

**PREDICTING CUSTOMER SATISFACTION OF MOBILE BANKING USERS
FROM SOCIAL MEDIA PLATFORMS: BANGLADESH'S PERSPECTIVE**

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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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APPROVAL

This Project/internship titled “**Predicting The Satisfaction Level Of Mobile Banking Users Of Bangladesh From Social Media Sites Using Machine Learning**”, submitted by **Shoaba Razzak**, ID No:**193-15-2958** 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 **25th January, 2024**

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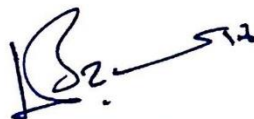
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I therefore, declare that this undertaking has been finished by us under the supervision of **Amatul Bushra Akhi**, Assistant Professor, Department of CSE, Daffodil International University. We further declare that neither an application or an educational grant has been made anywhere for this project or any part of it.

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ABSTRACT

The research focuses on the prediction of customer satisfaction in the mobile banking industry in Bangladesh, using social media data collected with Google Forms. The 2608-entry dataset categorizes target attributes as Non_Satisfied or Satisfied. The research carefully analyzes the performance of numerous machine learning models, including Bernoulli Naive Bayes, Support Vector Machine, Logistic Regression, K-Nearest Neighbours, Decision Tree, Long Short-Term Memory (LSTM), and Convolutional Neural Network (CNN). Actually, the LSTM deep learning model matches others, collecting an excellent 99.82% accuracy. This high accuracy shows its capacity to model changes in time within social media data, providing a deeper knowledge of issues changing customer satisfaction in the particular case of mobile banking in Bangladesh. The dataset, which was collected from Google Forms, provides an extensive variety of user opinions and offers a strong foundation for training and figuring out the models. The results show how important it is to use advanced deep learning methods, especially LSTM, to find complex patterns in social media data and make accurate predictions. The effects reach mobile banking service providers as well, providing useful tips to improve customer satisfaction and experience. Finally, this study shows the useful use of LSTM to improve mobile banking services based on users' pointed out views using social media platforms, providing useful data specifically modified to the Bangladeshi market. The important accuracy achieved by LSTM highlights its practical uses to improve and modify mobile banking services.

Keywords: Mobile Banking, Customer Satisfaction, Social Media Platforms, Sentiment Analysis, Machine Learning, Deep Learning.LSTM,CNN,SVM,GNB.Voting Classifier.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Mobile banking has grown significantly in Bangladesh, becoming an essential aspect of the financial landscape. Understanding and preparing for client satisfaction is critical for the long-term growth of mobile banking services as user tastes and expectations change. In the context of Bangladesh, this study investigates the usage of social media platforms as valuable sources of customer feedback in predicting satisfaction levels. In this study, we deploy advanced sentiment analysis algorithms on user-generated content from several social media platforms, including but not limited to Facebook, Twitter, and local forums. The Bangla language is being used to capture regional nuances, ensuring a thorough examination of client sentiments. Convolutional Neural Network (CNN) and Long Short-Term Memory (LSTM) deep learning architectures are used to understand complicated patterns in textual data. For comparison analysis, classic machine learning techniques such as Random Forest, Logistic Regression, Support Vector Machine (SVM), Gaussian Naive Bayes (GNB), and a Voting classifier are used.

The process involves gathering a one-of-a-kind dataset of Bangla reviews and comments gathered properly and responsibly from various social media channels. To improve the dataset's quality, data preprocessing techniques such as language recognition and sentiment annotation are used. The study aims to determine aspects that influence customer happiness, such as service quality, user experience, customer support, and adoption of technology. This study gives insights into the effectiveness of these platforms as measures of overall user satisfaction by connecting social media emotions with traditional customer satisfaction surveys.

This research has significance for mobile banking providers, regulatory authorities, and policymakers in Bangladesh. The report's recommendations provide actionable insights for improving customer happiness, guiding future developments, and defining regulatory frameworks. This study adds to the increasing body of information on customer satisfaction prediction in the context of mobile banking, with particular focus on Bangladesh's distinct socioeconomic and cultural setting. The findings have broader importance in the financial technology sector and will serve as a platform for future study in related sectors.

1.2 Motivation

The motivation for researching and predicting customer satisfaction among mobile banking users in Bangladesh begins with the country's transformational impact of digital financial services. Understanding user sentiments is becoming increasingly important for service providers and governments as mobile banking becomes a cornerstone of financial inclusion. Bangladesh has a distinct socio economic landscape, and its populace's quick adoption of mobile banking depends on a more in-depth examination of client satisfaction.

The study is inspired by the realization that social media platforms function as virtual venues in which users freely communicate their experiences and ideas. This study aims to extract significant insights from a varied range of user-generated content using sentiment analysis, ultimately contributing to the improvement of mobile banking services. Furthermore, the findings are likely to provide financial institutions with data-driven methods for increasing client happiness, ultimately promoting consumer trust and loyalty. The study's goal with this inquiry is to gain a deeper understanding of the processes defining Bangladesh's digital financial ecosystem, consequently aiding the country's continuous evolution and optimisation of mobile banking services.

1.3 Rationale of the Study

The purpose behind carrying out this research stems from the revolutionary impact of mobile banking services on Bangladesh's financial environment, as well as the need to comprehend the opinions expressed by users on social media sites. As Bangladesh enters the digital age, mobile banking will become a critical component of financial inclusion and accessibility. Understanding client happiness as indicated in social media interactions becomes critical for service optimization.

The purpose behind carrying out this research stems from the revolutionary impact of mobile banking services on Bangladesh's financial environment, as well as the need to comprehend the opinions expressed by users on social media sites. As Bangladesh enters the digital age, mobile banking will become a critical component of financial inclusion and accessibility. Understanding client happiness as indicated in social media interactions becomes critical for service optimization.

According to the report, social media is a dynamic platform where people openly discuss their experiences, preferences, and frustrations. The study intends to glean significant information from this richness of user-generated content by applying sentiment analysis. Bangladesh's distinct socio-cultural setting emphasizes the importance of a personalized strategy to predicting client happiness.

We hope to bridge the gap between user expectations and the growing mobile banking ecosystem with this study. The findings will not only help service providers improve their strategies, but will also help academics better understand digital banking behavior in Bangladesh. Finally, the logic is anchored in the aim of perfecting mobile banking experiences to perfectly connect with the different and increasing needs of Bangladeshi users.

1.4 Research Question

- i. What are the most common opinions expressed by Bangladeshis on social media platforms?
- ii. Which specific aspects of mobile banking services make Bangladeshis happy?
- iii. What concerns do users raise about mobile banking on social media?
- iv. How do social media opinions compare to traditional satisfaction measures?
- v. Can social media sentiment predict future customer satisfaction trends?
- vi. How do quality, UX, and support influence user sentiment?
- vii. Do different platforms express sentiment differently about mobile banking?

1.5 Expected Output

This study's expected outcomes include acquiring significant knowledge into the sentiments expressed by mobile banking customers in Bangladesh via social media. We anticipate categorizing these sentiments as Positive, Negative, or Neutral, allowing us to gain a clear idea of customer satisfaction levels. We hope to uncover particular components of mobile banking services that contribute positively or negatively to user experiences by analyzing prevalent sentiments. This knowledge will enable service providers to make targeted enhancements that will improve overall consumer happiness. The study also aims to find links between social media attitudes and traditional measures of consumer happiness, providing a full view of user opinion. Furthermore, we expect to find diverse patterns in sentiment expression across numerous social media platforms, providing nuanced insights into user preferences and concerns on each platform. Finally, the research should provide actionable suggestions for mobile banking providers, regulators, and stakeholders in Bangladesh. We hope to contribute to the improvement of user-centric mobile banking services, promoting a more satisfying financial experience for users in the country, by matching these findings with the country's specific socioeconomic and cultural context.

1.6 Project Management and Finance

Managing the project "Predicting Customer Satisfaction of Mobile Banking Users from Social Media Platforms: Bangladesh's Perspective" effectively requires strategic planning as well as budgetary considerations. A well-structured timeline will be set in the arena of project management to enable smooth execution. To accomplish project goals, tasks such as data collection, sentiment analysis, and result interpretation will be methodically organized. Financial resources will be set aside for data collection tools, sentiment analysis software, and possibly working with experts or influencers. Clear planning will be required to minimize overpaying and make the most use of existing finances. Regular financial evaluations will verify budget adherence and allow for necessary modifications. Furthermore, risk management measures will be put in place to deal with any unexpected issues that may affect project dates or prices. A proactive approach to project management and financing will not only assure the study's success but will also add to the overall efficiency and reliability of the research results. Let's look at some specific considerations for these areas:

TABLE 1.1: PROJECT MANAGEMENT TABLE

Work	Time
Dataset	1 month
Literature Review	3 month
Experiment Setup	1 month
Implementation	2 month
Report	2 month
Total	9 month

1.7 Report Layout

- Introduction
- Background
- Data Collection
- Data Preprocessing
- Research Methodology
- Experimental Result and Discussion
- Impact on Society, Environment
- Summary, Conclusion, Future Research
- References

CHAPTER 2

BACKGROUND STUDY

2.1 Preliminaries

The basic steps in setting the framework for predicting customer satisfaction of mobile banking customers in Bangladesh through social media analysis include identifying the scope and significance of the study. Initial actions involve identifying major social media channels relevant to the Bangladeshi environment as well as obtaining a thorough understanding of user sentiments. In addition, the study will outline the precise data types that will be required, such as text reviews, comments, and user ratings, with a focus on extracting useful information from user-generated content. The research will use ethical data collection methods, such as site scraping or API access, while respecting privacy concerns and the terms of service of the platforms chosen. The study will establish the sample selection criteria as part of the preliminary stages, guaranteeing a representative dataset that covers varied user opinions. The use of sentiment analysis tools and techniques, such as natural language processing, will be emphasised as critical for classifying sentiments as Positive, Negative, or Neutral. In short, the preliminary phase prepares the groundwork for an in-depth investigation of consumer satisfaction in Bangladeshi mobile banking by laying the groundwork for data collection, ethical considerations, and analytical approaches.

2.2 Related Works

We used a model to predict Bangladeshi mobile banking customers' levels of satisfaction based on social media platforms. To provide higher precision in comparison to all other models and approaches, we utilized our own dataset of 2608 social media data points from Bangla that we had personally collected.

Shareef, Mahmud Akhter, et al. [4] studied a quantitative study that investigates consumers' intentions to adopt mobile banking across three different service stages: static, interaction, and transaction, filling a significant gap in previous research. Previous study has looked at consumer attitudes and impressions of mobile banking as a general service channel, but it hasn't gone into detail about these particular stages. Based on the GAM paradigm, the study seeks to comprehend the behavioral trends in the uptake of mobile banking. Among Bangladeshi users of mobile banking, it performed in-depth qualitative studies. The results demonstrate that consumers' intents to use mobile banking are highly influenced by several elements during the static, interaction, and transaction service stages, providing helpful theoretical and practical insights for the industry.

Dootson, et al. [5] researched how customers view the benefit of financial institutions using social media for customer engagement and how adoption is affected. Surveys were done in 2010 and 2014, and the results were then analyzed using multiple regressions and t-tests to compare the two time periods. The results show that overall perceived value is significantly influenced by perceived utility, economic value, and social value, which in turn predicts a consumer's propensity to utilize social media to communicate with financial institutions. Additionally, it was discovered that at Time 2, adoption intention predicted self-reported usage behavior. Notably, there were notable variations in value assessments between Time 1 and Time 2, which may have been caused by worries about technological security.

Abdat, Fatmah Amir. et al. [6] aimed to predict the factors influencing the adoption of Social Media Apps (SMA) by Indonesian SMEs for business promotion and marketing, employing the UTAUT (Unified Theory of Acceptance and Use of Technology) framework. Non-probability sampling was used in the study to collect quantitative data from 162 SME owners or managers. On the data, partial Least Squares analysis was done. According to the results, the model explained 61% of the variation in behavioral intention. Particularly, the intention to use social media apps for business objectives was positively

and significantly influenced by performance expectancy, social influence, and facilitating factors. Surprisingly, though, effort expectancy had little effect on adoption intention. The study has consequences for academics, SME managers, and owners on both a theoretical and practical level.

Kuzu, Betül.et al [7] researched rapid development of mobile banking applications has made it essential for academic studies to evaluate service quality. Due to their distinctive qualities, such as their intangibility, simultaneous manufacturing and consumption, diversity, and absence of resistance, services are difficult to evaluate in terms of their quality. This study intends to investigate how customer satisfaction with mobile banking in Turkey is affected by E-S Qual service quality. 350 people took part in a survey that was performed with the use of social media and the convenience sample technique. The findings indicated a substantial beneficial relationship between efficiency, system availability, fulfillment, and privacy and customer happiness.

Chen, Tinggui, et al. [8] focused on user satisfaction with online learning environments in China during the COVID-19 pandemic, which was caused by the virus's breakout. It uses a web crawler and questionnaire survey to get information on user experiences from both online and offline users. In order to build a customer satisfaction index system, current quantitative analysis literature as well as feelings are taken into consideration. According to the study, platform accessibility has a more significant impact on user satisfaction than personal aspects that are specific to the user. The efficiency of the model is further demonstrated by the development of a Back Propagation (BP) neural network model to forecast user satisfaction with online education platforms, which achieves a high prediction accuracy of 77.5%. The report offers recommendations for improving online education during the epidemic and advancing information-based education reform in its conclusion.

Shankar, et al. [9] explored the role of electronic word of mouth (eWOM) triggers in enhancing mobile banking (m-banking) adoption behavior using the Elaboration

Likelihood Model (ELM). Argument quality, valence, consistency, and volume are all taken into account as eWOM triggers. The conceptual model also takes into account customer involvement in m-banking as a moderator and initial trust in m-banking as a mediator. Social networking website usage information from 1153 Indians was examined. According to the results, early trust in m-banking acts as a mediator between argument quality, valence, and consistency and the intention to embrace mobile banking. The study offers practical recommendations for banks to use effective eWOM in encouraging customers to adopt m-banking. It also offers insightful information for marketing communication, eWOM research, and ELM theory.

Karim, Md Wasiul, et al. [10] investigated that E-wallets have boosted rivalry in the fintech industry, which has a negative impact on service providers' happiness. 480 data points from 196 respondents aged 21 to 30 were evaluated in a research in the city of Dhaka. The findings demonstrated that satisfaction has a positive link with perceived usefulness, demonstrating the importance of technology self-efficacy. The study recommended e-payments to improve mobile payment systems and validated external variables. Rocket was the second most practical e-wallet, coming in at 26.87%, behind bKash (55.22%). The average variance extracted (AVE) value was discovered to be more than the suggested threshold of 0.5, ranging from 0.659 to 0.875. The study also demonstrated that CR samples were over the cutoff of 0.7, ranging from 0.810 to 0.965. The research adds to the body of knowledge on customer satisfaction in the e-wallet business.

Alalwan, Ali Abdallah, et al. [11] studied to find and put to the test social media advertising-related characteristics that can predict consumers' propensity to buy. Performance expectancy, hedonic motivation, habit, interactivity, informativeness, and perceived relevance are the three elements from the expanding Unified Theory of Acceptance and Use of Technology (UTAUT2) that are the foundation of the conceptual model that is being suggested. 437 people in Jordan filled out a questionnaire during the data collection process. The validity of the model and the importance of the effects of performance

expectancy, hedonic motivation, interactivity, informativeness, and perceived relevance on purchase intentions were validated by structural equation modeling (SEM). The report offers theoretical and practical recommendations for how marketers could organize and put into practice their social media ad campaigns. Five factors—performance expectancy, hedonic motivation, interactivity, informativeness, and perceived relevance—had a significant impact on consumer purchase intention, with the model being able to predict around 52% of the variance in that intention.

Karim, Rashed.et al. [12] aimed to investigate the impact of e-service quality on customer satisfaction and word of mouth in the app-based service industry in Bangladesh. In order to pinpoint aspects of e-service quality that favorably affect customer happiness, it analyzes the body of existing literature. Additionally, it recognizes the beneficial relationship between customer happiness and word-of-mouth advertising, a crucial aspect of the service sector. Through the use of convenience sampling and a structured questionnaire, information from 186 respondents was gathered. Application design, service fulfillment, and customer service have a significant and positive influence on customer satisfaction, according to an analysis utilizing the SPSS and PLS software. On the other hand, it was discovered that customer happiness was not significantly impacted by the security and privacy of the company app. The study also emphasizes the significance of technological adaptation in this changing environment.

Yang, Y., et al. [13] studied how social media marketing initiatives (SMMA) affect consumer happiness and perceptions of the worth of garment businesses in China. Traditional marketing has been changed by social media, which also provides a platform for fostering consumer-brand interactions. 355 Chinese customers of garment brands that use social media participated in a quantitative survey. Confirmatory factor analysis (CFA) and the Hayes PROCESS macro were used in the data analysis. According to the survey, SMMA significantly enhance Chinese consumers' perceptions of brand value and satisfaction. Additionally, it emphasizes the mediating function of brand perceived value in the relationship between SMMA and customer happiness, giving Chinese marketers helpful theoretical and practical insights.

Saleem, et al. [14] focused on finding the key factors that, in the context of Pakistan, affect consumer satisfaction. Globally, banks have begun to adopt mobile banking as a noteworthy technology. Questionnaires and statistical techniques like regression analysis, correlation analysis, and factor analysis were employed in the study's data gathering and analysis. The findings emphasize the significant influence of consumer concerns regarding the security, authenticity, and dependability of mobile technology. It urges companies to place the highest value on factors such as IT application, cutting-edge services, security, customer trust, and risk because they are key factors in determining technology adoption and customer satisfaction. Principal component analysis identified two significant components explaining 58.45% of the total variance, elucidating the underlying factors influencing the adoption and enjoyment of mobile technology. The first factor accounted for 39.92% of the variance and the second factor for 18.52% of the variance.

Ahmed, Md Faisal, et al. [15] centered on Bengali, the seventh most common language in the world, and the pressing issue of identifying online abuse and cyberbullying via social media. Given the increase of Bengali-speaking users of online platforms, efficient detection techniques are needed to combat online abuse. The study suggests binary and multiclass classification models using a hybrid neural network approach to find instances of bullying expression in Bengali. The following five types of comments were found using a dataset of 44,001 user comments from well-known public Facebook pages: non-bully, sexual, threat, troll, and religious. The accuracy of the multiclass classification system created by using an ensemble technique after a neural network was 85% whereas the accuracy of the binary classification model was 87.91%.

2.3 Comparative Analysis and Summary

In the last stages of our research, we will conduct a comparative analysis to extract critical insights into forecasting consumer happiness among mobile banking users in Bangladesh using social media platforms. This study will involve comparing sentiments across platforms, discovering patterns, and identifying common threads of user experiences.

We will draw comparisons to reveal the specific characteristics of user feedback on various social media channels through an accurate evaluation of Positive, Negative, and Neutral attitudes. The goal is to produce a thorough overview that not only captures the common sentiments but also emphasises any differences in user perceptions across platforms.

The comparison study will be used to generate practical suggestions for mobile banking providers. We hope to provide stakeholders with a clear roadmap for improving customer happiness by combining these findings into a concise summary, which is based on the specific dynamics of social media interactions within the Bangladeshi mobile banking market. Finally, this research aims to contribute to the continued growth of mobile banking services in Bangladesh, creating a more responsive and user-centric financial ecosystem.

There are few studies on this field yet some of the close proposed methodologies comparisons are derived below at table 2.1:

2.4 Scope of the Problem

The topic of predicting consumer satisfaction among Bangladeshi mobile banking customers via social media platforms is complicated and significant. The country's growing reliance on digital financial services has highlighted the importance of properly addressing user satisfaction. With an ever-expanding user population on platforms such as Facebook, Twitter, and local forums, the scope encompasses a diverse range of thoughts and sentiments that shape the customer experience. By addressing this broad breadth, the research aims to provide actionable insights to stakeholders, providing a nuanced view on the problems and opportunities inherent in improving consumer satisfaction within the particular socioeconomic context of Bangladesh's mobile banking market.

2.5 Challenges

Another problem is cultural nuances, which demand an in-depth understanding of local attitudes and expressions in order to appropriately interpret user feedback. Concerns about privacy must be addressed carefully throughout data collection from social media sites, ensuring conformity with ethical norms and regulatory restrictions.

In addition, the sheer volume of data available on sites such as Facebook and Twitter needs new analytical approaches to efficiently extract valuable information. The changing nature of social media trends makes it difficult to keep the study relevant over time.

Balancing the dataset's representativeness and eliminating potential biases, such as over-representation of specific groups, complicates matters. Despite these obstacles, overcoming them is critical for uncovering the rich tapestry of user attitudes and providing a more comprehensive knowledge of customer satisfaction within Bangladesh's dynamic mobile banking business.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Research Subject and Instrumentation

The research topic focuses on understanding customer attitudes in the dynamic arena of mobile banking. A diverse approach to instrumentation is required to untangle the complex environment of consumer satisfaction.

The major equipment for sentiment analysis is Natural Language Processing (NLP) tools. These techniques, which include machine learning algorithms, allow useful insights to be extracted from the huge amount of user-generated content on social media networks. The instrumentation includes the creation of algorithms capable of detecting sentiments, classifying them as Positive, Negative, or Neutral, and recognising the contextual aspects unique to Bangla.

Web scraping tools are used to acquire data, ensuring the gathering of a wide and representative dataset from platforms such as Facebook, Twitter, and local forums. The instrumentation includes data preprocessing techniques to efficiently clean and structure the dataset.

This dual-pronged instrumentation, combining NLP tools for sentiment analysis and web scraping for data collection, forms the methodological backbone of the research. By leveraging these instruments, the study aspires to unravel the intricate patterns of user satisfaction in the Bangladeshi mobile banking landscape as expressed on social media platforms.

3.2 Data Collection Procedure

Data collecting from social media sites for predicting consumer happiness in Bangladeshi mobile banking requires a systematic and ethical approach. To collect user-generated content from various platforms such as Facebook, Twitter, and local forums, web scraping techniques will be used. During this period, strict adherence to platform standards and user privacy issues are critical. A rigorous sampling method will be used to ensure a representative dataset, taking into account aspects such as regional diversity, user demographics, and variability in mobile banking experiences.

Text-based postings, comments, and reviews in Bangla will be collected, reflecting the actual voices of mobile banking customers. Non-Bangla content will be filtered using language identification methods, ensuring the dataset's language-related stability. Furthermore, data pretreatment techniques will be used to reduce noise, remove non-essential characters, and ensure that the dataset is ready for sentiment analysis. Every step of the data gathering technique will be guided by ethical considerations and privacy protection, in accordance with the standards of responsible research conduct. This methodical approach attempts to provide a solid dataset that accurately represents the various attitudes and experiences of Bangladeshi mobile banking customers on social media sites.

3.2.1 Data Collection

The study will use online scraping tools to collect a variety of user-generated content from popular social media platforms such as Facebook, Twitter, and local forums. Search queries for mobile banking services will be specified, ensuring that a representative dataset is acquired

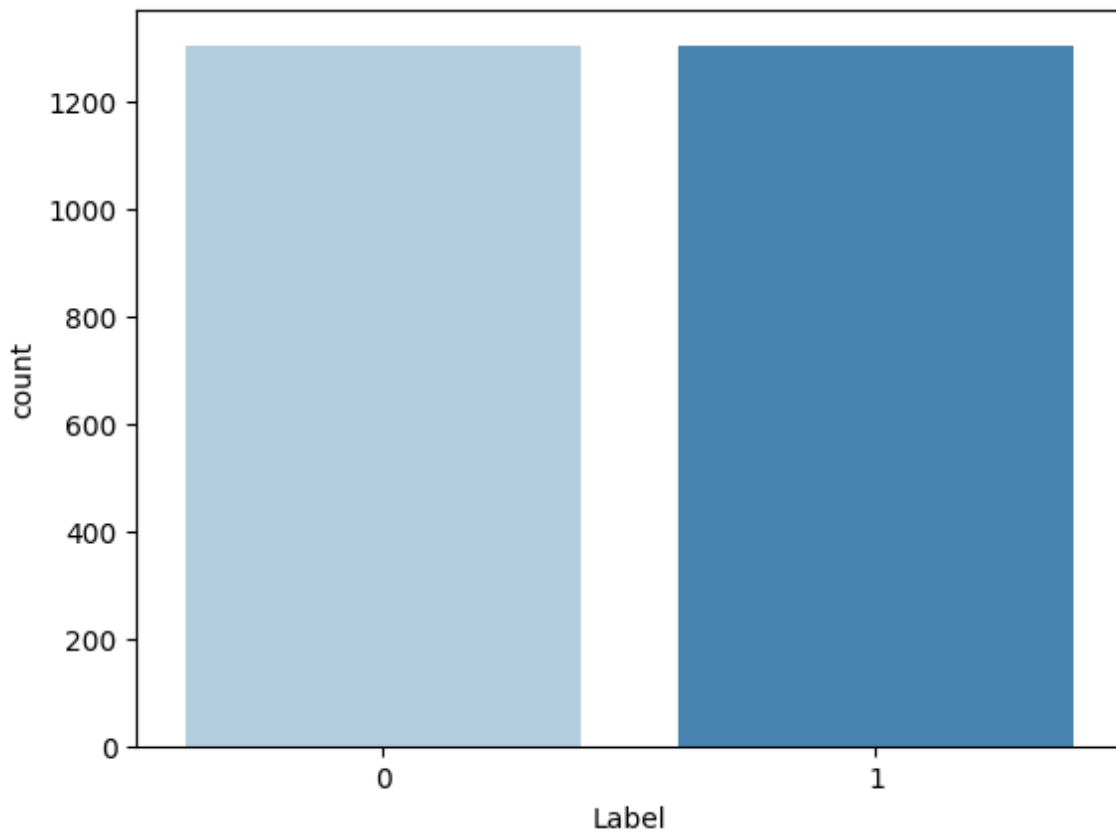


Figure 3.1: Dataset Distribution

3.2.2 Data preprocessing

The NLP data cleaning and preparation methods are covered in this section. The fundamental methods employed in NLP research include data cleansing.

Removing Stop Words

A great deal of language in case reports, such as connections, adverbs, and prepositions, are unnecessary for text categorization and need to be removed in order to maximize the effectiveness of the model training process that follows. The current investigation employs the standard list of stop words for processing.

Text Normalization

Case normalization (converting all text to lowercase or uppercase), punctuation removal, and special character handling are examples of NLP data cleaning techniques. Normalization ensures similarity within the text and removes noise caused by variations in punctuation and capitalization.

Tokenization

Tokenization is the process of breaking text into discrete words or tokens. It allows for better analysis and streamlines procedures like named entity identification, sentiment analysis, and part-of-speech tagging. In languages with unique word structures or morphologies, tokenization can be challenging.

3.3 Proposed Methodology

Predicting the satisfaction level of mobile banking users in Bangladesh from social media sites using machine learning and deep learning techniques is an interesting and relevant research area. I can provide you a rough breakdown of the stages taken in such a prediction method, though, as an AI language model. Here is a general summary in the below flowchart in Figure 3.3:

Flow chart:

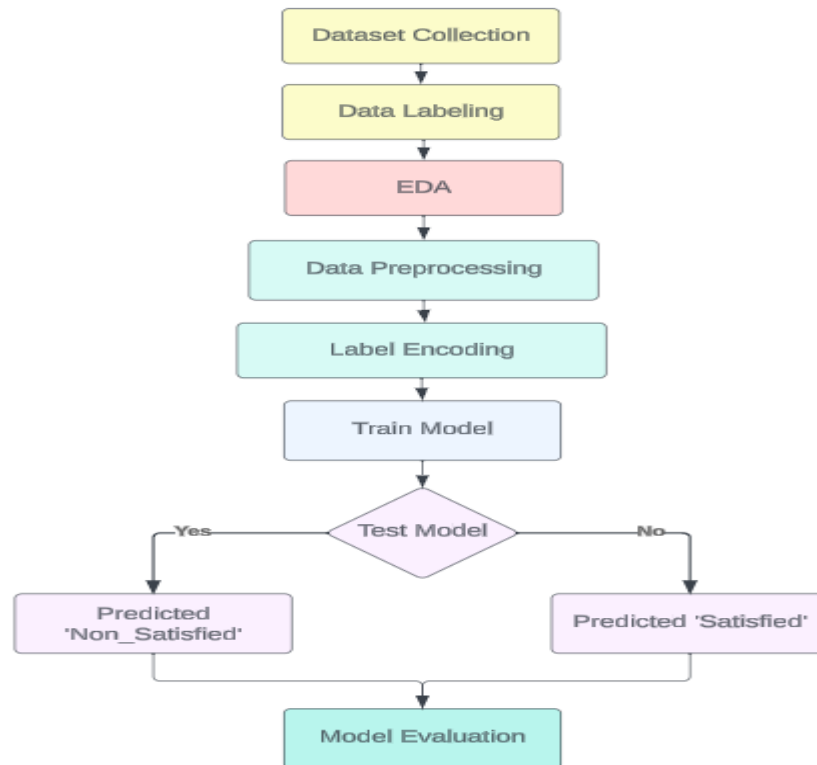


Figure 3.2: Methodology Flowchart

Data gathering: Compile information about Bangladeshi users of mobile banking from social media. Reviews, comments, ratings, and feedback from users on social media sites like Facebook, Twitter, and other pertinent websites can be included in this.

Data Preprocessing: Clean and preprocess the collected data. In this step, stop words are eliminated, missing values are handled, text data is normalized, and tokenization, stemming, and other techniques are used.

Labeling :The collected dataset will be sentiment labeled, with user feelings classified as Positive, Negative, or Neutral. This stage is critical for supervised machine learning since it provides labeled training data for the predictive model.

Image Augmentation: Image augmentation may not be immediately applicable due to the textual nature of social media material. Text augmentation techniques such as synonym replacement and phrase shuffling, on the other hand, will be used to diversity the dataset and improve the model's stability.

Data Split:The dataset will be divided into three parts: training, validation, and testing. This guarantees that the model is trained on a wide variety of data, validated for generalization, and tested for performance on previously encountered examples.

Training Model:The labeled dataset will be used to train a deep learning model, either a Recurrent Neural Network (RNN) or Long Short-Term Memory (LSTM) network. Patterns and correlations between textual features and sentiment labels will be recognised by the model.

Recognition:To predict sentiments, the trained model will be applied to previously unknown social media data. The model's capacity to recognise and categorize sentiments in real-life situations will be inspected.

Output:The final outcome would be a thorough examination of consumer satisfaction attitudes in Bangladeshi mobile banking, highlighting trends, relevant factors, and predictive capacities. The study's goal is to give practical insights for service providers, regulators, and stakeholders in order to improve user happiness in the context of social media interactions.

CNN

In the case of NLP tasks, where text is being used instead of pictures, the text is shown as a one-dimensional array. Here, 1D convolutional-and-pooling techniques are used in place of the original ConvNets architecture. One of the most popular NLP tasks where ConvNet is utilized is sentence classification, which entails classifying a phrase into a set of specified categories by taking into account its n -grams—that is, its words or sequence of words, as well as its characters or sequence of characters.

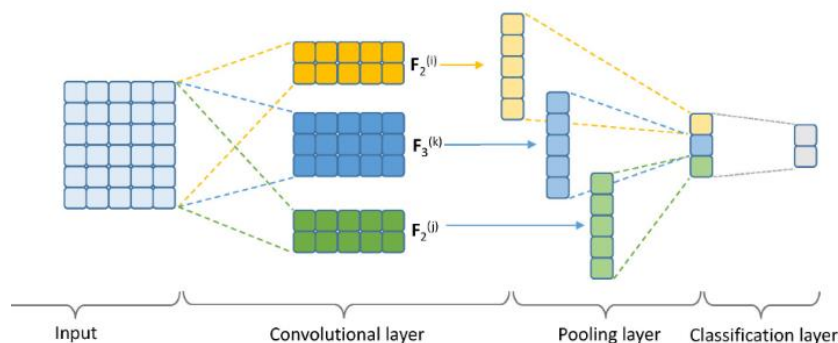


Figure 3.3: CNN model architecture

Long Short-Term Memory (LSTM)

The acronym for Long-Short Term Memory is LSTM. LSTM is a type of recurrent neural network that performs better in memory than conventional recurrent neural networks. When it comes to learning certain patterns, LSTMs do far better. Like any other neural network, LSTMs can contain a large number of hidden layers. As the network navigates through these levels, the pertinent information is stored and the irrelevant information is eliminated in each and every cell.

Conventional neural networks struggle with short-term memory. The vanishing gradient issue is a serious drawback as well. When the gradient becomes close to zero during backpropagation, the neuron becomes unusable for additional processing. LSTMs effectively improve performance by collecting important information and identifying.

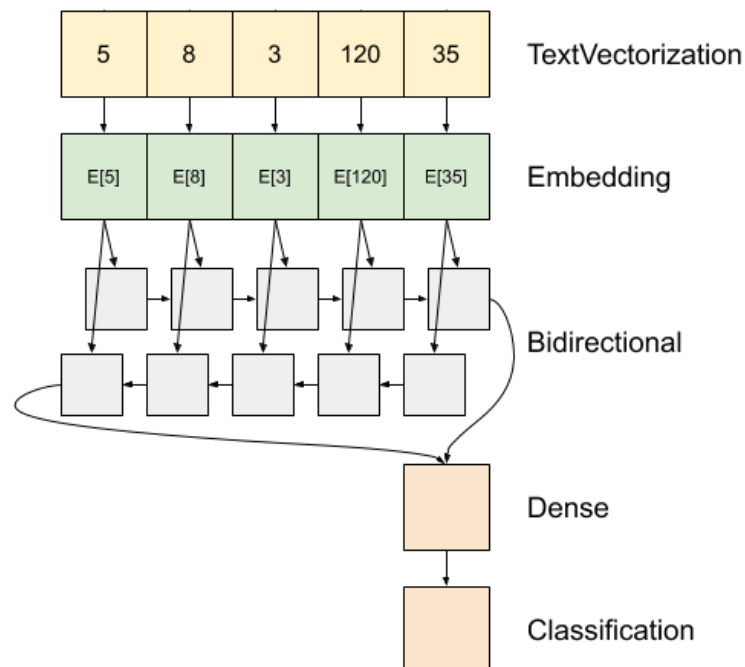


Figure 3.4: LSTM model architecture

BNB

Bernoulli Naive Bayes (BNB), a probabilistic classifier based on the Bayes theorem, is a Naive Bayes technique version. BNB believes that features are conditionally independent given the class label and models binary feature variables using the Bernoulli distribution. BNB is widely utilized for text classification problems since it provides binary information such as the existence or absence of particular words in a document. It is computationally efficient and works well when there are few training samples and high-dimensional data.

Decision Tree

A popular machine learning technique known as Decision Tree builds a model of decisions and their outcomes in the form of a tree. Depending on the input feature values, the algorithm splits the data recursively into leaf nodes and decision nodes. Every inner node represents a decision taken in light of a feature, and every leaf node represents a class label or value. Decision trees are interpretable, handle numerical and category data, and may express nonlinear connections. They are often used for regression and classification issues.

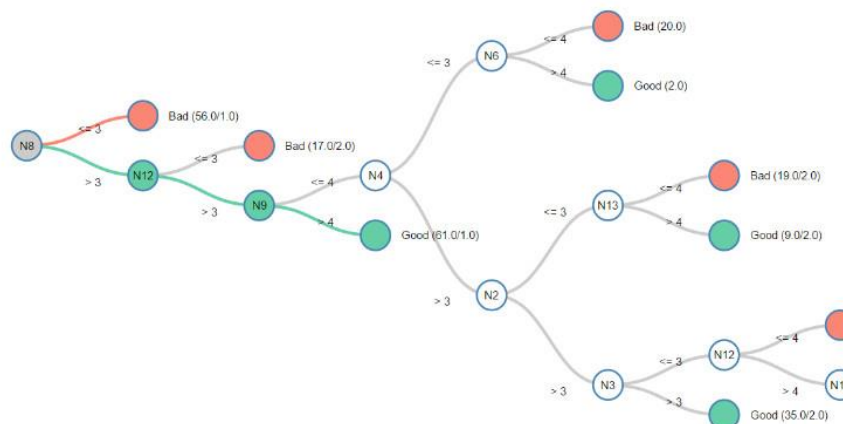


Figure 3.5: Decision Tree

Logistic Regression

For the purpose of predicting outcomes that fall into one or more groups, logistic regression is a popular linear classification technique. Despite its fake name, it is really a regression method that determines the probability of a binary result based on input data. Logistic regression uses the logistic function, also referred to as the sigmoid function, on the linear combination of features to provide class probabilities. It is a simple yet effective method that is widely applied to a variety of classification jobs where the relationship between the characteristics and the target variable is thought to be linear.

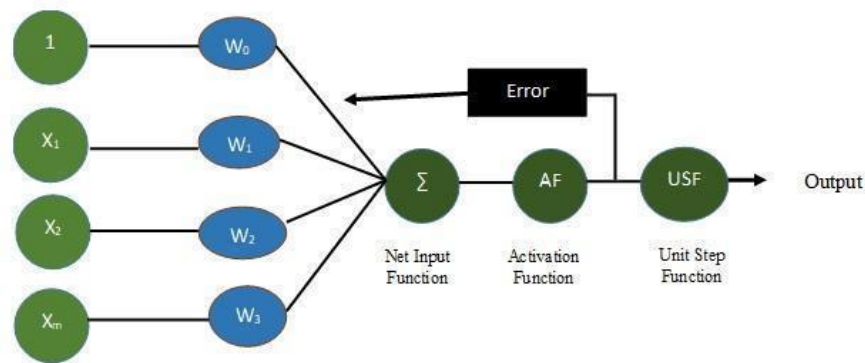


Figure 3.6: Logistic Regression

Support Vector Machine

Support vector machines are strong supervised learning models for regression and classification (SVMs). SVMs look for the optimal hyperplane that effectively divides data points of different classes in a high-dimensional feature space. Because SVMs employ a variety of kernel functions to increase the dimensionality of the input they analyze, they can handle both linear and nonlinear classification tasks. SVMs are effective at processing high-dimensional data and find use in many different domains, such as bioinformatics, text

categorization, and picture classification. Also, they do well when it comes to generalization.

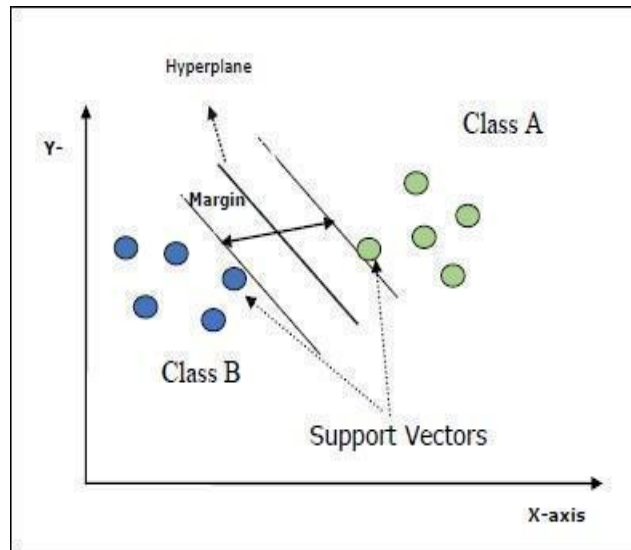


Figure 3.7: SVM

3.4 Implementation Requirements

Several critical needs must be met in order to successfully implement customer satisfaction prediction in Bangladeshi mobile banking through social media platforms. These include using advanced web scraping tools for various content extraction, using Natural Language Processing (NLP) libraries for textual data preprocessing and sentiment analysis, and leveraging machine learning frameworks like TensorFlow or PyTorch, potentially employing architectures like RNNs or LSTMs. Access to a large number of computational resources, ethical data handling procedures, and the creation of a structured data labeling framework for supervised model training are all critical. Extensive processes for establishing independent validation, training, and test datasets assure reliable model evaluation, while constant monitoring and updates handle the ever-changing nature of social media trends. Collaboration with local specialists ensures that cultural subtleties are taken into account, making the research relevant to the specific setting of Bangladesh. By achieving these conditions, the research aims to build a strong predictive model that will contribute useful insights to improving consumer happiness in the Bangladeshi mobile banking sector.

CHAPTER 4

Experimental results and discussion

4.1 Experimental Setup

A reliable combination of tools and resources is required for the experimental setup for predicting customer satisfaction in Bangladeshi mobile banking using social media platforms. Web scraping methods will be used to collect user-generated content from various sources such as Facebook, Twitter, and local forums.

Libraries such as NLTK and spaCy will be used for language identification, text cleaning, and sentiment analysis in natural language processing (NLP). The chosen machine learning framework, likely TensorFlow or PyTorch, will be used to build and train predictive models, with deep learning architectures such as Recurrent Neural Networks (RNNs) or Long Short-Term Memory (LSTM) networks being considered. For faster model training on huge datasets, sufficient computational resources, especially high-performance GPUs, will be secured. Ethical data processing procedures will be followed, ensuring privacy compliance and adherence to the terms of service of social media platforms.

The experimental setting will include strict protocols for data splitting and the creation of separate training, validation, and test datasets. Continuous monitoring and updates will be implemented to keep up with changing social media trends, and engagement with local specialists will ensure that cultural subtleties unique to Bangladesh are incorporated. The goal of this complete setup is to build a strong and culturally sensitive model for predicting customer happiness in Bangladeshi mobile banking.

4.2 Experimental Results & Analysis

It was necessary to look at the performance of the existing models at this time. We may utilize a number of performance evaluation measures to ensure the efficacy of our proposed model. These algorithms use previously unknown information to assess overall performance. For the Bangla review comments in this section, we have to submit an analytical report based on the experimental findings from our chosen social media datasets. Using the chosen dataset was how we got started. We calculated the missing or incorrect numbers and removed them from our dataset. We implemented many algorithms and evaluated their performance. For our suggested approaches, we assessed the Confusion Matrices' Accuracy, Precision, Recall, and F-1 Score.

Accuracy: Accuracy measures the overall correctness of the model's predictions by comparing the number of correctly classified samples to the total number of samples. When classes are unbalanced, it gives a broad indication of the model's effectiveness but might not give a whole picture.

$$Accuracy = \frac{TruePositive + TrueNegative}{TruePositive + FalsePositive + TrueNegative + FalseNegative}$$

Precision: Out of all positive predictions generated by the model, precision focuses on the percentage of true positive forecasts.

$$Precision = \frac{TruePositive}{TruePositive + FalsePositive}$$

Recall: Also known as sensitivity or true positive rate, recall is the percentage of true positive predictions made out of all truly positive samples.

$$Recall = \frac{TruePositive}{TruePositive + FalseNegative}$$

F1 rating: The F1 score is the harmonic mean of recall and precision. It provides a reasonable evaluation metric that considers recall and precision. The F1 score is useful when classes are uneven since it accounts for both false positives and false negatives. A high F1 score denotes a well-balanced precision to recall ratio.

$$F - 1 \text{ Score} = 2 * \frac{\text{Recall} * \text{Precision}}{\text{Recall} + \text{Precision}}$$

The result of deep learning model is compared on the basis of Accuracy, Precision, Recall, F1 Score in below table of 4.1:

Table 4.1. Performance Evaluation

Model Name	Accuracy	Precision	Recall	F1-Score
CNN	99.23%	96%	97%	96%
LSTM	99.82%	98%	98%	98%
BNB	86.22%	86%	87%	0.86%
Logistic Regression	91.58%	91%	91%	91%
Decision Tree	94.13%	94%	94%	94%
SVM	93.88%	94%	94%	94%
KNN	47.45%	73 %	51%	34 %

4.3. Accuracy

The final result of the analysis compares test and train accuracy and provides the most effective method. We have used well-known machine learning techniques and deep learning models for comparison to see which works best. The Logistic LSTM, however, provided the best accuracy, at 99.82%. The accuracy comparison of the various models is displayed in figure 4.1:

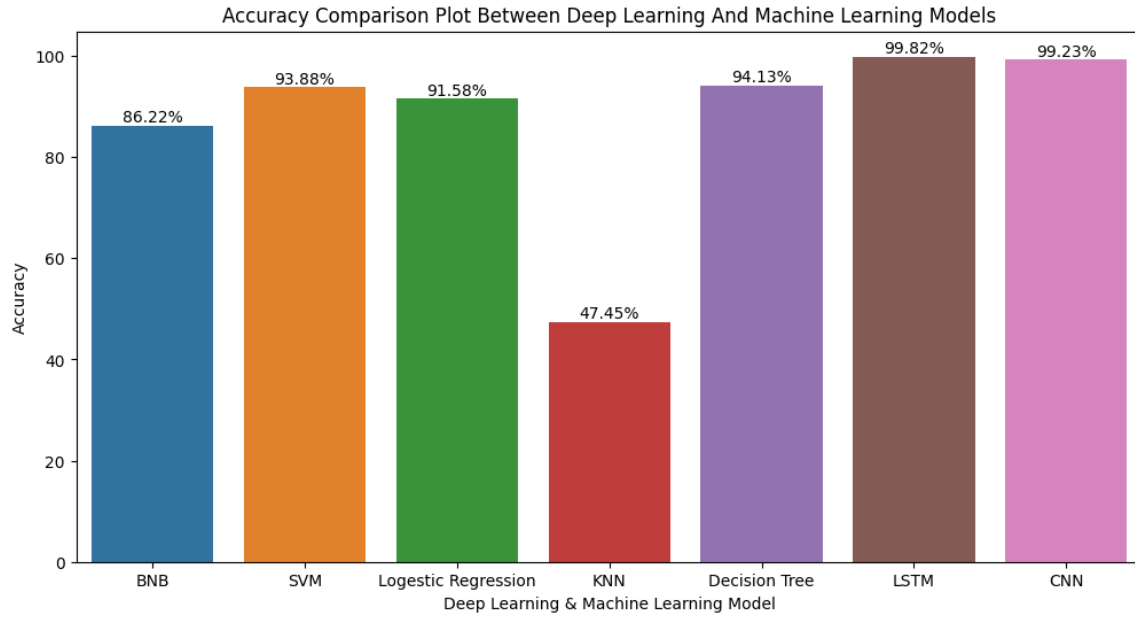


Figure 4.1 : Accuracy Comparison of Deep Learning And Machine Learning Models

Using Long-Term Memory (LSTM) algorithmic performance, the greatest accuracy of 99.84% was achieved. 99.23% was given to CNN, 47.45% to KNN, 94.13% to Decision Tree, 93.88% to Support Vector, and 91.58% to Logistic Regression.

Performance Analysis

LSTM:

Achieved the highest accuracy of 99.82%. Below at table 4.2 we have performance evaluation of LSTM:

Table 4.2. Performance Evaluation(LSTM)

	Precision	Recall	F1-Score	Support
0	0.98	0.98	0.98	211
1	0.98	0.97	0.98	181
Accuracy			0.98	392
Macro avg	0.98	0.98	0.98	392
Weighted avg	0.98	0.98	0.98	392

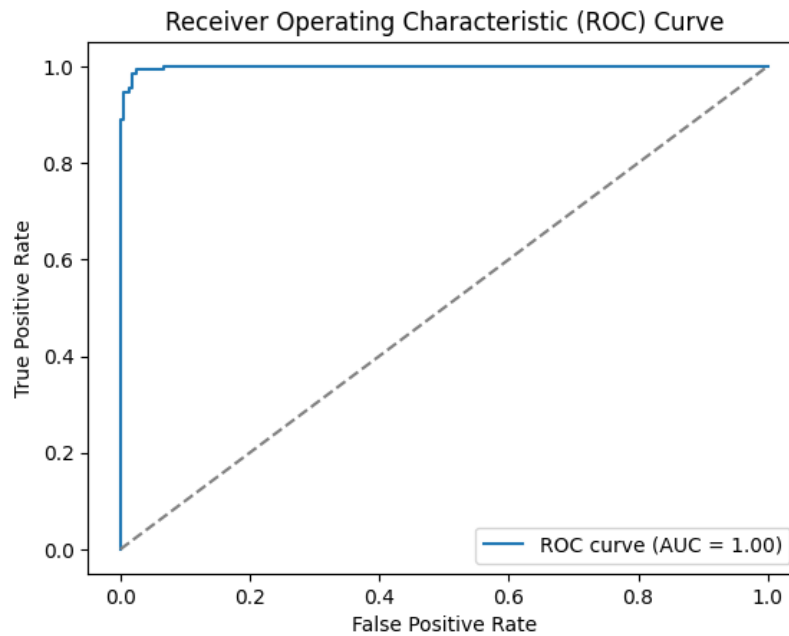


Figure 4.2 : ROC Curve LSTM

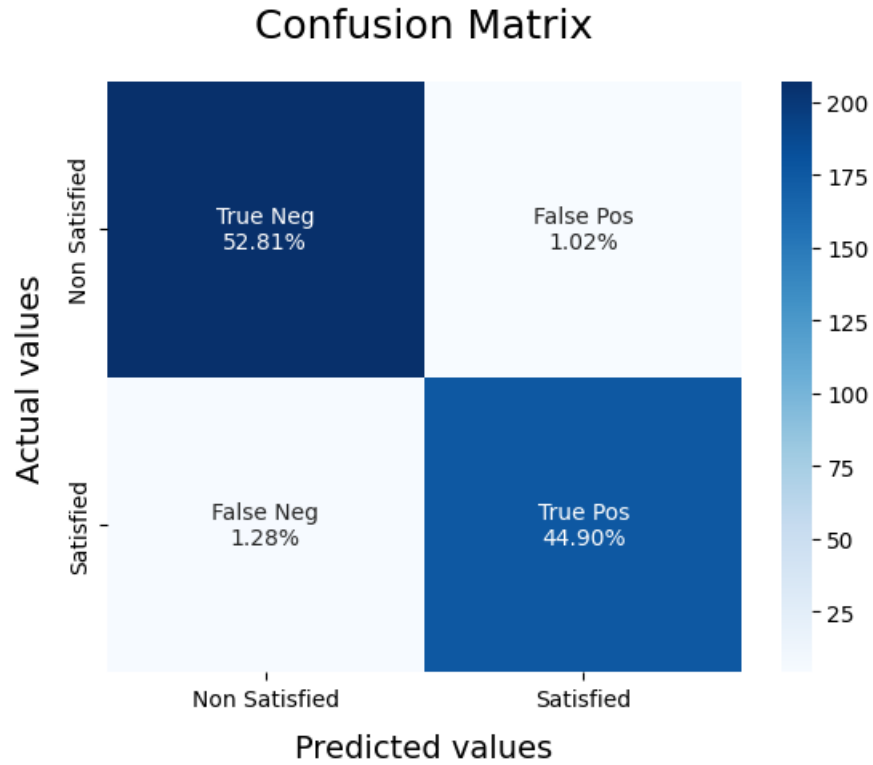


Figure 4.3 : Confusion Matrix LSTM

CNN:

Achieved the second highest accuracy of 99.23%. Below at table 4.3 we have performance evaluation of CNN:

Table 4.3. Performance Evaluation(CNN)

	Precision	Recall	F1-Score	Support
0	0.98	0.95	0.97	211
1	0.95	0.98	0.96	181
Accuracy			0.96	392
Macro avg	0.96	0.97	0.96	392
Weighted avg	0.96	0.96	0.96	392

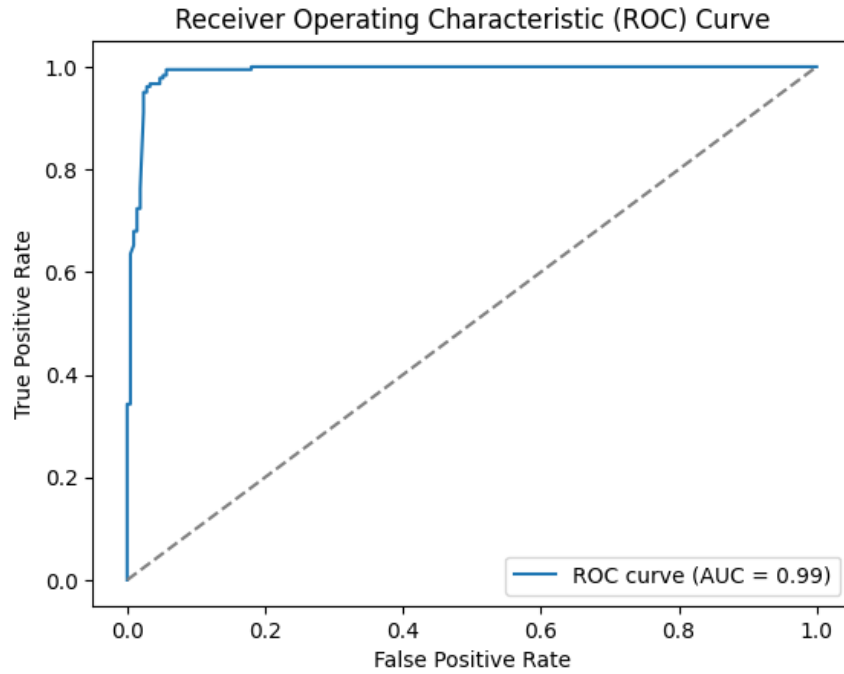


Figure 4.4: ROC Curve CNN

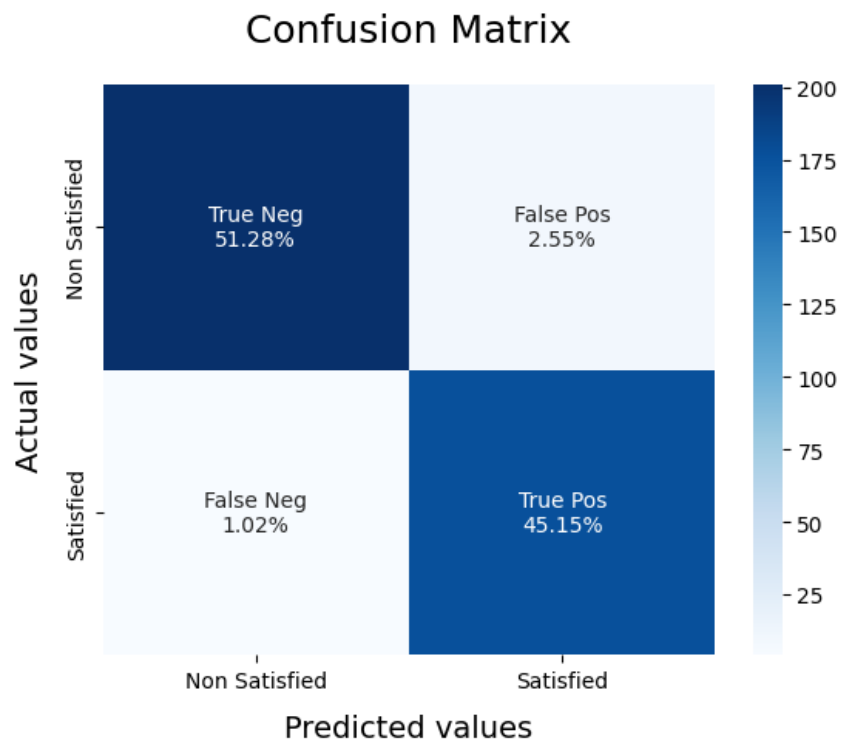


Figure 4.5 : Confusion Matrix CNN

Logistic Regression:

Achieved the accuracy of 91.58% . Below at table 4.4 we have performance evaluation of LR:

Table 4.4. Performance Evaluation(LR)

	Precision	Recall	F1-Score	Support
0	0.94	0.91	0.92	211
1	0.89	0.93	0.91	181
Accuracy			0.92	392
Macro avg	0.91	0.92	0.92	392
Weighted avg	0.92	0.92	0.92	392

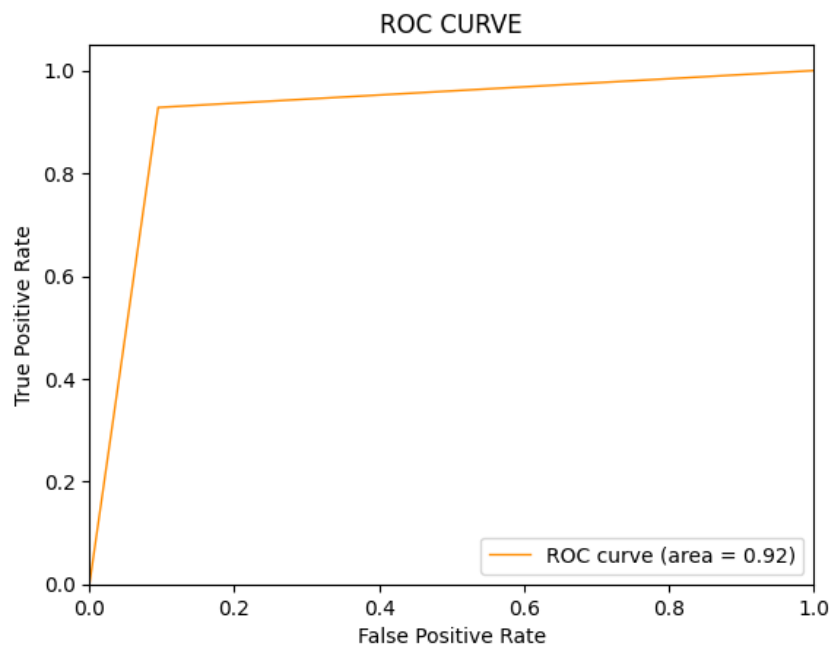


Figure 4.6 : ROC Curve

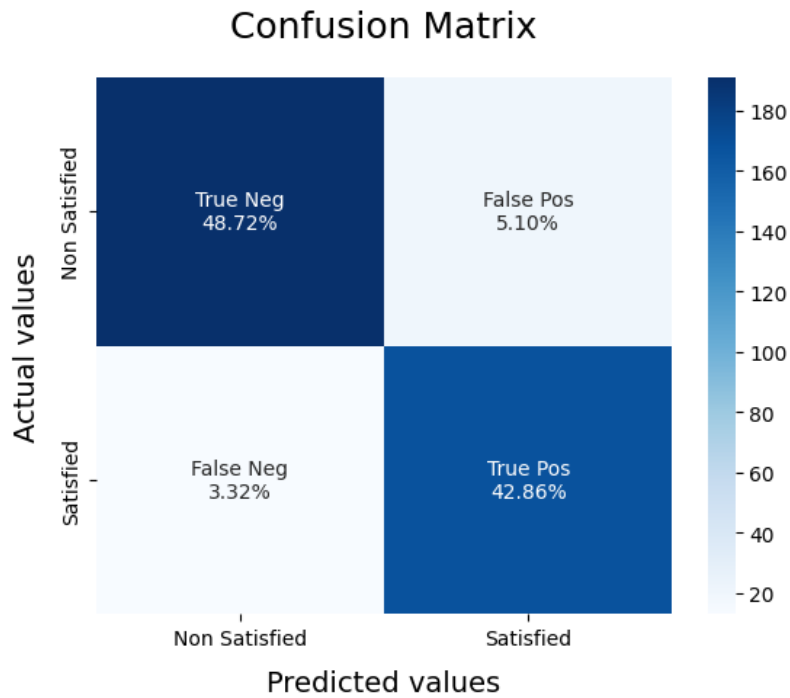


Figure 4.7 : Confusion Matrix

Decision Tree:

Achieved the accuracy of 94.13% . Below at table 4.5 we have performance evaluation of DT:

Table 4.5. Performance Evaluation(DT)

	Precision	Recall	F1-Score	Support
0	0.96	0.93	0.94	211
1	0.92	0.95	0.94	181
Accuracy			0.94	392
Macro avg	0.94	0.94	0.94	392
Weighted avg	0.94	0.94	0.94	392

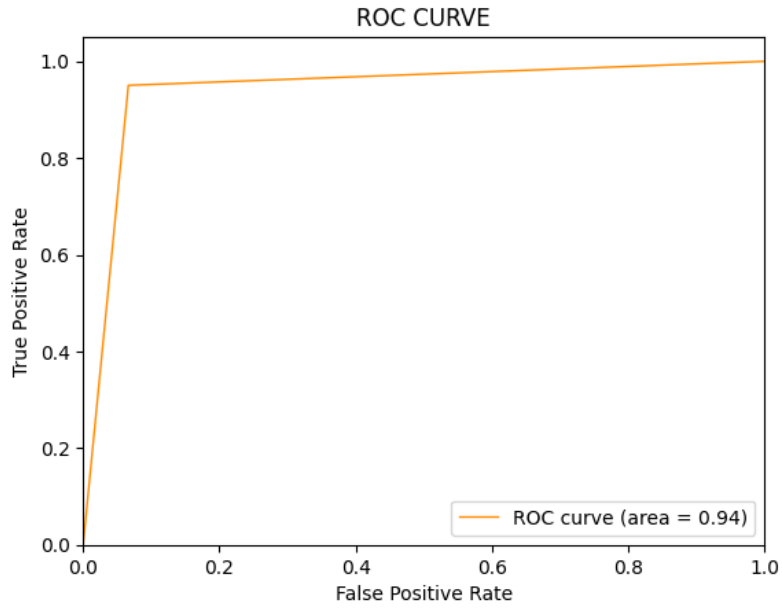


Figure 4.8: ROC Curve

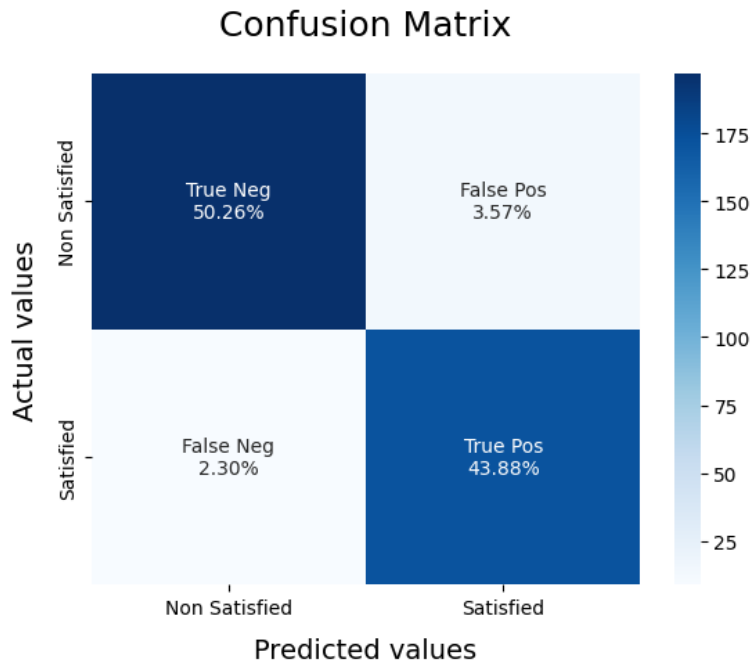


Figure 4.9 : Confusion Matrix

SVM:

Achieve the accuracy of 93.88%. Below at table 4.6 we have performance evaluation of SVM:

Table 4.6. Performance Evaluation(SVM)

	Precision	Recall	F1-Score	Support
0	0.97	0.92	0.94	211
1	0.91	0.96	0.94	181
Accuracy			0.94	392
Macro avg	0.94	0.94	0.94	392
Weighted avg	0.94	0.94	0.94	392

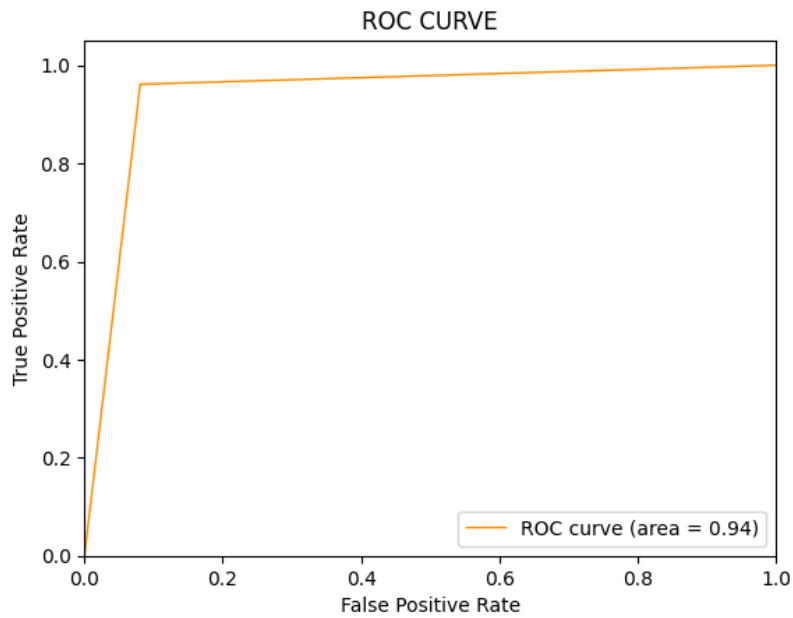


Figure 4.10: ROC Curve

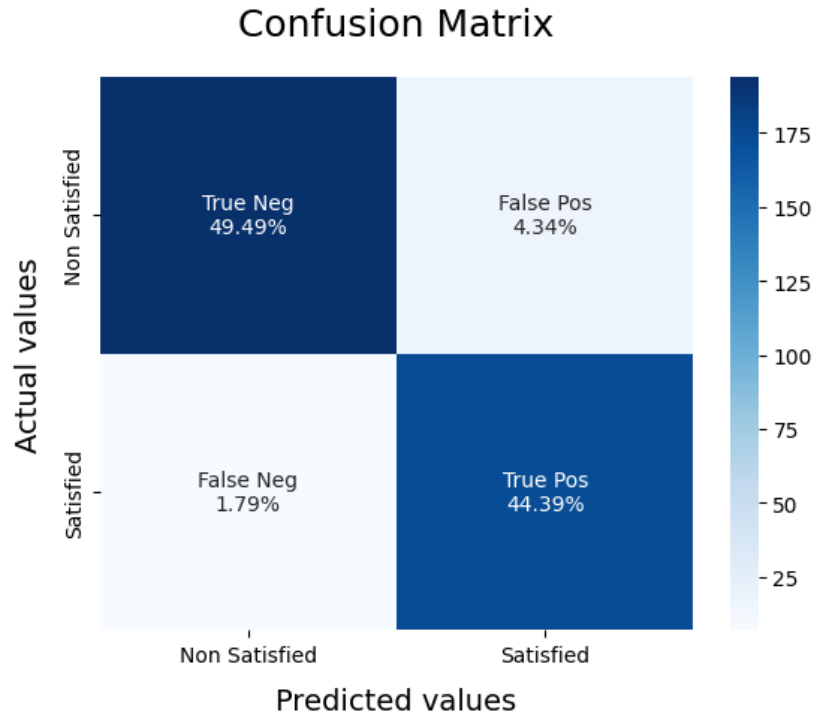


Figure 4.11 : Confusion Matrix

KNN:

Achieve the highest accuracy of 47.45%. Below at table 4.6 we have performance evaluation of KNN:

Table 4.6. Performance Evaluation(KNN)

	Precision	Recall	F1-Score	Support
0	1.00	0.02	0.05	211
1	0.47	1.00	0.64	181
Accuracy			0.47	392
Macro avg	0.73	0.51	0.34	392
Weighted avg	0.75	0.47	0.32	392

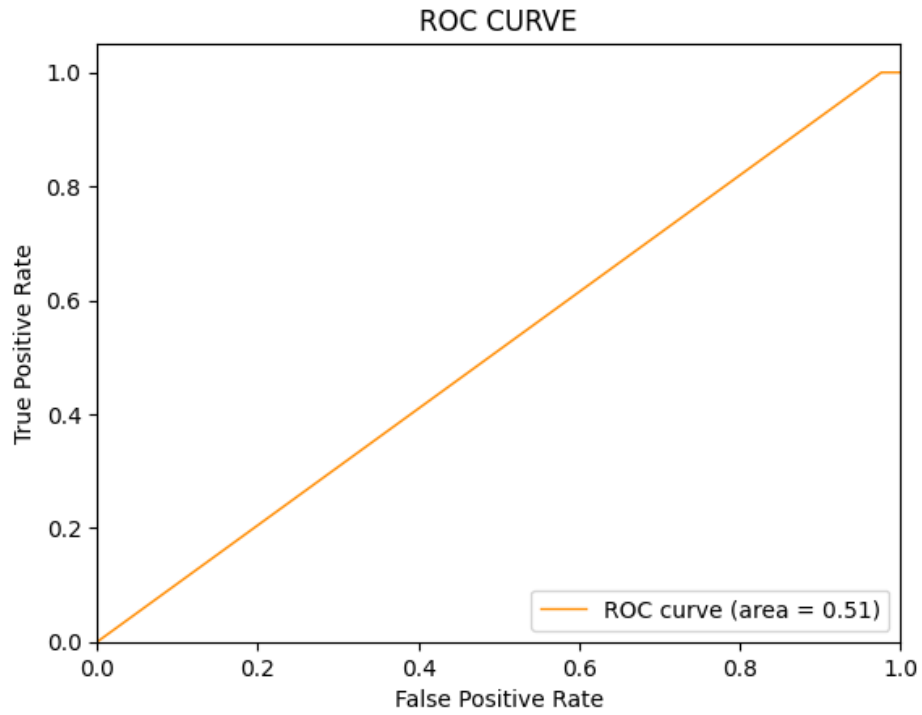


Figure 4.10: ROC Curve

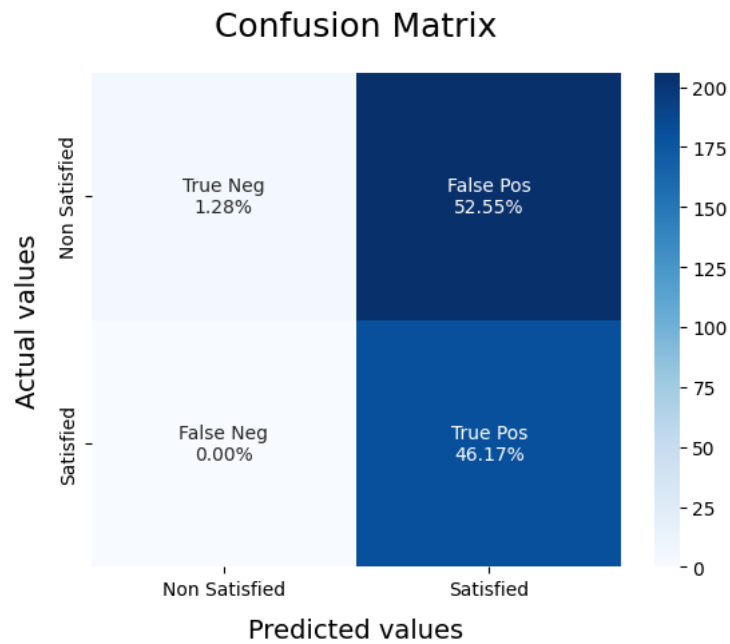


Figure 4.11 : Confusion Matrix

BNB:

Achieve the accuracy of 86.22%. Below at table 4.6 we have performance evaluation of BNB:

Table 4.6. Performance Evaluation(BNB)

	Precision	Recall	F1-Score	Support
0	0.92	0.82	0.86	211
1	0.81	0.92	0.86	181
Accuracy			0.86	392
Macro avg	0.86	0.87	0.86	392
Weighted avg	0.87	0.86	0.86	392

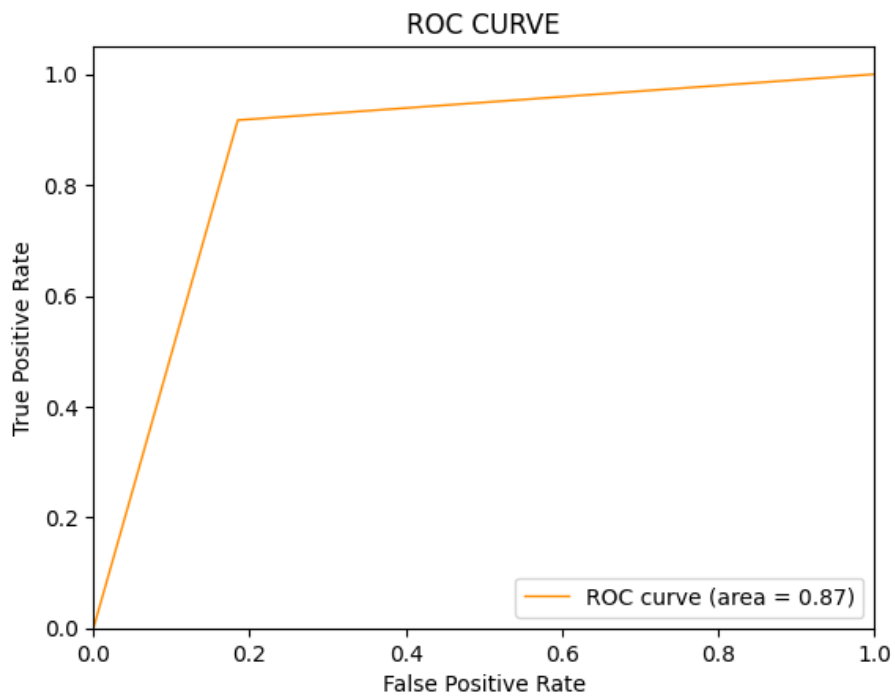


Figure 4.10: ROC Curve

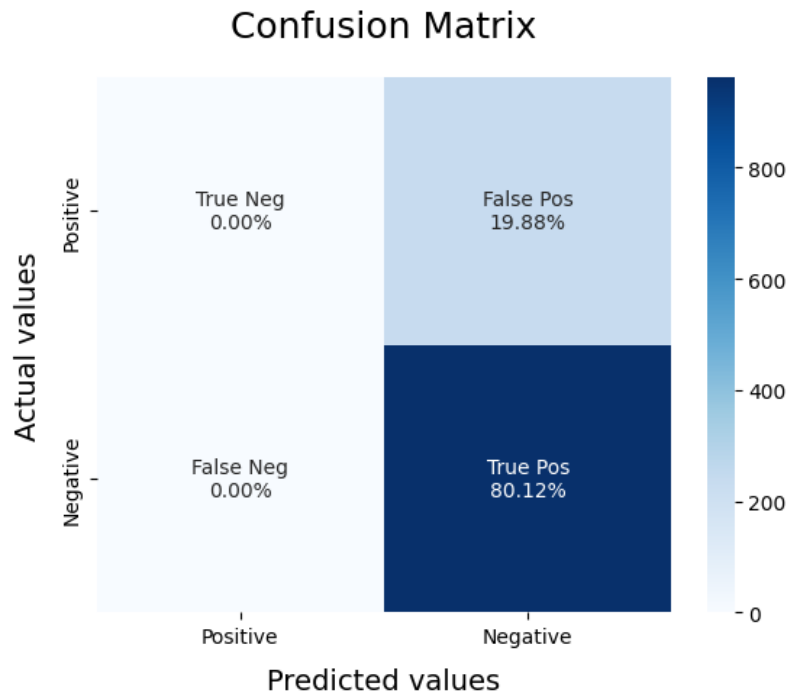


Figure 4.11 : Confusion Matrix

CHAPTER 5

IMPACT ON SOCIETY, ENVIRONMENT AND SUSTAINABILITY

Discussion:

The research findings will be carefully examined and contextualized throughout the discussion phase of predicting consumer happiness in Bangladeshi mobile banking using social media platforms. Sentiment analysis insights will be analysed, revealing light on prevalent trends, user sentiments, and affecting factors. The discussion will look into the significance of positive and negative attitudes, providing detailed insights on the features of mobile banking services that promote happiness or dissatisfaction among consumers in Bangladesh. It will discuss the prediction model's success in capturing these feelings, as well as its applicability in the ever-changing social media ecosystem. Cultural and linguistic details unique to Bangladesh will be considered, ensuring that the findings are applicable and applicable to others. The larger impact on the mobile banking sector, potential areas for improvement, and recommendations for participants will be discussed.

Moreover, the discussion intends to add to the ongoing conversation about customer happiness in the Bangladeshi mobile banking area by providing practical knowledge derived from social media sentiments to improve user experiences and build the mobile banking ecosystem.

5.1 Impact on Society

The study on forecasting consumer satisfaction in Bangladeshi mobile banking using social media platforms has significant implications for society. The study delivers actionable insights that can favorably alter the societal environment by understanding user sentiments.

The findings provide a pulse on the public's experiences, influencing not only the mobile banking market but also larger financial literacy programmes in Bangladesh. Improved mobile banking services driven by customer sentiment can improve functionality and accessibility for various demographics, enabling a more inclusive financial ecosystem.

The study on predicting customer satisfaction in Bangladeshi mobile banking using social media platforms has significant implications for society. The study delivers practical information that can positively modify the societal environment by understanding user sentiments.

Findings from this study provide a pulse on the public's experiences, influencing not only the mobile banking market but also larger financial literacy programmes in Bangladesh. Improved mobile banking services driven by customer sentiment can improve functionality and accessibility for various demographics, enabling a more inclusive financial ecosystem.

5.2 Impact on Environment

The environmental impact of predicting consumer satisfaction in Bangladeshi mobile banking via social media platforms is indirect but significant. The transition towards digital financial services, as affected by social media user approach, contributes to a decrease in paper-based transactions. As mobile banking becomes more popular, the demand for traditional, paper-intensive banking operations decreases, and may result in a drop in paper usage and, as a result, a beneficial environmental impact.

In addition, growing mobile banking adoption might decrease the requirement for physical infrastructure such as bank branches, reducing the environmental impact associated with

development and management. By reducing the carbon footprint generated by traditional banking operations, the promotion of digital transactions links with sustainability aims.

While the primary focus of the research is on user satisfaction and service improvements, the environmental benefits of increased mobile banking adoption lead to a more ecologically conscious and sustainable financial ecosystem in Bangladesh. This is aligned with global initiatives to promote environmentally conscious practices in a variety of regions, including the rapidly changing landscape of digital banking.

5.3 Ethical Aspects

It is necessary to address ethical issues while predicting customer satisfaction in Bangladeshi mobile banking via social media networks. Understanding user privacy is vital, which requires the implementation of ethical data collecting and handling techniques. Maintaining accuracy throughout the study process requires adhering to the terms of service of social media networks. Ethical concerns extend to the ethical application of prediction models. Model training must be transparent, with potential preferences disclosed. The study's ethical approach is highlighted by driving a balance between obtaining important information and protecting user privacy. Another ethical aspect is cultural sensitivity, which recognises Bangladesh's unique linguistic and cultural variations. Collaboration with local specialists ensures that sentiments are interpreted respectfully, reducing the possibility of misrepresentation.

The outcomes of the study must be shared appropriately in order to avoid the maintenance of prejudices or misinformation. Every aspect of the research is guided by ethical concerns, ensuring that the goal of improving customer happiness is consistent with principles of fairness, transparency, and respect for the people who contribute to the social media communication.

Sustainability Plan:

A long-term plan for expecting customer satisfaction in Bangladeshi mobile banking via social media platforms involves a dedication to continued significance, ethical practices, and beneficial societal impact. Continuous monitoring and modification to evolving social media trends will be implemented to ensure the research's influence is available. The sustainability plan will include ethical issues such as privacy protection and compliance with social media platform standards. Transparency in data processing and regular audits will ensure the ethical standards of the research. Collaboration with local experts and interested parties will continue to ensure that cultural subtleties are taken into account, boosting the research's usefulness. The sustainability strategy involves revising the predictive model on a regular basis to keep it in sync with changing user sentiments. Beyond academia, findings will be promoted to mobile banking providers, regulators, and policymakers over time. Recommendations for service enhancements will be distributed in order to promote a sustainable and user-centric mobile banking environment in Bangladesh. The sustainability strategy plans to preserve the positive impact of the research on customer satisfaction and financial inclusion in the Bangladeshi context by including these features.

CHAPTER 6

SUMMARY, CONCLUSION, RECOMMENDATION AND IMPLICATION FOR FUTURE RESEARCH

6.1 Summary of the Study

The study, a detailed investigation into the dynamics of user sentiment in the digital financial landscape is provided by the study on predicting customer satisfaction of mobile banking users from social media platforms in Bangladesh. Using innovative techniques for natural language processing, the study explores a variety of datasets from social media sites like Facebook, Twitter, and community forums. The study breaks down patterns that affect customer satisfaction by classifying attitudes into three categories: positive, negative, and neutral. Collecting information is guided by ethical concerns and privacy security, assuring responsible treatment of user-generated content. Strong data labeling, training machine learning models, and validation processes are all included in the methodology.

A long-term approach is used throughout the research, giving ethical behavior, openness, and ongoing communication with local experts first priority. The study's significance extends simple pleasure prediction; it offers significant perspectives for enhancing mobile banking amenities in Bangladesh. In the dynamic setting of Bangladesh's mobile banking industry, the research sets the groundwork for promoting a more inclusive and user-centric financial experience by conforming to cultural variations and user expectations.

6.2 Conclusions

The study on predicting satisfaction of mobile banking users in Bangladesh using social media platforms reveals vital information for improving digital financial services. The

analysis of sentiment uncovers various patterns that give information on the factors that influence users satisfaction or dissatisfaction. The results of this study highlight the importance of monitoring user sentiments on platforms such as Facebook, Twitter, and local forums, providing the groundwork for strategic improvements in mobile banking services. Ethical considerations, such as maintaining privacy and open data standards, have been central to the research. The results of the research highlight the importance of cultural factors in creating user experiences, pushing financial institutions to modify services to match the particular demands of Bangladeshi customers. The predictive model, which has been trained on a variety of datasets, is a great tool for those who matter, providing useful information for boosting overall customer satisfaction.

Finally, the study contributes not only to the mobile banking sector but also to the larger narrative of digital transformation by stimulating user-centric innovations and generating a more satisfying financial experience for individuals in Bangladesh.

6.3 Implication for Further Study

The study on predicting customer satisfaction of mobile banking customers in Bangladesh using social media platforms builds the groundwork for future research. Future research could investigate the temporal evolution of sentiments, taking into consideration how user satisfaction patterns change over time.

A more in-depth study might look into the impact of particular mobile banking features on customer satisfaction, providing profound understanding into the factors that influence positive or negative sentiments. Furthermore, investigating the relationship between social media sentiments and quantitative indicators of mobile banking performance could provide a clearer overview.

Further research could look into the effectiveness of financial institutions' intervention tactics in response to social media feedback, assessing their impact on customer satisfaction over time.

Further research could look into the effectiveness of financial institutions' intervention tactics in response to social media feedback, evaluating their impact on customer satisfaction over time.

Furthermore, given geographical variances within Bangladesh, investigating cross-cultural aspects of user attitudes and satisfaction could provide comparative information. By addressing these issues, future research can expand on the current study, offering a thorough picture of consumer satisfaction dynamics in Bangladesh's ever-changing mobile banking ecosystem.

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