

**BANGLADESHI AIRLINES CUSTOMER REVIEW ANALYSIS
USING ML BOOSTING AND HYBRID TECHNIQUES**

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FINAL YEAR DESIGN PROJECT REPORT

This Report Presented in Partial Fulfillment of the Requirements for the
Degree of Bachelor of Science in Computer Science and Engineering

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DHAKA, BANGLADESH

14 July 2024

APPROVAL

This Project titled “BANGLADESHI AIRLINES CUSTOMER REVIEW ANALYSIS USING ML BOOSTING AND HYBRID TECHNIQUES”, submitted by Jannatul Fardous Orpa to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 14 July 2024.

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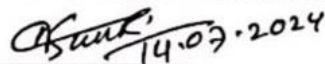
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ACKNOWLEDGEMENT

First, we express our heartiest thanks and gratefulness to almighty for His divine blessing making it possible for us to complete the final year project/internship successfully.

We are grateful and wish our profound indebtedness to **Ms. Shayla Sharmin**, Senior **Lecturer**, Department of CSE Daffodil International University, Dhaka. Deep Knowledge & keen interest of our supervisor in the field of *Artificial Intelligence* to carry out this project. His endless patience, scholarly guidance, continual encouragement, constant and energetic supervision, constructive criticism, valuable advice, reading many inferior drafts, and correcting them at all stages have made it possible to complete this project.

We would like to express our heartiest gratitude to the **Head of the Department of CSE**, for his kind help in finishing our project and also to other faculty members and the staff of the Department of CSE, Daffodil International University.

We would like to thank our entire course mate in Daffodil International University, who took part in this discussion while completing the course work.

Finally, we must acknowledge with due respect the constant support and patience of our parents.

ABSTRACT

Airlines must understand customer feelings and preferences to stay competitive and successful in today's dynamic and fiercely competitive airline market. Customer reviews provide extensive information about passengers' experiences, attitudes, and expectations. Analysing these evaluations using modern machine learning (ML) techniques allows airlines to extract actionable insight from massive amounts of unstructured data to make informed decisions and better serve customers. This study analyses Bangladeshi airline customer reviews using boosting and voting ML. This study uses 3000 reviews from official airline websites like Novo Air, Bangladesh Biman, and US Bangla and social media traveller groups to understand passenger opinions of Bangladeshi airlines' services. This research uses advanced ML algorithms like CatBoosting, AdaBoosting, XGBoosting, and Gradient Boosting and ensemble techniques like Voting RM, SVM, and Naive Bayes to find hidden patterns, trends, and insights in customer feedback. highest accuracy 87% achieved by SVM and random-forest voting techniques.

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LIST OF ACRONYMS

SVM	Support Vector Machine
RF	Random Forest
NB	Naive Bayes

CHAPTER 1

INTRODUCTION

1.1 Overview

Day by day, the people of Bangladesh are showing a growing interest in transporting themselves via airplane. The volume of traffic on roads both inside and outside the country is growing on a daily basis. It was reported by the Chief Executive Officer of Biman Manager Bangladesh that Bangladesh Airlines agencies had transported approximately 8,80,000 passengers over the course of the past three months. This time around, it has made approximately 1563 crores, which is a record that has surpassed all previous records. Something that has never occurred in the past. Additionally, he stated that around 32 lakh travelers would be spared annually if this clause were to be removed. [1] Manufacturers of airplanes have forecast that by the year 2032, the number of passengers travelling by air will have doubled. It will also have a significant impact on the rate of expansion of Bangladesh's gross domestic product. And it will expand at a rate that is greater than five percent of the GDP on an annual basis. Bangladesh's capacity has expanded by 11 percent since 2022, following the lifting of the prohibition on travel to a variety of nations that had been imposed after the Corona incident. [2] Certainly, this is a really encouraging outcome. Bangladesh Biman, US Bangla, Novo Air, and a number of other airlines are among those that offer agency services in Bangladesh. Bangladesh Biman is the only airline that operates in Bangladesh. Considering the fact that passengers are becoming increasingly reliant on it, the quality of its service needs to be improved. Sky travel is a topic that everyone is very interested in because it reduces the amount of time it takes to get from one location to another. On the other hand, when it comes to domestic travel, it is observed that the majority of the time, airlines provide a service of a low quality. To give you an example, if you mess up the timetable and leave the plane late, then the transportation of the cargo or the luggage is also generating a lot of problems. In this particular instance, you can find a variety of passengers' points of view. After each voyage, customers are providing feedback in the form of reviews. Specifically, a number of websites that are responsible for managing a variety of tickets, as well as a number of social media groups that are beneficial to people's air travel. In these online communities and on these platforms, individuals are

voicing their ideas. To determine the extent to which passengers in Bangladesh have faith in the services offered by an airline, my project does an analysis of the evaluations that people in Bangladesh have left. Bangladesh's aviation business has grown rapidly, with many domestic and foreign airlines opening to accommodate demand. However, this expansion has made it harder to maintain service quality, reduce operating inefficiencies, and resolve consumer concerns quickly. Machine learning-based sentiment analysis can help airlines figure out what makes customers happy and unhappy so they can improve their services. [3] This project aims to create robust machine learning models capable of accurately classifying customer reviews based on sentiment polarity. Sentiment analysis is used to detect passengers' emotions and viewpoints, ranging from positive feedback on exceptional service to grievances on flight delays, luggage handling, and in-flight amenities. This study employs advanced machine learning techniques including boosting and voting ensemble methods to enhance sentiment categorization accuracy. This enables airlines to promptly pinpoint areas for enhancement and take proactive measures.

1.2 Problem Statement

In order to evaluate and comprehend the feelings of customers that are communicated through official airline websites and social media platforms, the Bangladeshi airline business, which is experiencing rapid growth, need powerful technologies. It is difficult to draw conclusions for strategic decision-making and the enhancement of service quality when dealing with customer evaluations because of their bulk and disorganization. However, customer evaluations are valuable sources of feedback. In order to ascertain how clients of Novo Air, Bangladesh Biman, and US Bangla feel about their respective services, it is necessary to evaluate one thousand customer reviews that have been gathered from a variety of sources. Understanding the perspectives of passengers and determining ways to improve airline operations are the goals of this project.

1.3 Motivation and Objectives

Motivation of this project are

- Raising the standard for service in order to delight customers and encourage positive interactions.

- Making a name for oneself in the market by catering to specific customer wants and providing individualized services.
- Building long-lasting connections with passengers by always delivering exceptional service.
- Increasing productivity by fine-tuning the allocation of resources and standard operating procedures.
- Keeping airlines' good names intact by responding quickly to passenger comments and complaints.
- Applying analytics to data in order to draw useful conclusions for decision-making.
- To increase customer happiness and loyalty, businesses must adapt their strategy to match the tastes of their customers.
- Staying ahead of market advancements and client expectations requires embracing a culture that is focused on continuous improvement.

Objective of this studies are

- Create effective algorithms for analysing sentiment in airline reviews from Bangladesh.
- After extensive testing, choose the top machine learning algorithms for sentiment analysis.
- Find out what drives customer emotions by doing in-depth research on feature importance.
- Improve the precision of sentiment analysis by employing novel approaches.
- To assist stakeholders in making informed decisions, ensure that model results are easily accessible and can be understood.
- Evaluate the robustness and flexibility of the model by subjecting it to various datasets and scenarios.
- Use sentiment research to make real improvements to airline service.
- For the sake of information sharing and industry impact, meticulously record research procedures, results, and suggestions.

1.4 Project Scope

This study examines Bangladeshi airline consumer reviews using machine learning sentiment analysis. The job involves gathering, analyzing, and assessing 3000 airline website and social media reviews. The goal is to create robust sentiment analysis algorithms that accurately classify evaluations as positive, negative, or neutral. Project scope includes numerous key elements. Client reviews from multiple sources are collected to ensure diversity and representativeness. Preprocessing involves tokenization, stop word removal, and normalization of text data. Text input is converted to numerical representations for machine learning models during feature extraction. Research on sentiment analysis trains and evaluates machine learning systems to classify reviews by sentiment polarity. To determine the optimal method, CatBoosting, AdaBoosting, XGBoosting, SVM, Naive Bayes, and ensemble techniques like Voting RM will be tested. The primary factors affecting sentiment classification will be identified via feature significance analysis. The study evaluates model generalization to assure applicability across datasets and real-world scenarios. Analysis findings will guide strategic decision-making and improve airline services via recommendations. The programmed would priorities collecting and sharing study findings to improve aviation sector transparency and information dissemination.

1.5 Project Outcome

- Bangladeshi airline consumer feedback specialised sentiment classification algorithms.
- The main aspects influencing passenger emotions and experiences are studied.
- Methods that really work to improve satisfaction and service for customers.
- Machine learning models that generalise across datasets.
- Extensive documentation and dissemination of study results for the purpose of information dissemination.
- Improving training and development for airlines. Airline customers in Bangladesh have their preferences and expectations clarified.
- Using data from sentiment analysis helps with decision-making.
- Enhanced competitiveness through better service and client focus.

1.6 Report Organization

Chapter1

This introduction introduces the study's issue and purpose. It summarises the online safety study's goals, questions, scope, and significance. The chapter discusses report structure.

Chapter2

While analyzing Bangla airline review literature, this chapter examines word embedding and machine learning. We examine literature gaps and constraints.

Chapter3

Chapter 3 discusses this study method. I detail datasets and collection methods. This chapter covers cleaning, tokenization, and categorization. Text classification machine learning. The chapter covers unique adaptability, model training, and evaluation.

Chapter 6

In this part select best model or algorithms for a project. Here some of graph represent their values for each algorithm. It will be easy technique for Identify best model.

Chapter5

The study's results and discussion are here. It verifies model accuracy and functioning. This chapter examines word embeddings' effects on discovery, approach, and results. Compared model's news-detecting, flexibility, and practicality.

Chapter 6

Project efficacy is discussed in Chapter 5. This chapter discusses my business and ecology's longevity and effectiveness. Ethics are considered in the project.

Chapter 7

The last chapter finishes the report. It covers study objectives, methodologies, results, and implications. This chapter analyses the study's effects on internet safety and content moderation. Hate speech detection research exists. Ending remarks complete this report. To help readers understand the report's organisation and research, these paragraphs describe each chapter.

1.7 Summary

This chapter described a machine learning investigation using Bangladeshi airline customer feedback. We addressed the project's goals: improving service, establishing a

competitive edge, and keeping customers. Sentiment analysis models, machine learning algorithm comparisons, and actionable recommendations were project goals. The project scope includes data gathering, preprocessing, sentiment analysis, and generalisation. The chapter closes with exact sentiment categorization models, advanced analysis, actionable recommendations, and airline information dissemination.

CHAPTER 2

BACKGROUND STUDY

2.1 Overview

This chapter provided a full account of a machine learning analysis that was performed on feedback received from passengers of Bangladeshi airlines. My primary focus was on accomplishing the project's goals, which included improving customer service, creating a competitive advantage, and keeping existing customers and clients. The objective of the programme was to identify sentiments, evaluate different machine learning algorithms, and offer advice that might be put into practice. Collecting data, performing preprocessing, conducting sentiment analysis, and generalising are all included in the scope of the project. The chapter comes to a close with detailed models for the categorization of sentiments, advanced analysis, recommendations that are applicable to real-world situations, and the dissemination of information regarding airlines.

2.2 Related Works

Hasib et al. [4] provided results from Skytrax and Tripadvisor show that airlines have a lot of interested and involved customers. In order to help airlines, make better decisions, Skytrax and Tripadvisor collect consumers' data. Reviews of Bangladesh Airlines written by actual customers were culled from various online sources. Researchers in Bangladesh combed through 1,095 customer reviews of four different airlines. Critical terms in internet reviews were located using topic modelling and sentiment analysis. According to the results, client unhappiness is primarily due to wait times. When looking at topic modelling, the words "good," "biman," and "service" appear most frequently in the "Food and beverage" category, according to sentiment analysis.

Zaki et al. [5] This study recommends identifying significant labels that mirror customers' perceptions by utilising the total rating, a quantitative variable. The pertinent labels were extracted from comment titles, as they frequently include the most fitting phrases to characterise the consumer experience. They utilised this information to verify extensive internet customer reviews in order to ensure our categories precisely represent writers' sentiments. The findings indicate that labels created from titles are suitable for evaluating the feelings of comments, streamlining the process of analysing consumer feedback online.

Lucini et al. [6] adopts a novel technique to evaluating airline consumer happiness. They use text mining to examine internet customer reviews in order to assist airlines in their competitive strategies. The database examines more than 55,000 Optical Character Recognitions (OCRs) from over 400 airlines and 170 countries. Through Latent Dirichlet Allocation, they identified 27 satisfaction factors characterised by 882 adjectives. An accuracy of 79.95% was achieved when predicting which airlines users would recommend based on dimensions and adjectives. Key dimensions were selected to forecast airline recommendations.

Kwon et al. [7] offered The Skytrax community convenes to enhance airline choices through customer feedback. Online customer reviews from Asian airlines were collected. They gathered nearly 14,000 reviews from 27 distinct airlines. Topic modelling and sentiment analysis were utilised on the gathered data to identify significant terms from online reviews. Topic modelling revealed that flight-related issues such as "seat," "service," and "meal" were identified through frequency analysis. Sentiment analysis can determine consumer satisfaction by examining the topic of 'staff service' in relation to meals and food. The primary concern was the delay, which can lead to client dissatisfaction.

Patel et al. [8] They provide a technique utilises machine learning to differentiate between positive and negative phrases or reviews in text-based datasets. Unfavourable remarks are visualised with a word cloud and bar graph. This article examines airline customer reviews through sentiment analysis. The results of sentiment analysis performance tests using the Naive Bayes, SVM, and DT algorithms exhibit inconsistency. Several machine learning techniques, including Google's BERT algorithm, were evaluated. This study also examines Bert, a model designed for masked language modelling and sentence prediction. The "Random Forest" is frequently compared to the "BERT Model" for its superior machine learning capabilities. BERT surpassed other machine learning methods in terms of F1-score, recall, accuracy, and precision.

Ban et al. [9] The study assessed customer satisfaction by analysing online reviews posted by passengers of the airlines involved. The study conducted research by analysing reviews of the top 10 airlines on Skytrax using qualitative semantic network analysis. This study also assessed the association among six rating variables. 9632 Skytrax reviews were included in this study. The CONCOR research revealed six-word groups: airline brand,

value for money, ground service, entertainment, staff, and seat comfort. Every rating category significantly influenced customer satisfaction and recommendation, except for "entertainment," as indicated by the linear regression study.

2.3 Comparison between existing works

Table 1 representation of comparative analysis of this project with another project

TABLE 2.1: COMPARATIVE ANALYSIS WITH PREVIOUS WORK

SL No	Author Name	Used Algorithm	Best Accuracy with Algorithm
1.	Zaki et al. [5]	utilizing the total rating, a quantitative variable	82% Regression Based Rating
2.	Lucini et al. [6]	Optical Character Recognitions	accuracy of 79.95% ML based Recom engine
3.	Patel et al. [8]	BERT, Naive Bayes, SVM, and DT	Random Forest best
4.	My work	Boosting and Hybrid Models	Accuracy 87%

2.4 Gap Analysis

An analysis of the project uncovers various areas that need additional scrutiny or enhancement. Sentiment analysis is frequently used across various sectors, but distinct approaches are required for evaluating customer ratings of Bangladeshi airlines. It is important to carefully select and modify algorithms because Bangladeshi clients' language and cultural subtleties can significantly affect the accuracy of sentiment categorization in machine learning models. Ensemble methods like voting classifiers and boosting algorithms show promise in enhancing prediction accuracy, but further research is needed to assess their efficacy in evaluating Bangladeshi airline evaluations. Interpretability remains an issue since deriving practical insights from sentiment analysis findings necessitates understanding the underlying elements. To ensure widespread impact of research results in the aviation sector, specific measures may be required to promote knowledge dissemination and real-world application. Overcoming these limitations will

improve sentiment analysis's capacity to boost the quality of Bangladeshi airline services and consumer satisfaction.

2.5 Summary

This section describes our machine learning Bangladeshi airline customer review work. The competitive airline industry relies on customer feedback and attitudes. Our sentiment analysis and airline suggestion algorithms aim to improve service quality, market share, and consumer loyalty. Project tasks included data collection, cleansing, sentiment analysis, and generalizability. The project covers sentiment analysis, machine learning, and ensemble methods. The gap study proposed making algorithms more interpretable, personalising them, and exchanging pertinent data to better R&D. This section describes the goals, scope, and challenges of our Bangladeshi airline customer review research.

CHAPTER 3

METHODOLOGY/ REQUIREMENT ANALYSIS AND DESIGN SPECIFICATION

3.1 Overview

Chapter 3 describes this study's approach. Bangladeshi airline reviews are analyzed using machine learning. Chapter begins with data sources and analytics. To assure consistency and accuracy in future investigations, clean, tokenize, and normalize raw text data. The chapter addresses feature extraction algorithms that convert text input into numerical representations for machine learning models following data preparation. Machine learning algorithms use sentiment analysis to classify customer evaluations as positive, negative, or neutral. The chapter covers CatBoosting, AdaBoosting, XGBoosting, SVM, Naive Bayes, Voting Classifier, and Stacking technique selection. Training, evaluating, and changing hyperparameters improve sentiment analysis models. The chapter also evaluates the model's generalization across datasets and real-world settings. Package includes model output interpretation and practical sentiment analysis insights.

3.2 Requirement Analysis

Every research project needs requirement analysis to set goals, scope, and outcomes. We analyze Bangladeshi airline reviews using machine learning. The requirement analysis has several important components.

- Find airline websites, social media networks, and review aggregators with user input.
- Calculate the data volume and diversity needed for analysis representativeness and reliability.
- Define sentiment analysis goals, such as grading reviews as good, negative, or neutral.
- Hardware and software requirements for machine learning must be assessed.
- List data preprocessing, model training, and evaluation programming languages, tools, and frameworks.
- Identify study stakeholders as airlines, passengers, researchers, and regulators.

- Set data collection, preprocessing, model creation, evaluation, and documentation timelines.

3.3 Proposed Methodology/System Design

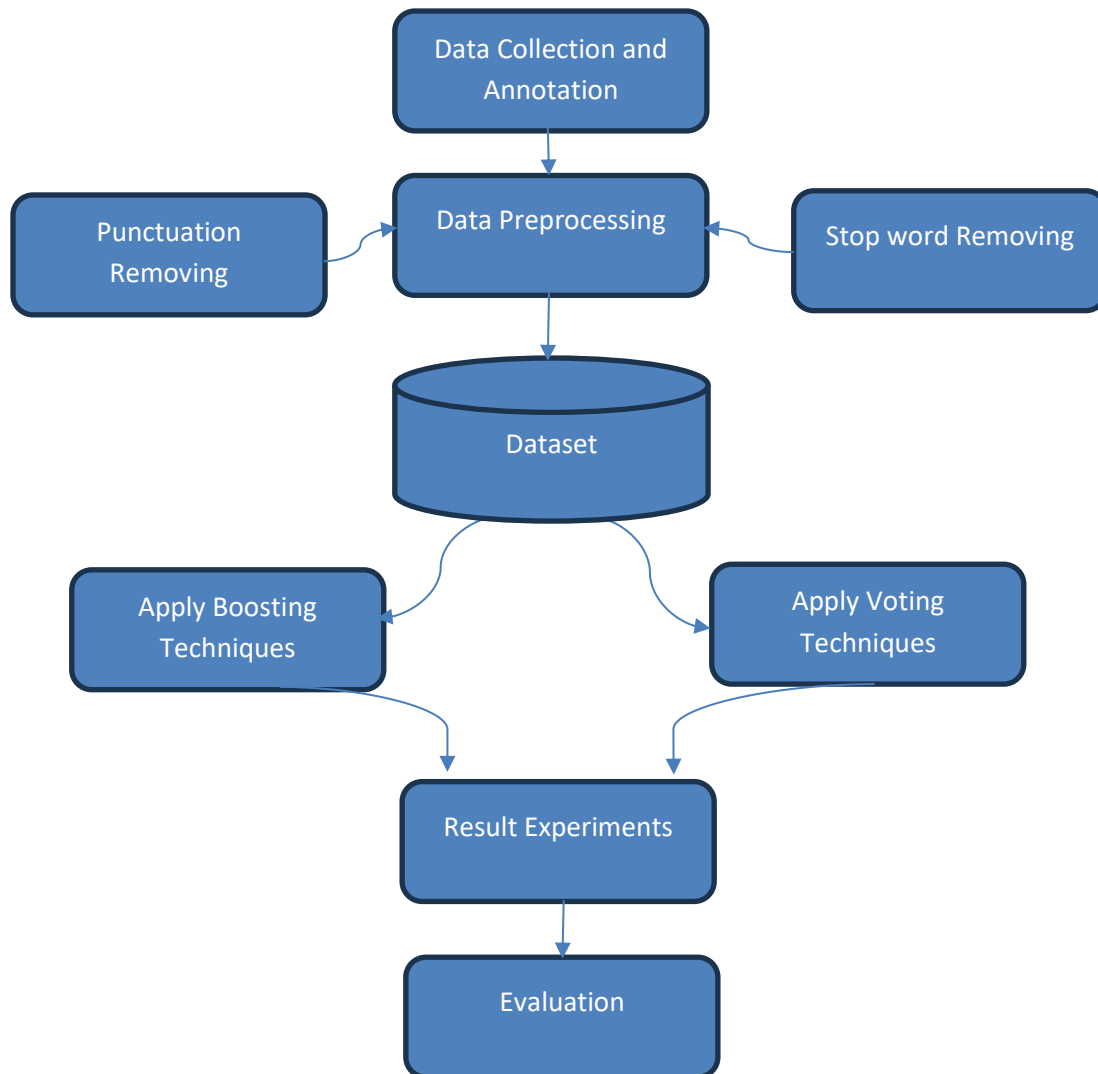


Figure 3.1: representation the mythology diagram

For this project I followed six steps. They are data collection, data processing, balance data set creation, apply algorithm, result analysis, and finally evaluation. In this case I have taken some boosting algorithms and applied voting to them with some machine learning algorithms.

3.4 Data Collection/Input Output Analysis

For the data collection of the project I have observed the websites of various airlines like US Bengal, Bangladesh Biman, Novoair. Besides, there are some companies that buy and sell air tickets as a third party. Like go zayan. Besides, there are several social media groups that work for different travel. They manage tickets for various airlines. I have collected their important opinions from these websites and groups. In this case, I have collected about three thousand comments. Some of my comments here are good comments, some are negative comments, some are mixed comments. I myself have collected these comments or reviews from these websites. I originally collected these reviews in Bengali language. Good data collection is very important for a project. So, I have collected data in a very important way. Since it is its own collection of data, it can be said that this project has a high probability of turning into a good project.

3.5 Data preprocessing

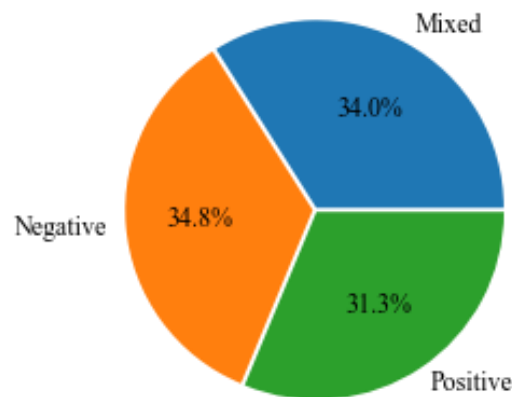


Figure 3.2: dataset representation

For this project I have collected 3000 review for different airlines service website or different social grope that maintain the air travels. In process data have lots of noise and emoji and stop words but machine does not understand those noise and it also important

noise free data is very important for a valuable project. So, I classification my data set. In my data set there was 32.3% positive data and negative data was 34.8% and last mixed data was 34.0% shown in figure 2.

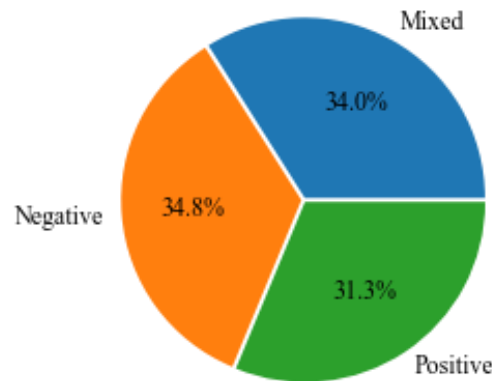


Figure 3.3: Balance dataset

Figure 3 show the balance dataset of this project. In this part I have balanced my dataset. It is very important for a project for make dataset balanced. It means all of label will be set in a balanced form. After balanced dataset it shown positive dataset is 31.3% and Negative is 34.8% and mixed is 34.0%. This is very well and noise free and balanced dataset for this project.

3.5 Project Management and Financial Analysis

Week 1 Project The start:

- Introduce stakeholders and project goals at a kickoff meeting.
- Set project scope, deliverables, schedule, and success criteria.
- Calculate the expenses related to personnel, data collection, software/hardware, and general administrative costs.
- Develop a project budget that allocates funding to each component.

Data Collection/Preprocessing (Weeks 1-2):

- Find Bangladeshi airline customer reviews.
- Prepare data by cleaning, tokenizing, and normalizing.

Week 3 Feature Extraction:

Use TF-IDF and word embeddings to extract characteristics from preprocessed text.

Weeks 4-5: Model Development

Select sentiment analysis machine learning and ensemble approaches.

Train and optimize models using extracted characteristics.

Week 6 Model Evaluation:

Use metrics to assess sentiment analysis models.

Develop and tune models depending on evaluation outcomes.

Week 7 Generalization Test:

Use unseen data to test model generalization.

Adjust models to increase generality.

Weeks 8–9: Reporting:

Project methods, findings, and results should be documented.

Provide stakeholders with progress reports and presentations.

3.6 Summary

Chapter 3 describes how we use machine learning to analyze Bangladeshi airline customer evaluations. The first section describes data collection, including data sources and analysis. The chapter addresses cleaning, tokenizing, and normalizing raw text data to ensure consistency and accuracy in future investigations. Sentiment analysis uses machine learning algorithms to classify client input as positive, negative, or neutral. The chapter discusses CatBoosting, AdaBoosting, XGBoosting, SVM, Naive Bayes, Voting Classifier, and Stacking method selection. The course improves sentiment analysis models through model training, evaluation, and hyperparameter adjustment.

CHAPTER 4

METHODOLOGY/ REQUIREMENT ANALYSIS AND DESIGN SPECIFICATION

4.1 Overview

Chapter 4 provides a thorough assessment of the implementation of our sentiment analysis methodology in the examination of customer reviews pertaining to airlines based in Bangladesh. In addition to data collection and preprocessing, feature extraction, model construction, evaluation, and deployment are among the numerous subjects addressed. The present chapter is devoted to the practical considerations, processes, and instruments utilized during each phase of the implementation. It also encompasses the methodologies, strategies, and processes that were employed to surmount challenges. This chapter concludes with a comprehensive guide for the airline industry on how to implement our research methodology in order to generate actionable insights and tangible outcomes.

4.2 Train Model

I used Different Boosting and hybrid model in my work. All of the details is given below:

4.2.1 Xgboost confusion matrix

As seen in Figure 1, the confusion matrix that was produced by the xgboost algorithm reveals itself. This is an accurate identification of 75, which is a negative evaluation. It identified a total of seventy-five reviews that were positive evaluations. The system was able to effectively recognize and identify a total of 76 data points in the case that the data contained a combination of distinct categories. There were multiple instances of erroneous positive identifications

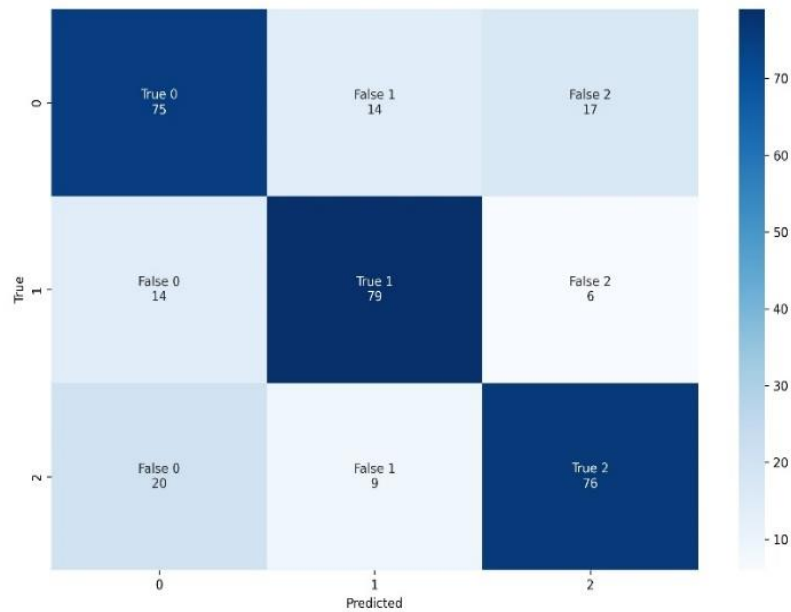


Figure 4.1: xgboost confusion matrix

4.2.2 Gradient Boost

The confusion matrix for gradient boost is seen in Figure 2. The graph indicates that 86 instances were accurately detected, which corresponds to a negative assessment. A total of 78 reviews were determined to be positive assessments. The program accurately detected and classified 74 data points, even when the data consisted of numerous categories. There were other instances where incorrect positive identifications occurred.

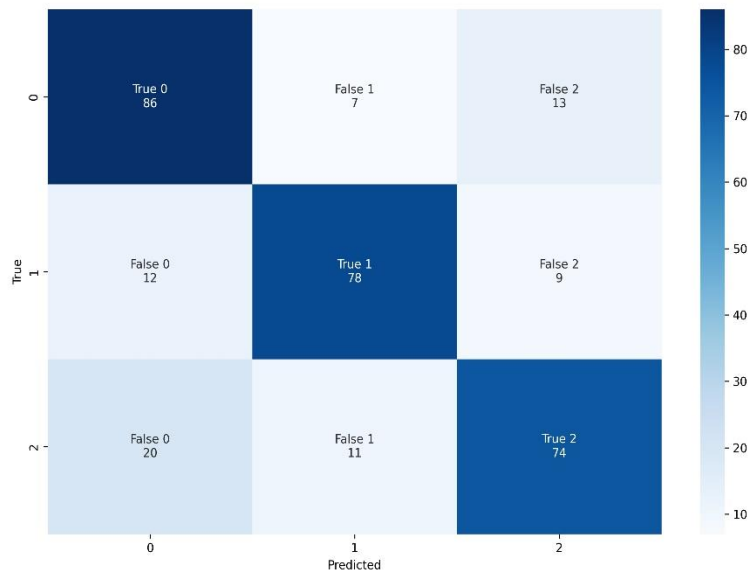


Figure 4.2: Gradient boost confusion matrix

4.2.3 Adaboost

The Adaboost confusion matrix is illustrated in Figure 3. The data presented in the graph demonstrates that 71 occurrences were detected with accuracy, signifying a negative evaluation. A grand total of 64 evaluations were deemed to be favorable. 68 data points were detected and classified with precision by the program, despite the data comprising a multitude of categories. Additional occurrences of erroneous positive identifications transpired.

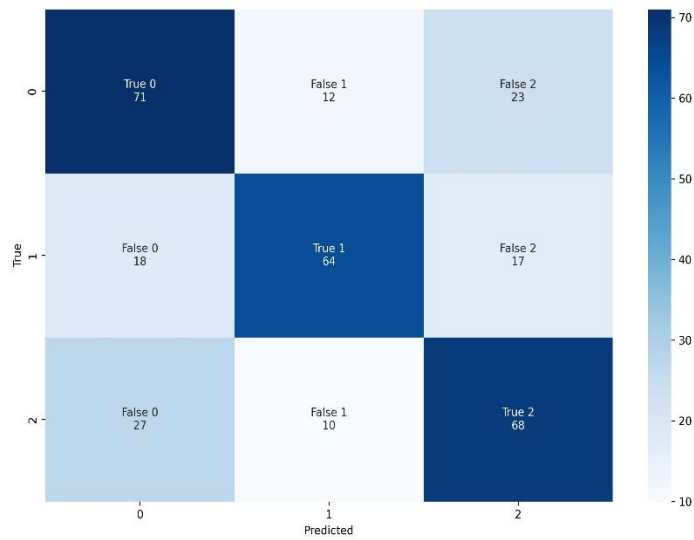


Figure 4.3: Adaboost confusion matrix

4.2.4 Catboost

The confusion matrix for Catboost is depicted in Figure 4. The graph illustrates that a total of 75 instances were accurately detected, indicating a negative assessment. A cumulative count of 79 evaluations was considered positive. The program accurately identified and categorized 76 data points, which was remarkable considering the program was presented with a wide variety of categories. Further instances of erroneous positive identifications occurred.

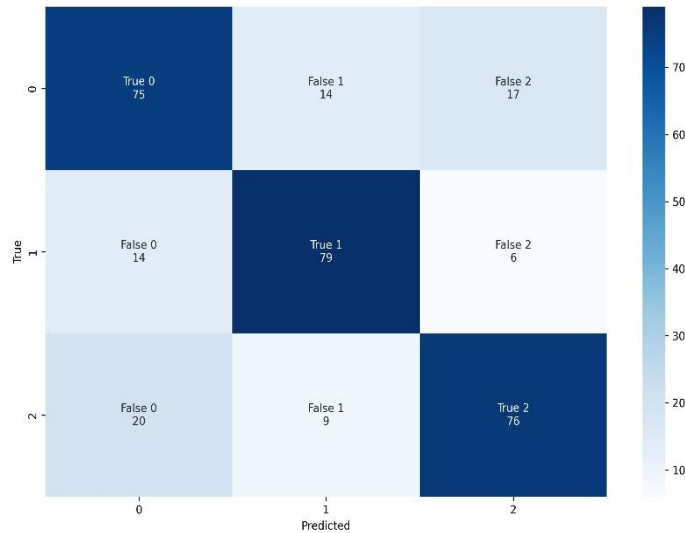


Figure 4.4: Adaboost confusion matrix

4.2.5 RF and NB

Figure 5 displays the confusion matrix for RF and NB. The graph data indicates that there were 86 instances recognized with precision, indicating a negative assessment. A total of 71 evaluations were considered to be good. The algorithm successfully discovered and accurately classified 69 data points, even though the data consisted of many categories. More instances of incorrect positive identifications occurred

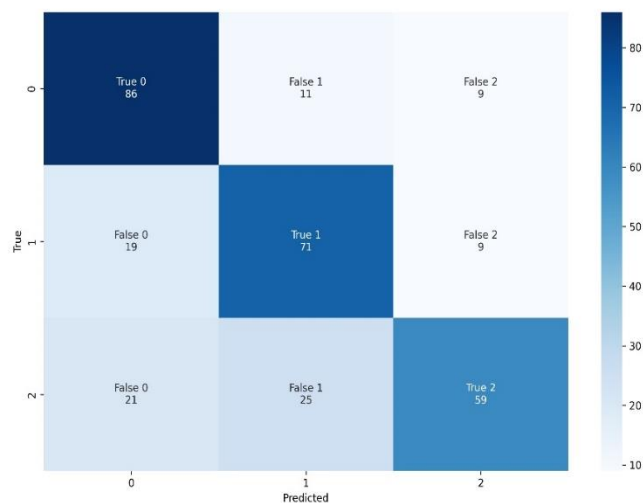


Figure 4.5: RF and NB confusion matrix

4.2.6 RF and SVM

As shown in Figure 5, the confusion matrix for both NF and SVM is displayed. As can be seen from the graph, there were a total of 92 instances that were correctly detected, which is indicative of a negative rating. There were a total of 93 evaluations that showed a good outcome. An impressive number of 89 data points were correctly identified and categorized by the algorithm, which is particularly significant considering the wide variety of categories that were provided to it. According to the findings of the research, the level of misprediction is substantially reduced when compared to previous cases. When it comes to another label, the rate of incorrect prediction is quite low.

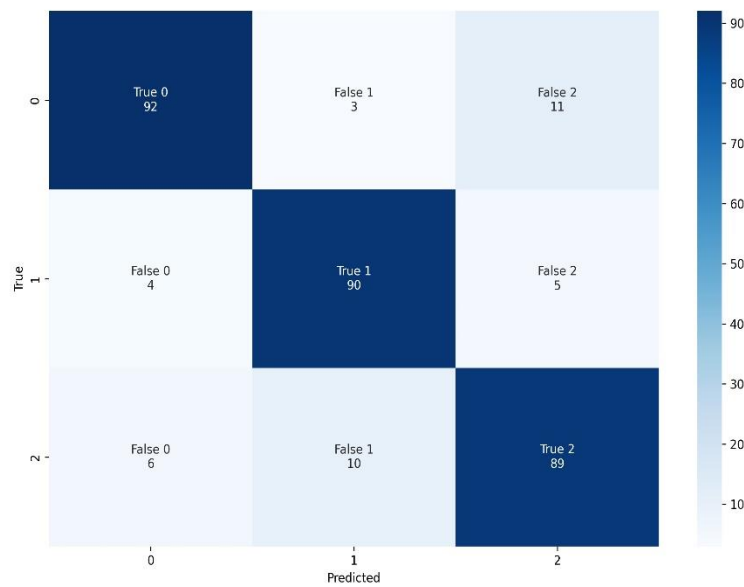


Figure 4.6: RF and SVM confusion matrix

This algorithm is believed to be the most effective in anticipating results, which is why I have picked it for future implementation. In order to evaluate this graph, I will be using this approach.

4.3 System Testing

A representation of the evaluation graph for this project may be found in Figure 1. Here, the orange line represents the data that was predicted, while the blue line represents the

actual data that was used for testing purposes. After analysing this graph, it is possible to conclude that the algorithm that I applied performed quite well. There were 37 real data in this process, and my model missed predicting only seven fewer data. Positive prediction was practically equal to the number of genuine data. When it came to negative data, there were 21 real data models that were unable to forecast only three fewer data. Last but not least, the mixed data count was 41, however my model was able to successfully forecast 33 data points. After conducting all of the aforementioned analyses, it is possible to conclude that this model method performed the best in terms of prediction.

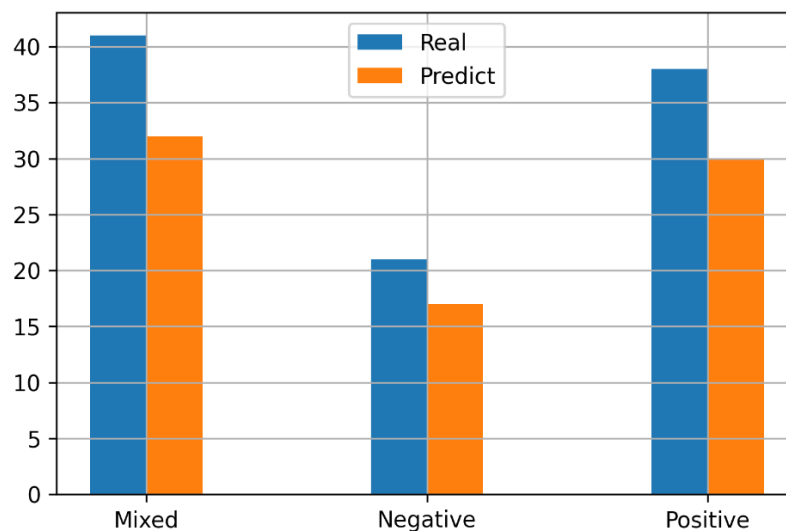


Figure 4.7: Evaluation graph

There are confusion matrices displayed in picture 2. However, this study failed to correctly identify five of the positive data as negative, and three of the data were mixed. This is a relatively small percentage of the data that was incorrectly predicted. There were 17 negative data points, three of which were mixed, and one of which was positive. The prediction is also accurate. At the end of the day, the mixed data consisted of 32 model misses, with four negative and five positive data. As a result of this network analysis, I am able to assert that the implemented algorithm makes quite accurate predictions. In addition to that, it is perfect for the dataset that this project uses

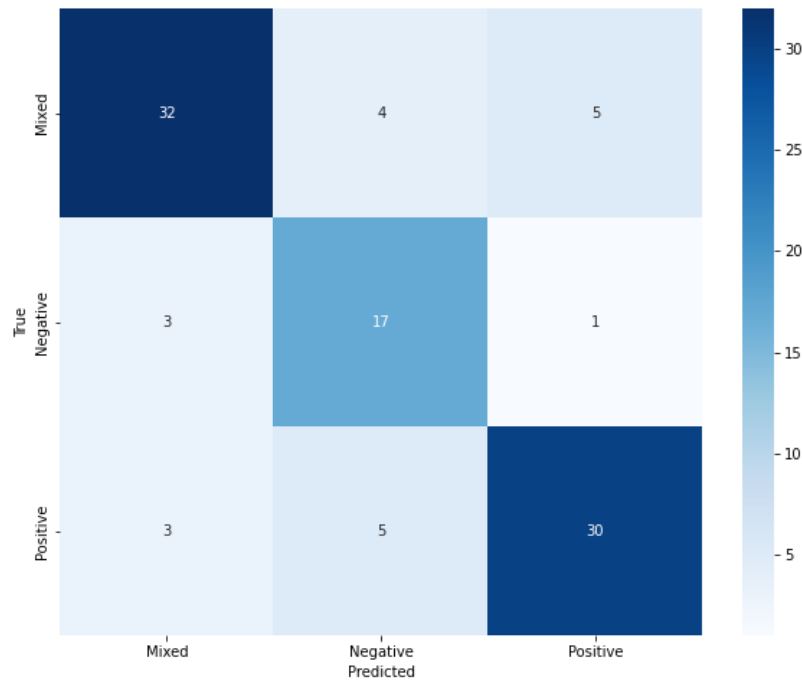


Figure 4.8: confusion matrices

4.4 Summary

This chapter discussed the usage of sentiment analysis models for real-time review analysis, as well as how to incorporate beneficial findings into airline operations. These initiatives will most certainly improve consumer satisfaction, service quality, and airline decision-making processes by delivering more information. In conclusion, Chapter 4 demonstrates the effective application of machine learning approaches to extract relevant data from passenger reviews in the airline industry.

CHAPTER 5

RESULT AND ANALYSIS

5.1 overview

In this part, I use a classification report of applied different algorithms. Here I compare my accuracy to three different metrics which are precision, recall and f1-score. These matrices compare algorithm results to how much is acceptable for prediction. The numerical value is important for easy learning for machine. So, I transferred my label as a numerical value that “0” represents negative, “1” indicates positive, and “2” stands for mixed review. By the process, I support 310 data for applied classification.

5.2 Experimental Result

Table 1 represents the overall experimental Results of my work. To find best model among all 6 different algorithms I used Test accuracy, Precision, Recall, and f1 score. Most algorithms perform quite similar scores the lowest test accuracy achieved by the AdaBoost algorithm. Gradient boosting, catboost and xgboost algorithms are produced with very close test accuracy. The highest test accuracy achieved by Random Forest and SVM hybrid model and precision, Recall, and f1 score are also better than all other algorithms. So we decided to use Random Forest and SVM for final prediction.

TABLE 5.1: EXPERIMENTAL RESULTS

Model	Test Accuracy	Precision	Recall	F1-Score
Random Forest and Naive Bayes	0.6968	0.7048	0.6968	0.6932
Gradient Boosting	0.7677	0.7698	0.7677	0.7674
CatBoost	0.7419	0.7426	0.7419	0.7420
Random Forest and SVM	0.8742	0.8746	0.8742	0.8742
XGBoost	0.7419	0.7426	0.7419	0.7420
AdaBoost	0.6548	0.6602	0.6548	0.6559

5.2.1 xgboost

Table 2 presents the categorization report that was generated by Xgboost. Within the context of this classification report, the precision for label 0 is 0.69, the recall is 0.71, and the f1score is approximately 0.70. This statistic has a maximum value of 0.80 for the recall value of Label 1, which is the greatest value possible. Both the precision value and the f1-score for Label 1 are 0.77. Label 1 has a precision value of 0.77. Label 2 presents the height value with a precision of 0.77, indicating that it is accurate. There is no difference between the macro and weighted average accuracy numbers. When the support was set to 310, there was a 0.74 percent increase in the accuracy by which this algorithm performed. The accuracy of this algorithm's results was far lower than expected.

TABLE 5.2: XGBOOST CLASSIFICATION REPORT

Label	Xgboost			
	Precision	Recall	F1-score	Support
0	0.69	0.71	0.70	106
1	0.77	0.80	0.79	99
2	0.77	0.72	0.75	105
accuracy	0.74			310
Macro avg	0.74	0.74	0.74	310
Weighted avg	0.74	0.74	0.74	310

5.2.2 Gradient Boosting

The gradient boosting classification report is shown in Table 3, which contains a representative example of the report. In this classification report, the precision is 0.73, recall is 0.81, and f1score is 0.77. Label 0 precision is 0.73, and recall is 0.81. Label 1 displays a recall of 0.79, an accuracy of 0.81, which is the best possible value for 1, and a f1-score of 0.80. All of these characteristics are presented on the label. Label 2 indicates that the heights value is 0.77, which may be determined by using precision. In terms of precision, the figures are identical to those of the macro and weight averages. This method's accuracy increased by 0.77 percent when aid was 310, as shown in the previous sentence. This algorithm was able to earn a substantial amount of value prior to the Xgboost algorithm, despite the fact that it had a low level of accuracy.

TABLE 5.3: GRADIENT BOOSTING CLASSIFICATION REPORT

Label	Gradient Boosting			
	Precision	Recall	F1-score	Support
0	0.73	0.81	0.77	106
1	0.81	0.79	0.80	99
2	0.77	0.70	0.74	105
accuracy	0.77			310
Macro avg	0.77	0.77	0.77	310
Weighted avg	0.77	0.77	0.77	310

5.2.3 AdaBoost

To illustrate the AdaBoost classification report for Table 4, this is a representation of the report. Within the context of this classification report, the precision for label 0 is 0.61, the recall is 0.67, and the f1score is 0.64. Label 1 demonstrates a precision of 0.74, which is the number that produces the best results for 1. A recall of 0.65 and a f1-score of 0.69 are both satisfactory. The height value is displayed on Label 2, which does so with an accuracy of 0.63. There is no difference between the macro and weighted average accuracy numbers. It was determined that increasing the support to 310 resulted in a 0.65% increase in the accuracy of this algorithm. When contrasted with other boosting algorithms, this method possesses a level of accuracy that is much lower than the others.

TABLE 5.4: ADABOOST CLASSIFICATION REPORT

Label	AdaBoost			
	Precision	Recall	F1-score	Support
0	0.61	0.67	0.64	106
1	0.74	0.65	0.69	99
2	0.63	0.65	0.64	105
accuracy	0.65			310
Macro avg	0.65	0.65	0.65	310
Weighted avg	0.65	0.65	0.65	310

5.2.4 Catboost

The Catboost classification report is presented in Table 5, which displays the representation of the report. In this classification report, the precision is 0.69, recall is 0.71, and f1score is 0.70. Label 0 precision is 0.69, and recall is 0.71. While the precision is 0.77 and the f1-score is 0.79, the recall for Label 1 is 0.80, which is the best possible number for 1. In addition, the precision is 0.77. Based on the information provided by Label 2, the value of the heights at precision is 0.77. In terms of precision, the figures are identical to those of the macro and weight averages. In situations where the support is 310, this method saw a 0.74 percent improvement in its accuracy. The level of accuracy that our method achieved was quite high in comparison to that of previous ways of boosting.

TABLE 5.5: CATBOOST CLASSIFICATION REPORT

Label	Catboost			
	Precision	Recall	F1-score	Support
0	0.69	0.71	0.70	106
1	0.77		0.79	99
2	0.77	0.72	0.75	105
accuracy	0.74			310
Macro avg	0.74	0.74	0.74	310
Weighted avg	0.74	0.74	0.74	310

5.2.5 Random Forest and naïve Bayes

Additionally, the RF and NB classification report is presented in Table 6. Within the context of this classification report, the precision for label 0 is 0.68, the recall is 0.81, and the f1score is approximately 0.74. It is the greatest number possible, with a recall precision of 0.72, which was assigned to Label 1. It has been determined that label 1 has a precision of 0.66, and its f1-score is 0.69. The height value is displayed on Label 2, which does so with an accuracy of 0.77. There is no difference between the macro and weighted average accuracy numbers. The modification of this algorithm to 310 resulted in a 0.77 percent increase in the accuracy of the method. In comparison to RF and SVM, this method demonstrated a lower level of accuracy with its results.

TABLE 5.6: RF AND NB CLASSIFICATION REPORT

Label	RF and NB voting			
	Precision	Recall	F1-score	Support
0	0.68	0.81	0.74	106
1	0.66	0.72	0.69	99
2	0.77	0.56	0.65	105
accuracy	0.70			310
Macro avg	0.70	0.70	0.70	310
Weighted avg	0.70	0.70	0.70	310

5.2.6 Random Forest and support vector machine

The classification report for the voting ensemble of Random Forest (RF) and Support Vector Machine (SVM) models is presented in Table 7. The precision for label 0 in this classification report is 0.90, the recall is 0.87, and the f1score is 0.88. Label 1 exhibits a recall of 0.91, which represents the optimal value for this metric. Additionally, the precision is measured at 0.87, while the f1-score stands at 0.89. Matrix 2 exhibits identical values across all three matrices. Model 2 achieved a gain of 0.85. The macro and weighted average accuracy numbers are same. The accuracy of this algorithm increased by 0.87% when the support was set to 310.

TABLE 7: RF AND SVM CLASSIFICATION REPORT

Label	RF and SVM			
	Precision	Recall	F1-score	Support
0	0.90	0.87	0.88	106
1	0.87	0.91	0.89	99
2	0.85	0.85	0.85	105
accuracy	0.87			310
Macro avg	0.87	0.87	0.87	310
Weighted avg	0.87	0.87	0.87	310

5.3 Performance

This approach demonstrated exceptional precision when compared to other boosting algorithms. This RM and SVM voting algorithm achievement height value all of boosting and voting algorithm. It gained accuracy 0.87%. So, I take this algorithm for future implementation.

5.3 Summary

I employed ensemble methods like stacking and voting classifiers along with algorithms like CatBoost, AdaBoost, XGBoost, Gradient Boosting, SVM, and Naive Bayes to improve the performance of the model. The efficacy of the model was assessed using evaluation measures such as accuracy, precision, recall, and the F1-score; the SVM and random forest voting algorithms produced the greatest accuracy of 87%. Finally, the chapter examined how real-time review analysis can be facilitated by using sentiment analysis models and how to integrate actionable insights into airline operations.

CHAPTER 6

IMPACT ON SOCIETY, ENVIRONMENT AND SUSTAINABILITY

6.1 Impact on life

- Increased service quality and customization improve travel experiences.
- Customer satisfaction improved by proactive feedback and complaint resolution.
- Improved safety and communication to reassure passengers.
- Client retention and revenue growth improved corporate performance.
- Excellent service and customized experiences give a competitive edge.
- Positive contacts and connection improve community well-being.
- Improving life quality by implementing a customer-centric aviation strategy.

6.2 Impact on society and environment

The application of machine learning to the evaluation of consumer feedback from Bangladeshi airlines has the potential to have an impact not just on business but also on society and the environment. By placing a high priority on customer satisfaction and providing great service, airlines have the potential to improve the travel experiences of their customers and to assist the advancement of their social connections. In order to create a global society that is more dynamic and interconnected, increased economic growth, commercial ties, and cultural exchange are all potential outcomes. Through the utilization of sentiment analysis, airlines have the potential to limit their impact on the environment and conserve resources by optimizing their operations and working to reduce inefficiencies. The installation of waste reduction measures during flights, the adoption of environmentally conscious practices in the construction and maintenance of aircraft, and the optimization of flight routes to minimize fuel consumption are all examples of what is included in this category. The utilization of machine learning for the purpose of analyzing customer feedback on airlines has the potential to enhance travel experiences and encourage the implementation of environmentally friendly policies that are beneficial to both passengers and the environment.

6.3 Ethical Aspects

- Ensuring the confidentiality of client data throughout analysis.
- The aim and usage of consumer feedback openness.
- Developing unbiased sentiment analysis methods via mitigating bias.
- Customer feedback encompasses a diverse array of backgrounds and opinions.
- Respecting client choices by offering the choice to opt out of receiving comments.
- We can mitigate the effects of algorithmic bias and unexpected decision outcomes.
- Strict adherence to ethical principles is upheld in the management, storage, and sharing of data.
- Maintain integrity and accountability in sentiment analysis consistently.

6.4 Suitability Plan

The sustainability plan of this project is based on the principles of sustainability, long-term viability, and social responsibility. To accomplish these objectives, we must successfully carry out certain crucial duties during the project's duration. We aim to initiate the digital collection of data with the purpose of minimizing paper use and waste. Moreover, to mitigate the energy consumption and carbon emissions associated with data processing, we will employ cloud computing technology. In order to enhance the protection of customer data, we will adhere to ethical data standards during the process of gathering information for analysis. We will demonstrate our commitment to social responsibility by actively working to create a project team that is diverse and inclusive. Additionally, we will acknowledge and value the contributions of every team member. We will maintain transparency and integrity in soliciting stakeholder input and integrating their perspectives into our decision-making process. Finally, our sustainability endeavors will be recorded and disseminated, offering useful insights and exemplary methods to motivate and educate future endeavors in data analysis and machine learning. By implementing sustainability principles in project management, our objective is to minimize our environmental footprint, foster social accountability, and ensure the enduring prosperity of our research endeavors.

6.4 Summary

This chapter studied how machine learning influences Bangladeshi airline customers' sustainability, environmental, and social ratings. Customer satisfaction on airlines can encourage economic growth, cultural connectedness, and community connection. Sentiment analysis can lower the airline's environmental effect by streamlining processes and saving resources. Privacy, cultural awareness, and algorithmic fairness are needed for ethical consumer feedback analysis. I developed a sustainability strategy to extend the project, reduce its environmental impact, and promote social responsibility. Data analysis programs' social and environmental impacts and the need for ethical and sustainable technology are discussed in this chapter.

CHAPTER 7

CONCLUSION AND FUTURE WORK

7.1 Conclusions

This machine learning customer review analysis study for Bangladeshi airlines has brought benefits to the airline industry, community, and sustainability. Data collection, preprocessing, and sentiment analysis have improved our understanding of passengers' preferences, concerns, and emotions. Ensemble methods and machine learning techniques were used to develop robust sentiment categorization models for happy, sad, and neutral customer reviews. My analysis suggests ways airlines may boost productivity, please customers, and stay competitive. Data-driven insights and customer feedback help airlines satisfy passenger needs, address pain points, and build customer connections. Data analytics also has social and environmental implications, according to our research. By promoting diversity and inclusion, privacy rights, and ethical data practices, I can ensure that technological discoveries benefit society. Project management that incorporates sustainability can reduce environmental consequences, increase social responsibility, and assure long-term success. I must keep up with data analysis, machine learning, and sentiment analysis models that include stakeholder feedback. I can transform aviation and improve society and the environment for future generations by embracing innovation, collaboration, and responsible stewardship.

7.2 Further Suggested Works

- The study examines the impact of cultural factors on passengers' impressions.
- Customer attitudes analyzed longitudinally.
- An extensive examination utilizing multiple forms of data.
- Utilizing predictive algorithms to predict patterns in travel satisfaction.
- Customer preferences and behaviors are utilized to categorize and target specific service providers.
- Data accountability requires integrity in sentiment analysis.
- Analyze the impact of sustainability measures on customer mood and ecological conditions.
- Mobile softer base platform will appear in future.

- I will implement AI base concept in future.

7.3 Limitations

- The reliability and quality of the data used can affect how accurate a sentiment analysis model is.
- There may be missing information about passengers' experiences in the study's dataset.
- It could be difficult to understand someone's feelings when there are language and cultural barriers.
- Depending on the machine learning algorithms used, sentiment analysis results could be different.
- Concerns about privacy and fairness are examples of ethical issues that research ought to tackle.
- Limitations in time and money could limit how thorough the analysis is.
- The relevance of research could change due to changes in legislation or market conditions.

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Appendix A

Complex Engineering Problems (EP) and Complex Engineering Activities (EA) Analysis

Title: Bangladeshi Airlines Customer Review Analysis by Boosting and Voting ML Approach

Students ID: 201-15-3265

CO Description for FYDP-Phase-I

CO	CO Descriptions	PO
CO1	Integrate recently gained and previously acquired knowledge to identify a real-life complex engineering problem for the Final Year Design Project	PO1
CO2	Analyze different aspects of the goals in designing a solution for the Final Year Design Project	PO2
CO3	Explore diverse problem domains through a literature review, delineate the issues, and establish the goals for the Final Year Design Project	PO4
CO4	Perform economic evaluation and cost estimation and employ suitable project management procedures throughout the development life cycle of the Final Year Design Project	PO11

Addressing of COs, Knowledge Profile (K), and Attainment of Complex Engineering Problems (EP):

SN	EP Definition	Attainment	CO	Justification (with Knowledge Profile)	References
1.	EP1: Depth of Knowledge required	Yes	CO1, CO2, and CO3	My project needs to gather data collection from deferent airlines website and traveler group. I have to gather knowledge about machine learning functionality and model selection. That cover K3 and K4	Page no: 1-4

				For this project I have studies so many related works. K8	Page no: 6-8
2.	EP2: Range of Conflicting Requirements	Yes	CO2	I faced many challenges in data collection. Our Bangladeshi passengers are not very interested in writing their reviews. And all the third-party apps that sell tickets are also not interested in collecting these reviews. And customers are not patient enough to take their time to leave a nice review. In that case it was quite a challenge for me to collect reviews from a good source.	Page no: 11
3.	EP3: Depth of analysis required	Yes	CO2	I have collected information from various websites to know about this project. I have carefully observed the websites of various airlines. Observed various groups and observed their comments. So that I can get a fairly good idea.	Page no: 11
5.	EP6: Extends of stakeholders involved and conflicting requirements	Yes	CO3	I have carefully observed all the websites of all the airlines of Bangladesh that provide facilities. And observed various social media groups. I have carefully observed the various comments of Biman users.	Page no: 4
6.	EP7: Interdependence	Yes	CO3	I first collected the data and then analyzed the data and processed it. I have selected models and trained them. And evaluated with that train and data. I have implemented my project to see if it works in real life. So here multiple steps are related to one.	Page no: 10-12

7.	-	Yes	CO4	I have ready a well budget for evaluate and estimate the cost need for FYDP	Page no: 12
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