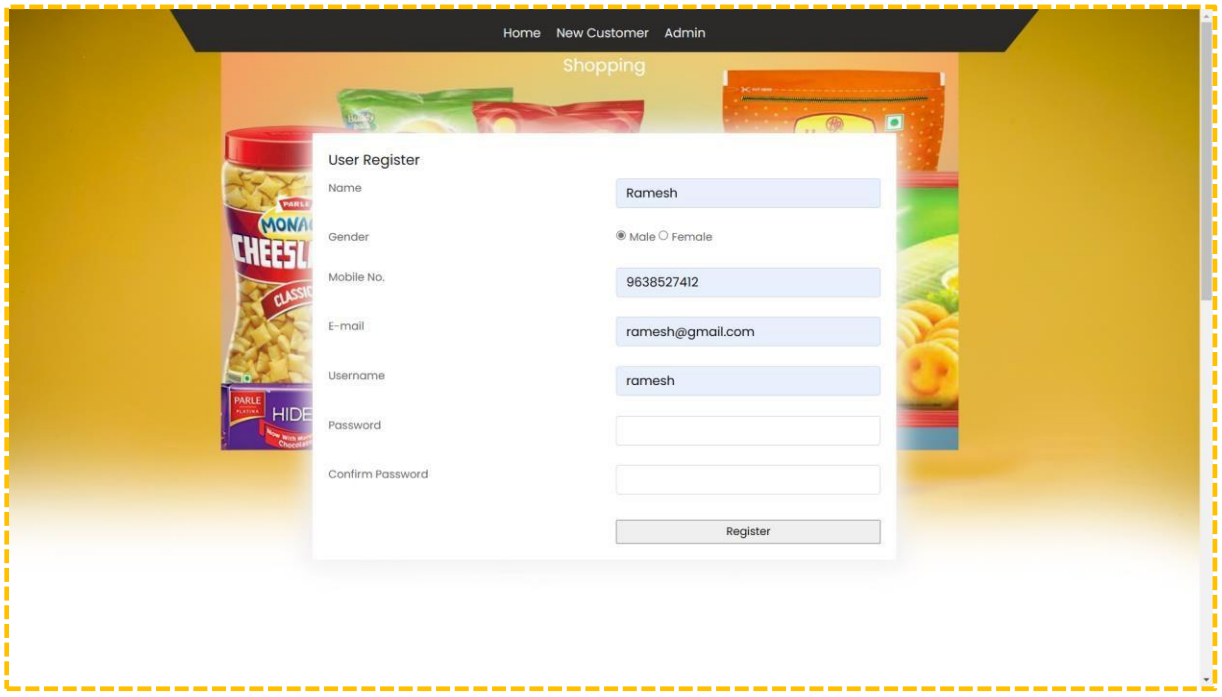
9.1. Sample Screenshots

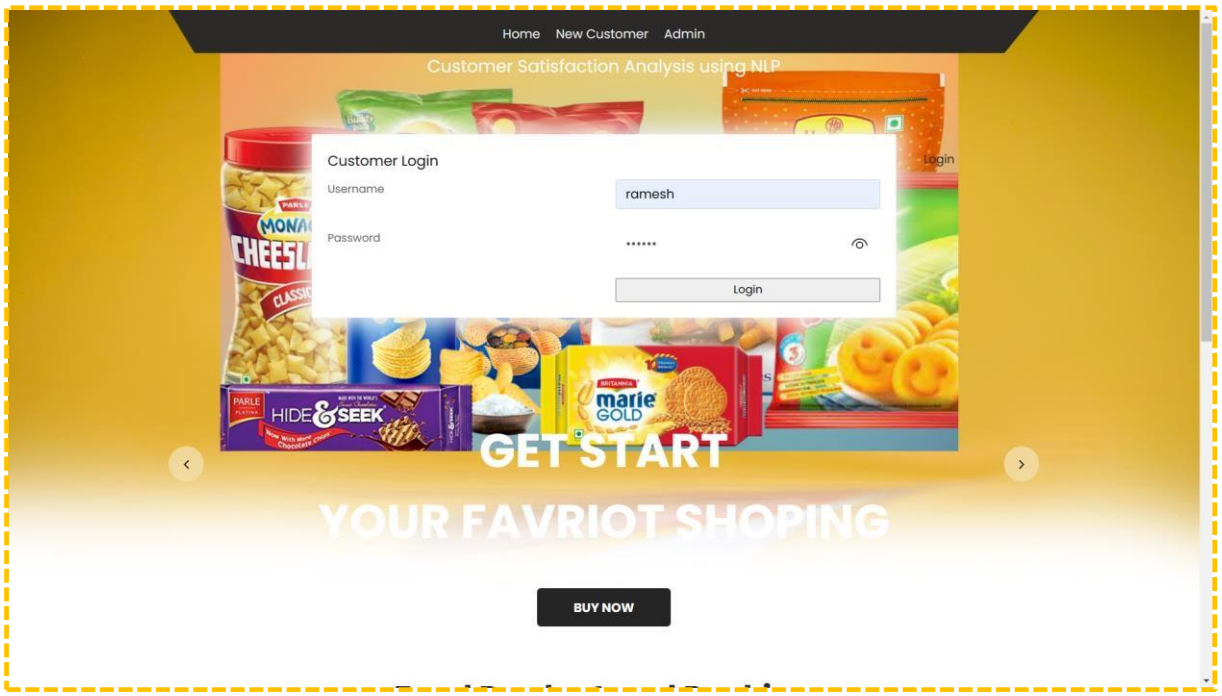




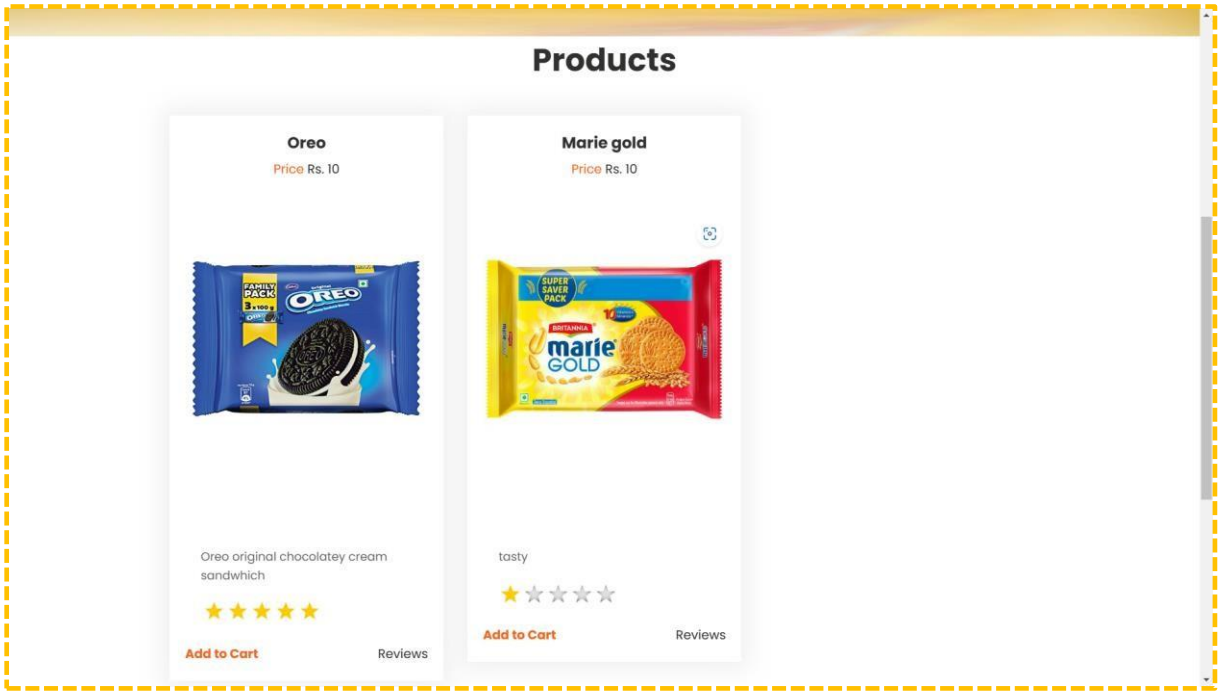
9.2 **ADMIN LOGIN**

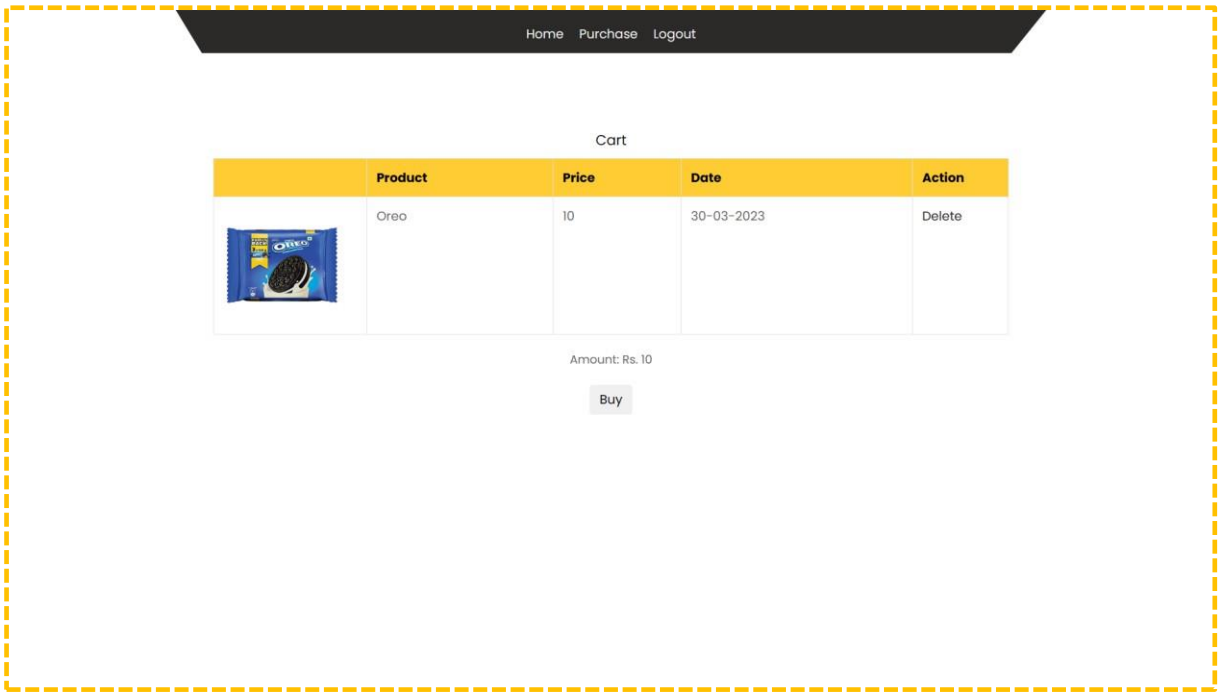


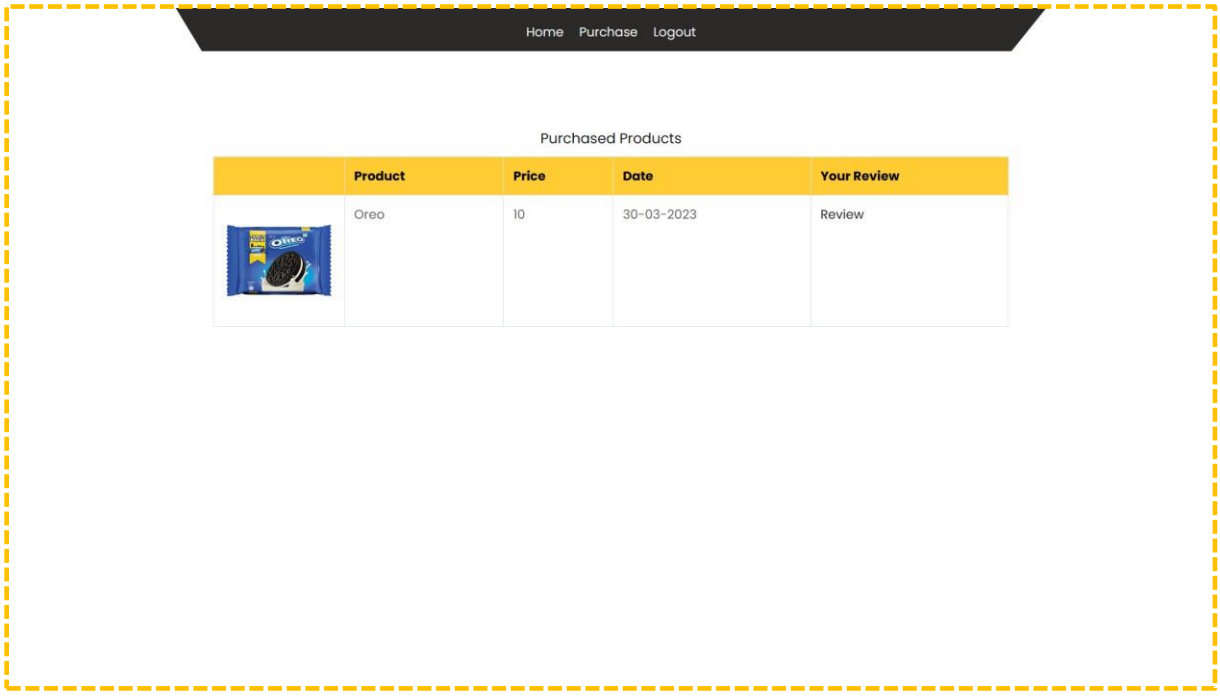


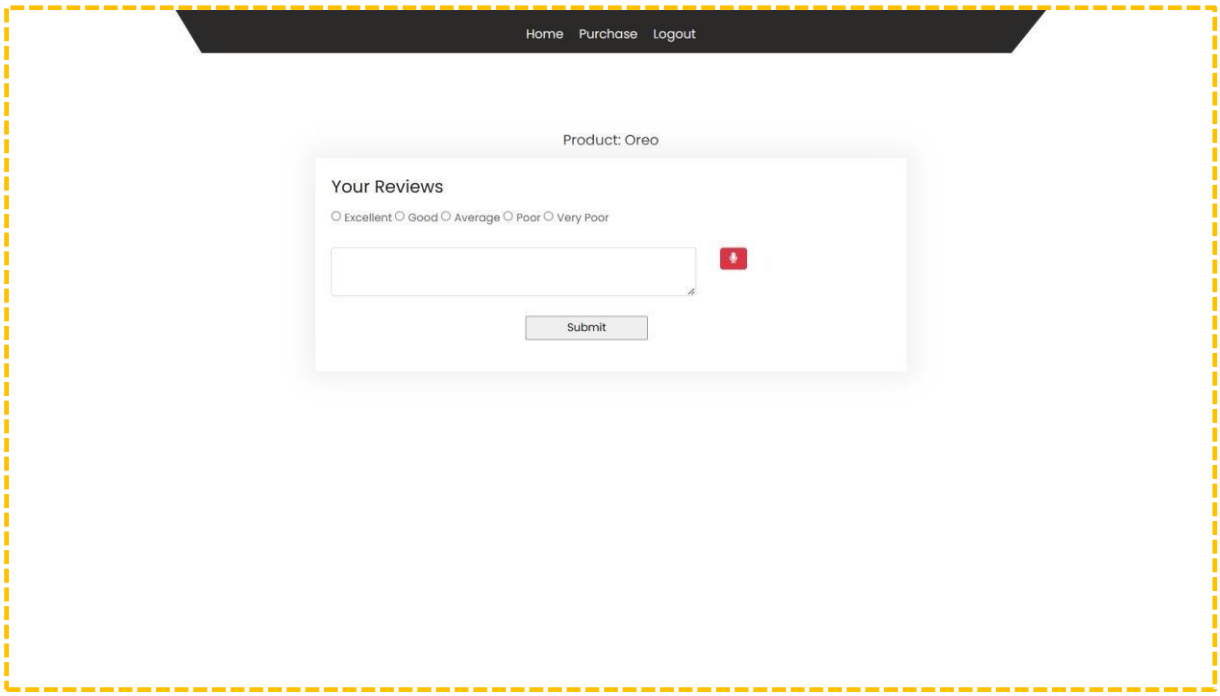

Home
New Customer
Admin
Customer Satisfaction Analysis using NLP
Customer Login
Username
ramesh
Password
Login
Login
GET START
YOUR FAVRIOT SHOPING
BUY NOW

9.3 PRODUCT

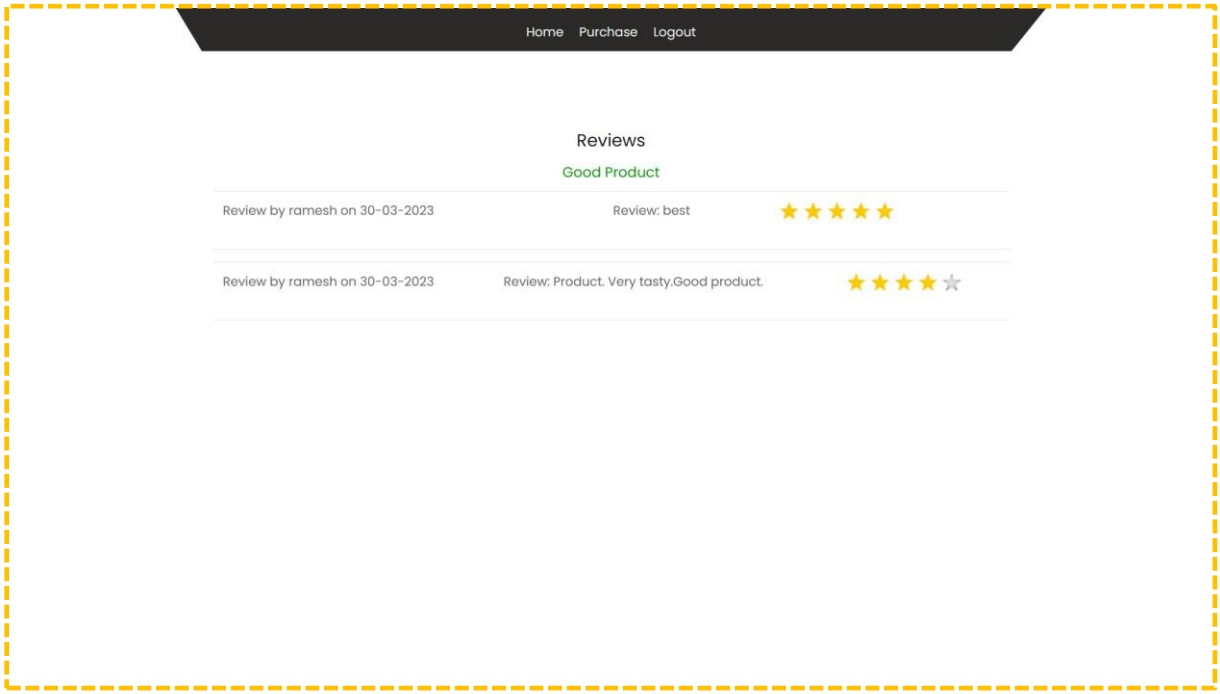

Products
Oreo
Price Rs. 10
Oreo original chocolatey cream sandwhich
Add to Cart
Reviews
Marie gold
Price Rs. 10
tasty
Add to Cart
Reviews

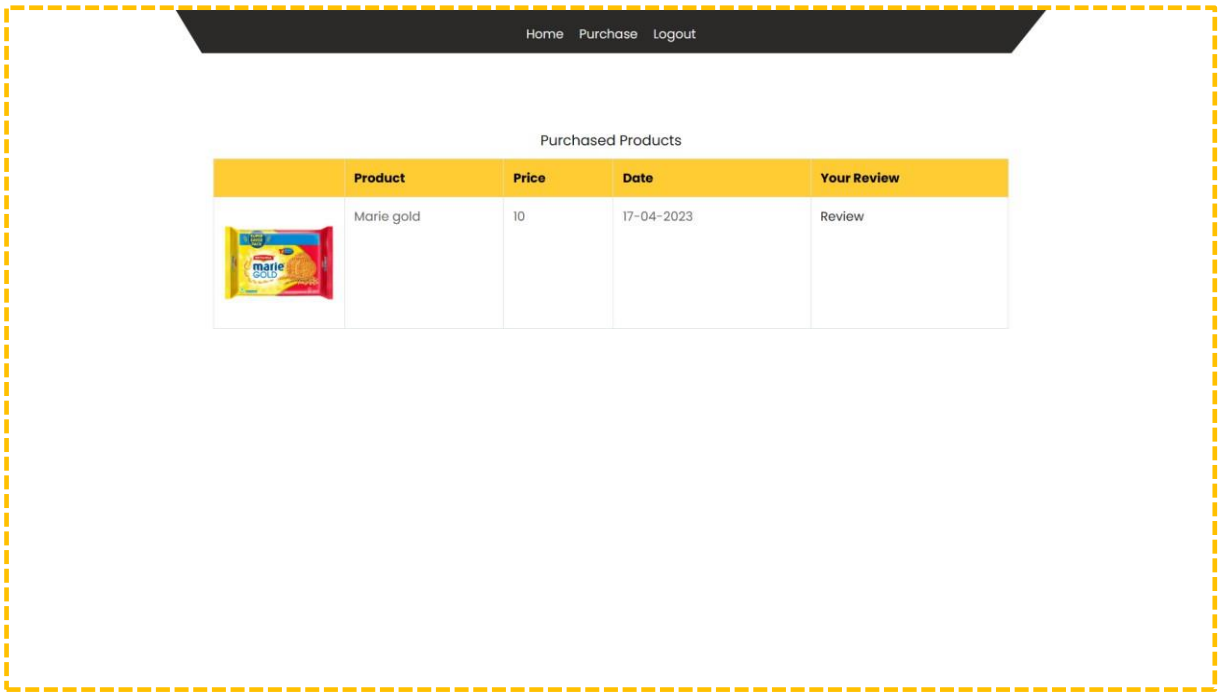

Home Purchase Logout
Cart
Product
Price
Date
Action
Oreo
10
30-03-2023
Delete
Amount: Rs. 10
Buy

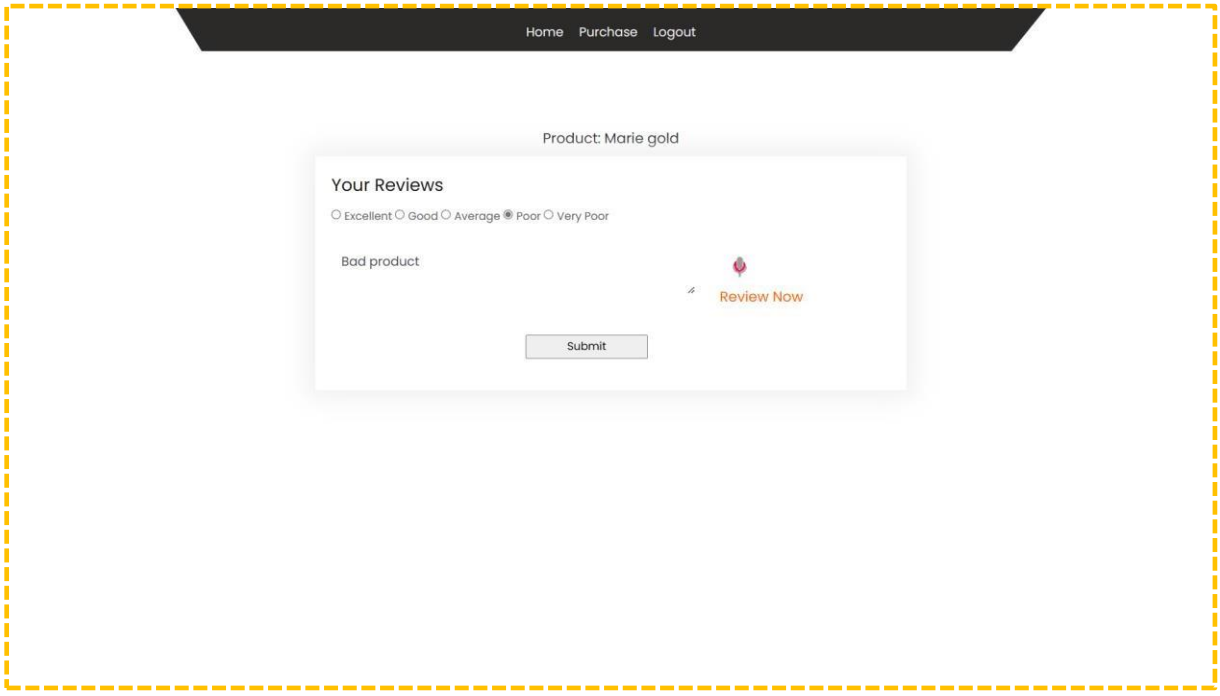

Home Purchase Logout
Purchased Products
Product
Price
Date
Your Review
Oreo
10
30-03-2023
Review


Home Purchase Logout
Product: Oreo
Your Reviews
Excellent Good Average Poor Very Poor
Submit

9.4 REVIEW


Home Purchase Logout
Reviews
Good Product
Review by ramesh on 30-03-2023
Review: best
Review by ramesh on 30-03-2023
Review: Product. Very tasty.Good product.


Home Purchase Logout
Purchased Products
Product
Price
Date
Your Review
Marie gold
10
17-04-2023
Review


Home Purchase Logout
Product: Marie gold
Your Reviews
Excellent Good Average Poor Very Poor
Bad product
Review Now
Submit

CHAPTER 10

10.1. References

[1] Lu, Y., & Zhang, L. (2018). Aspect-based sentiment analysis of e-commerce product reviews using deep learning model. IEEE Access, 6, 52195-52205.

[2] Zhang, Y., Chen, Y., Liu, L., & Liu, Z. (2019). Sentiment analysis of e-commerce product reviews using deep learning approaches. Journal of Intelligent & Fuzzy Systems, 37(1), 595-602.

[3] Kwon, H. K., Kim, J. H., & Lee, S. J. (2019). A comparative study on the effectiveness of various deep learning models in sentiment analysis of e-commerce product reviews. Sustainability, 11(21), 6083.

[4] Guo, H., Zhang, Y., Chen, J., & Chen, X. (2021). Sentiment analysis of e-commerce product reviews based on a deep learning model. IEEE Access, 9, 22132-22141.

[5] Li, W., Li, W., Li, Y., Li, W., & Huang, L. (2021). Sentiment Analysis for E-commerce Product Reviews Based on Convolutional Neural Network. IEEE Access, 9, 15341-15351.

10.2. Book References

[1] "Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems" by Aurélien Géron

[2] "Python Machine Learning" by Sebastian Raschka and Vahid Mirjalili

[3] "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville

[4] "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition" by Daniel Jurafsky and James H. Martin

[5]"Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking" by Foster Provost and Tom Fawcett

10.3. Web References

[1] Keras documentation: https://keras.io/

[2] Flask documentation: https://flask.palletsprojects.com/en/2.1.x/

[3] MySQL documentation: https://dev.mysql.com/doc/

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AN ISO 9001 :2015 CERTIFIED INSTITUTION

International Conference on Computing Communication & Sustainable Energy System (ICCCSES-2024)

Certificate Awarded To

Mohamed Thowfiq. P

for presented a paper entitled
Real Time Voice Review based Audio Sentiment Analysis System using Multi Perception Model for E - Commerce
at International Conference on Computing Communication & Sustainable Energy System on 5th April 2024.

Convenor

Principal