SENTIMENT ANALYSIS ON PANDEMIC AND CURRENT GLOBAL CONFLICTS: BANGLADESHI ECONOMIC PERSPECTIVE

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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

July 2024

APPROVAL

This Project titled "Sentiment Analysis on Pandemic and Current Global Conflicts: Bangladeshi Economic Perspective", submitted by **M. Mekail** and **Shareair Sakib** 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 13-07-2024.

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We hereby declare that this project has been done by us under the supervision of **Ms. Tania Khatun, Assistant Professor, Department of Computer Science and Engineering, Daffodil International University**. We also declare that neither this project nor any part of this project has been submitted elsewhere for the award of any degree or diploma.

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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. Tania Khatun**, **Assistant Professor**, Department of CSE Daffodil International University, Dhaka. Deep Knowledge & keen interest of our supervisor in the field of "*Machine Learning*" 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

Natural disasters, pandemics, and social unrest are examples of crises that persistently endanger our planet and have a profound emotional impact on millions of people worldwide. We face various challenges in Bangladesh, including the Russia-Ukraine conflict, Israel-Hamas, and the COVID-19 epidemic conflict. These global issues have had a significant impact on the country's economy and have contributed to worldwide inflation. Sentiment analysis using machine learning can provide a fast and accurate alternative to traditional polls for understanding public political opinions. The paper aims to analyze the mental state of the country's youth in light of these events and to quantify the economic impact of these conflicts. This research investigates the socio-economic and psychological impacts of the COVID-19 pandemic, the Russia-Ukraine war, and the Israel-Hamas conflict on Bangladesh, with a particular focus on the country's youth. The study reveals that these global crises have significantly affected Bangladesh's economy, leading to increased inflation rates and economic instability. The research employs various machine learning models to analyze the sentiment of the young population towards these events, using data collected through a comprehensive survey. The findings highlight the profound effects of these crises on the mental health of the youth, providing valuable insights for policymakers and stakeholders. The study underscores the need for robust strategies to mitigate the adverse effects of such global crises on developing economies like Bangladesh. The research contributes to the existing literature by offering a unique perspective on the socio-psychological impacts of global crises on a developing country.

Keywords: Covid-19, Russia-Ukraine War, Israel-Hamas Conflict, Sentiment analysis, Emotion analysis, Economic crisis, Machine Learning.

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ML	Machine Learning
SVM	Support Vector Machine
KNN	K-Nearest Neighbors

CHAPTER 1
Introduction

1.1 Overview

In Bangladesh, we face a multitude of challenges daily. Among them are the far-reaching consequences of global conflicts such as the Russia-Ukraine war, the recent Israel-Hamas conflict, and the COVID-19 pandemic. These international issues, coupled with our nation's long-standing economic difficulties, exacerbate the complexities we navigate regularly. Worldwide conflicts inevitably impact our economy and many other nations, significantly influencing inflation rates.

The interplay between global conflicts and economic health is profound. For instance, the COVID-19 pandemic disrupted supply chains and led to sporadic inflation across various countries. As the world was grappling with the aftermath, the onset of the Russia-Ukraine war in early 2022 further destabilized global economies. This conflict intensified inflationary pressures more than the pandemic had, with significant impacts on commodity prices, especially energy and food. The Federal Reserve [1] noted that by the second half of 2022, geopolitical concerns were projected to raise global inflation by 1.3 percentage points.

The Russia-Ukraine conflict disrupted critical energy supplies, driving up prices for oil and natural gas. This not only affected the European markets heavily dependent on Russian energy exports but also had a ripple effect worldwide, leading to increased costs in transportation and manufacturing sectors. As energy prices soared, so did the costs of goods and services, contributing to a higher inflation rate globally.

Moreover, the recent Israel-Hamas conflict has added another layer of complexity to the global economic landscape. This conflict has particularly impacted oil trade inflation. The Middle East, being a crucial region for oil production, sees its stability significantly influencing global oil prices. Any escalation in the region can disrupt supply routes and create uncertainty in the oil markets, leading to price hikes. This, in turn, increases the cost of energy worldwide, further fueling inflation. In our study, we aim to explore the overall mental environment of young people in Bangladesh amidst these global upheavals. We seek to understand how these international conflicts and

economic challenges are shaping their outlook, mental health, and future prospects. Additionally, we will delve into the statistical and mathematical outcomes of the economic impact of these global events. Through this, we hope to present a comprehensive analysis of the interplay between global conflicts, economic stability, and the mental well-being of the youth in Bangladesh.

Understanding these dynamics is crucial for policymakers, economists, and mental health professionals. By addressing the economic challenges and their mental health repercussions, we can better equip our young population to navigate these turbulent times and build a resilient future.

1.2 Background and Present State

Since the COVID-19 pandemic, the global momentum toward progress has markedly slowed. The world's economy experienced a significant downturn during this period, and Bangladesh was no exception. The first coronavirus [2] case in Bangladesh was detected on March 8, 2020, leading to several months of lockdown. This lockdown severely impacted Bangladesh's economy, causing a sharp increase in the inflation rate. Consequently, the economic crisis hit the lower-middle class particularly hard, exacerbating their financial struggles.

As the world began to recover from the COVID-19 crisis, the Russia-Ukraine war emerged, further destabilizing the global economy. This conflict disrupted supply chains and spiked commodity prices [3], stalling the economic recovery process. Recently, the Israel-Hamas conflict has added yet another layer of inflationary pressure, particularly affecting oil prices. These compounded crises have significantly impacted Bangladesh's economy, leading to various challenges, including heightened inflation rates and economic instability. In light of these ongoing global issues, our research focuses on the sentiments of young people in Bangladesh. We aim to understand their perspectives on these crises and the overall mental environment they experience. Specifically, we will analyze their sentiments to determine the potential outcomes whether negative or positive of their thoughts and feelings about these crises.

This research is crucial as financial volatility poses a significant burden on many households in Bangladesh [4], particularly in the wake of the COVID-19 pandemic and

its aftermath. Economic instability can profoundly impact family well-being, affecting nutrition, education, healthcare, and social mobility. Despite this, there is a notable lack of empirical studies examining the relationship between financial status and family outcomes in Bangladesh, especially those using qualitative methods and longitudinal data. Our study will also delve into the broader impacts of worldwide economic depletion, specifically focusing on the economic effects and causes of the Ukraine-Russia war as they pertain to Bangladeshi people. By studying the impacts of financial instability on poverty and economic development in Bangladesh, we aim to shed light on the underlying causes and use raw data to support our research.

We will analyze and discuss our findings, highlighting how the financial crisis has predominantly affected various segments of the population. By focusing on the young generation, we hope to provide valuable insights into their mental environment and their responses to these global crises. This research will not only help us understand their sentiments but also contribute to developing strategies to support and improve the resilience and well-being of young people in Bangladesh amidst ongoing economic challenges.

1.3 Problem Statement

Economic challenges in burgeoning nations such as Bangladesh are a matter of global concern. These challenges are multifaceted, sprouting from diverse sources such as geopolitical instability, fluctuating global demand for exports, a downturn in remittances, dwindling foreign exchange reserves, and soaring inflation. In this complex scenario, sentiment analysis emerges as a beacon of understanding. Sentiment analysis, often known as opinion mining, is a sophisticated technique used in the fields of machine learning and natural language processing (NLP). It's designed to dissect data and categorize it as positive, negative, or neutral. This technique can be particularly instrumental in gauging public sentiment on economic matters, thereby helping to pinpoint the primary concerns of the populace. Machine learning is the powerhouse that fuels sentiment analysis. It equips computers with the ability to learn from examples of emotions embedded in text, enabling them to autonomously detect sentiment without human intervention. Sentiment analysis can benefit from a variety of machine learning techniques, such as deep learning, unsupervised learning, semi-supervised learning, and

supervised learning. Each of these approaches has benefits of its own and can be chosen based on the specific requirements of the analysis.

In the context of Bangladesh's economic conundrums, sentiment analysis could be employed to scrutinize social media posts, news articles, or other forms of public discourse to comprehend the public's sentiment towards these issues. This could provide invaluable insights for policymakers and economists striving to tackle these challenges.

The outbreak of the Coronavirus (COVID-19) significantly impacted the population of Bangladesh, leading to moral, financial, and economic instability. Those affected faced limited access to healthcare and challenges in running businesses. The pandemic exacerbated existing food insecurity, leaving millions struggling to obtain basic necessities. Initially, people adapted to staying home during the lockdown, but as it extended, anxiety, depression, and mental stress became prevalent.

As Bangladesh began to recover from the COVID-19 crisis, the Russia-Ukraine war brought a new wave of economic challenges. The conflict caused oil prices to soar, leading to increased costs for nearly all products. This resulted in financial stress as people had to cut down on essential groceries, food, and even savings. Additionally, the USD shortage [5] at Bangladesh Bank raised concerns about potential economic instability similar to that experienced by Sri Lanka.

The conflict between Israel and Hamas, which erupted on October 7, 2023,[6] has further complicated the global economic landscape, especially in the oil sector. Geopolitical tensions led to the rerouting of several oil tankers, disrupting traditional transportation routes and triggering a surge in global inflation rates. The effects of this conflict are not confined to Gaza and Israel but extend to other countries, including those in the Middle East and North Africa (MENA) region. For Bangladesh, the rising oil prices may increase the cost of necessities, impacting the daily expenses of the average person. Consequently, the country's inflation rate could also see an upward trend.

This conflict illustrates the interconnectedness of our global economy and how geopolitical events can create a domino effect, influencing economic stability

worldwide. For Bangladesh, already grappling with post-pandemic recovery and the fallout from the Russia-Ukraine war, the additional strain from the Israel-Hamas conflict underscores the challenges of maintaining economic resilience in a volatile global environment. Understanding these impacts is crucial for developing strategies to mitigate the adverse effects on the population and ensure economic stability.

In this research, we are trying to analyze what young people think about the Israel-Hamas conflict. Russia-Ukraine war and COVID-19 and what people think about the compactness of these conflicts. In this study, we will explore the younger generation's perspectives on three major international events: the COVID-19 epidemic, the Russia-Ukraine war, and the Israel-Hamas conflict. We want to comprehend their perspectives, concerns, and understandings of these events, which have unquestionably influenced the society they live in. We are especially curious to know what they think about how these disputes and the epidemic are related, as well as how compact they think they are. This study will shed important light on how young people understand and respond to global crises, which could influence future interventions and policies.

In conclusion, the amalgamation of sentiment analysis and machine learning offers a potent tool for understanding public sentiment towards economic issues in developing countries like Bangladesh. By harnessing these tools, we can delve deeper into these issues and work towards crafting more effective solutions.

1.4 Objective

Since the COVID-19 pandemic, progress worldwide has slowed significantly. The global economy faced a severe downturn during the COVID-19 period, and Bangladesh was no exception. The first coronavirus case in Bangladesh was detected on March 8, 2020, leading to a prolonged lockdown. This lockdown severely impacted the economy, causing a sharp increase in inflation. Consequently, the lower-middle [7] class in Bangladesh faced significant economic hardship.

As Bangladesh began to recover from the COVID-19 crisis, the Russia-Ukraine war brought new economic challenges. This conflict disrupted the global economy, further complicating recovery efforts. Recently, the Israel-Hamas conflict has added additional

inflationary pressures, particularly affecting oil prices. The increased inflation rate has created various economic problems for Bangladesh.

Our research focuses on analyzing the sentiments of young people in Bangladesh regarding these crises. We aim to understand their perspectives and determine whether their thoughts are predominantly negative or positive. This study will provide insights into what young people think about these crises and their mental environment.

Financial volatility poses a significant burden for many households in Bangladesh, particularly in the wake of the COVID-19 outbreak and its aftermath. Economic instability can have profound impacts on various aspects of family well-being, including nutrition, education, healthcare, and social mobility. Despite this, there is a notable lack of empirical studies examining the relationship between financial status and family outcomes in Bangladesh, especially using qualitative methods and longitudinal data.

Our study will also explore the broader impacts of global economic depletion, focusing specifically on the economic effects of the Ukraine-Russia war on Bangladeshi people. By studying the impacts of financial instability on poverty and economic development in Bangladesh, we aim to shed light on the underlying causes and use raw data to support our research. We will analyze and discuss our findings, highlighting how the financial crisis has predominantly affected various segments of the population.

This research is crucial for developing strategies to support and improve the resilience and well-being of young people in Bangladesh amidst ongoing economic challenges. Understanding these impacts will help policymakers, economists, and mental health professionals address the economic and mental health repercussions of these global crises.

1.5 Scope

In this research, we aim to analyze the perspectives of young people on three major international events: the COVID-19 pandemic, the Russia-Ukraine war, and the Israel-Hamas conflict. We are particularly interested in understanding their thoughts on the

interconnectedness of these conflicts and the pandemic. By exploring their concerns and interpretations, we hope to gain insight into how these global crises have influenced their worldview and daily lives.

Our study will delve into the younger generation's viewpoints, examining their perceptions and emotional responses to these events. We aim to uncover how they relate these conflicts and the pandemic to each other and their thoughts on the broader implications. This research will provide valuable insights into how young people comprehend and react to global crises, which could inform future interventions and policy decisions.

The vast amount of data available for this research offers significant potential for psychological analysis but also presents considerable challenges. Handling and processing this data require specialized tools and techniques, as traditional methods may struggle with the volume of information. Utilizing distributed storage and parallel processing frameworks will be essential to manage the data effectively.

Moreover, the sensitive nature of psychological data necessitates careful ethical considerations. Researchers must ensure informed consent, secure storage practices, and appropriate anonymization to protect participants' privacy. Building trust with participants and adhering to strict data privacy protocols is crucial to maintaining the integrity of the research.

Another challenge lies in extracting accurate data from individuals. Responses can be influenced by various biases, such as memory lapses, social desirability, or fatigue during long questionnaires. To mitigate these issues, careful questionnaire design is necessary. Employing a mix of question types and piloting studies with smaller groups can help refine the tools and ensure more reliable data collection.

Understanding the younger generation's perspectives on these global crises will shed light on their mental environment and how they navigate these challenging times. This research will not only contribute to the field of psychology but also provide valuable information for policymakers, educators, and mental health professionals. By addressing the economic and mental health repercussions of these global events, we can

develop strategies to support and improve the resilience and well-being of young people in Bangladesh.

1.6 Report Organization

The suggested report has a thorough format that walks readers through the methodology, conclusions, and ramifications of the study. Every chapter has a distinct function and adds to the document's overall coherence and depth.

Chapter 1: Introduction

The world economy was severely damaged by the COVID-19 pandemic after the first Corona case was found in Bangladesh in March 2020. Lockdowns and rising prices hurt the nation's economy, especially for the lower middle class. The situation is made worse by the ongoing confrontation between Israel and Hamas and the Russian-Ukrainian war. Because of geopolitical worries, the Federal Reserve projects that global inflation will increase by 1.3 percentage points by 2022.

Chapter 2: Literature Review

literature review discussing the financial status of families in Bangladesh and its impact on their well-being. It highlights the high poverty rate and its consequences, such as limited access to essential services and social exclusion. The chapter also discusses the psychological impact of financial instability, including increased stress, depression, and social isolation. In the related works section, it discusses the use of sentiment analysis in studying the impact of the COVID-19 pandemic. It mentions several studies that used deep learning-based language models to analyze public sentiment on Twitter during the pandemic. The research examined several models for the job of sorting attitudes into categories such as positive, negative, and neutral.

Chapter 3: Research Methodology

The method used to carry out the study is described in the research methodology chapter. It sheds light on the model architecture, data gathering techniques, study design, and the reasoning behind particular methodology selections. The ethical issues and potential constraints on the investigation are also covered in this chapter.

Chapter 4: Implementation

The experimental findings from the several Machine-Learning algorithms used to analyze Bangladeshi people's sentiments are presented in this chapter. Comprehensive evaluations of the effectiveness of various detection and segmentation techniques are offered, accompanied by graphical depictions and statistical metrics to corroborate the results.

Chapter 5: Result and Analysis

In this section, we discuss how the experimental dataset undergoes thorough preprocessing, cleaning, and feature scaling to ensure high-quality inputs for machine learning models, enhancing their predictive capabilities. The research employs multiple machine-learning classification models to refine sentiment analysis, analyzing the strengths and weaknesses of each approach.

A comparative analysis of several pre-trained machine learning architectures, including SVM, Random Forest, Decision Tree, KNN, and Naive Bayes, reveals that KNN, Random Forest, and SVM achieve the highest accuracies of approximately 75%, 74.3%, and 73.7%, respectively. These models handle sentiment analysis on raw datasets effectively. Naive Bayes and Decision Tree show slightly lower accuracies of around 70%. The variation in accuracy underscores the importance of selecting the appropriate machine-learning model for sentiment analysis to ensure accuracy and reliability, with KNN excelling due to local pattern identification, Random Forest's ensemble technique, and SVM's hyperplane optimization.

Chapter 6: Impact on Society

These issues' social effects on Bangladeshi youth include the disruption of work and education brought on by COVID-19, increased geopolitical awareness and worries about the stability of the international community in light of the Russia-Ukraine war, and the promotion of activism and solidarity in addition to widening social divides brought on by the Israel-Hamas conflict.

Chapter 7: Summary, Conclusion, Recommendation, and Implications for Future Research

The whole report is summarized in this last chapter. It provides recommendations for real-world applications and more research in addition to summarizing the main results

and restating the research's conclusions. The implications for more research are examined, offering a path forward for scientists who wish to build on the present work.

The person studying is guided through the study process from the introduction to the wider implications and suggestions by this organized arrangement, which guarantees a logical flow of information. It makes it possible to have a thorough grasp of the study methodology and how it could affect sentiment detection with machine learning from an academic and practical standpoint.

1.7 Summary

Since the coronavirus pandemic began, people worldwide have slowed down significantly. The global economy suffered greatly during the pandemic, and Bangladesh was no exception. The first COVID-19 case in Bangladesh was detected on March 8, 2020, leading to a prolonged lockdown. This lockdown severely impacted the economy, causing a sharp increase in the inflation rate. The lower-middle class in Bangladesh faced a serious economic crisis during this period. As the world began to recover from the pandemic, the Russian-Ukrainian war further destabilized the global economy. The ongoing Israel-Hamas conflict has added additional pressure, exacerbating inflation rates. Consequently, Bangladesh's economy faces several challenges due to rising inflation. Issues such as COVID-19, the Russia-Ukraine war, and the Israel-Hamas conflict have significantly impacted both the economy and the mental health of young people. The Federal Reserve indicated that by the second half of 2022, geopolitical concerns pushing up prices could cause global inflation to rise by 1.3 percentage points. The Israel-Hamas conflict, in particular, has exacerbated inflation in the global oil sector, further straining economies worldwide. These international conflicts have created a challenging environment for Bangladesh, highlighting the interconnectedness of global events and their far-reaching economic impacts.

In summary, this study explores the views of young people on the COVID-19 pandemic, the Russia-Ukraine war, and the Israel-Hamas conflict, focusing on their perceptions of the interconnectedness of these events. The research highlights the challenges of handling large-scale psychological data and the importance of ethical

considerations in data collection. Ultimately, the findings will inform future interventions and policies to better support the younger generation in navigating global crises.

CHAPTER 2
Background

2.1 Overview

The financial status of families in a developing country, such as Bangladesh, can have significant consequences on the overall well-being of individuals and the country as a whole. Several studies have been conducted on this topic, highlighting the impact of financial instability on various aspects of life in Bangladesh. One of the major challenges that families in Bangladesh face is poverty. According to the World Bank, approximately 18.7% of the population of Bangladesh lives below the national poverty line [8]. Bangladesh's high rate of poverty negatively impacts families' financial situation by preventing them from accessing basic services and products like clean water, healthcare, and education. Poverty [9] can also result in social isolation as impoverished families might not be able to engage in certain social and economic activities. Poverty may increase depression and anxiety which affect mental health.

Anxiety and long-term stress get worse by the ongoing pressure to manage debt, pay bills, and fulfill financial obligations. This ongoing financial insecurity can worsen depressive symptoms by creating a sense of worthlessness and hopelessness. When people find it difficult to keep up relationships or participate in activities, social isolation may result. Financial difficulties can also impair one's performance at a job or at school, which feeds the cycle of stress and mental health issues. Breaking this loop and creating plans to manage and lessen the negative effects of financial concerns on well-being require expert assistance, both in the form of financial guidance and mental health support.

2.2 Related Works

Recent years have seen the emergence of sentiment analysis as a potent tool with a wide range of applications, partly because of the enormous volume of data collected from multiple platforms. In order to assess public opinion, feelings, and sentiments mostly in English this method has proven especially helpful in researching the effects of the COVID-19 pandemic. One study examined the themes and opinions that users

of Twitter had to say about COVID-19. The scientists gathered and categorized tweets regarding COVID-19, classifying them as neutral, negative, or favorable. This section covers a number of research papers that use deep learning and machine learning methods to analyze sentiment on COVID-19-related Twitter data. The techniques include LSTM, BD-LSTM, BERT, and other models. These studies focus on classifying sentiments into categories like positive, negative, and neutral. In certain research, the effectiveness of deep learning models and conventional machine learning classifiers is also contrasted. The time periods for these studies range from the early months of the pandemic to over a year later, providing insights into the public sentiment during different phases of the pandemic. The studies highlight the effectiveness of these techniques in understanding the context and sentiment of the text data, with some achieving high accuracy rates. The text also mentions the use of different feature extraction methods and transfer learning classifiers. Overall, this research shows the promise of deep learning and machine learning in sentiment analysis and add to our understanding of public opinion during the COVID-19 pandemic.

In response to the rise in newly reported COVID-19 instances in India, Rohitash Chandra et al. [10] describe a system that implements deep learning-based language models for sentiment analysis using long short-term memory (LSTM) recurrent neural networks. The authors perform multi-label sentiment classification on tweets gathered between March and September 2020 using LSTM, BD-LSTM, and BERT language models. They contrast the monthly opinions expressed about India with those of Delhi and Maharashtra, two states with significant COVID-19 case counts. The bulk of the tweets, according to the authors, were optimistic and cheerful, with low levels of negative sentiments like melancholy and anxiety.

Vernikou et al. [11] seem to focus on classifying the sentiments of Twitter posts into three categories: negative, neutral, and positive. This is achieved by utilizing seven different deep learning models that are built on Long Short-Term Memory (LSTM) neural networks. The paper's comparison of these deep learning models with conventional machine learning classifiers is intriguing. Language processing and analysis of the data is done using Natural Language Processing (NLP) techniques. Understanding the context, semantics, and sentiment of the text data is made easier

with the aid of this vital phase in sentiment analysis. The time period examined (from March to mid-April 2020) is also significant as it was a time when the pandemic had a global impact, and understanding the sentiment of the public during this time could provide valuable insights.

Jim Samuel et al. [12] researched R statistical software and its sentiment analysis tools to evaluate publicly available Twitter data pertaining to coronavirus, which were gathered during February and March of 2020. Additionally, the article uses logistic regression and Naïve Bayes machine learning (ML) classification techniques to categorize coronavirus tweets into positive and negative sentiment categories. The research charts the rise in dread sentiment as COVID-19 neared peak levels in the US and finds that, with an accuracy of 91%, Naïve Bayes performs better at identifying brief tweets than logistic regression, which offers a respectable accuracy of 74%.

Sosea et al. [13] conduct a thorough examination of the expression of emotions in COVIDEMO, highlighting the psychological impact of COVID-19, how it differs from natural disasters, and how themes and emotions change over time.The COVIDEMO dataset, which spans 18 months and includes approximately 3,000 English tweets annotated with Plutchik-8 emotions, is presented by the authors. The authors examine the emotion distribution, co-occurrence, and association with content words and hashtags in COVIDEMO. They find that negative emotions are more prevalent than positive ones and that emotion distribution varies significantly over time. They also identify topics and events that are related to different emotions using latent Dirichlet allocation (LDA).

N. Yeasmin et al. [14] analyze the tweets on the COVID-19 epidemic, the research article in question provides a thorough analysis. To categorize feelings into good, negative, and neutral groups, the authors use a range of deep learning and machine learning models1. Logistic regression, SVM, naive Bayes, k-NN, decision tree, random forest, CNN, XGBoost, and LSTM are among the models that are employed. The study also examines other feature extraction methods, including GloVe, Word2Vec, TF-IDF, and bag-of-words. The findings show that deep learning models perform better than machine learning models in general, with the LSTM model combining with Word2Vec to achieve the maximum accuracy of 99.88%. With an accuracy of 97.11%, the random forest model performs similarly as well.

Mahmud Hasan et al. [15] suggest experimenting with different transfer learning classifiers, starting with a Bi-LSTM model as a baseline and going up to multilingual BERT, DistilBERT, XLM-RoBERTa, and BanglaBERT. Additionally, it shows the optimizers, criteria, and network training parameters that are utilized to fine-tune the models. Furthermore, with an F1 score of 0.82, the top-performing model had the highest accuracy, at 86%. BanglaBERT performs better than the baseline and every other transformer-based classifier in terms of accuracy, F1 score, and AIC. The authors want to make their dataset publicly available for additional study, claiming it to be the first of its sort for sentiment analysis in the context of the conflict between Russia and Ukraine.

Abdullah Al Maru et al. [16] introduced the topic of emotion detection from text, which is a challenging and important task in human-machine interaction, economic contexts, and decision-making. They are using supervised machine learning classifiers such as Naive Bayes, Logistic Regression, Decision Trees, and SVM. The ensemble method of boosting is also applied using algorithms such as AdaBoost, gradient boost, and XGBoost to improve the accuracy of emotion detection.

Ganesh Kumar Wadhwani et al. [17] aimed to examine the public perceptions and opinions of the crisis using social media data. The paper collects 11,250 tweets related to the war using SNSCRAPE API and applies TextBlob to label them as positive, negative, or neutral. It then uses three feature extraction techniques (BoW, TF-IDF, and N-gram) and nine machine learning models (RF, LR, DT, SVM, XGB, GNB, ADA, KNN, ETC) to classify the tweets' sentiments. The paper finds that the ETC model achieves the highest accuracy of 0.84 with BoW features, followed by the XGB model with 0.83 accuracy. Additionally, the study analyzes the models' performances using several assessment measures and talks about the ramifications of the results.

Bilal et al. [18] compare the effectiveness of their new fuzzy time series model with various forecasting techniques like ARIMA, ANN, SVM, and XGBoost in order to predict changes in WTI crude oil prices throughout the conflict. The recommended model, according to the paper, predicts more accurately than the other methods and points to a future trend of declining WTI crude oil prices, which is excellent news for global trade. The article also examines the effects of geopolitical shocks, wars, and conflicts on oil prices, financial markets, and economic growth, as well as the use of fuzzy time series models for forecasting.

Kai et al. [19] suggest an analytical study to analyze public opinion toward the Israeli-Palestinian conflict using Israeli political Twitter data. Three machine learning techniques are used in the document: Naïve Bayes (NB), Decision Tree (DT), and Support Vector Classifier (SVC) to classify the tweets into positive, neutral, and negative sentiments. It also uses Bag of Words (BoW) to represent the text data as vectors. The document uses a number of metrics, including precision, recall, and F1 score, to present the sentiment analysis results. It demonstrates that out of the three algorithms, Naïve Bayes (NB) achieves the highest accuracy of 93.21%.

Rizqika Mulia Pratama et al. [20] describe the process of scraping Twitter data using keywords such as “Hamas”, “Gaza”, “Palestine”, and “Israel”, and then constructing a decision tree based on the presence or absence of specific words in the tweets. Along with several instances of tweets and their classifications, the paper also includes a graphical depiction of the decision tree.

Iyad Al-Agha et al. [21] The study shows how various data mining methods might be applied to acquire a more comprehensive and detailed understanding of public opinion. The study demonstrates that traditional sentiment analysis might not be sufficient for determining political polarization and addresses the unique issues of political sentiment analysis. Using data from Twitter, they conduct an analytical study to gauge public opinion regarding the political standing of the Palestinian-Israeli issue. They use an innovative model that makes use of both individual and national levels of analysis. Every level investigates distinct facets of public opinion using diverse forms of study.

There are a few journals, and articles about the Israel-Hamas conflict based on economic consequences. We found information and data from various websites. According to their study, there will be an effect on the global economy as well as people’s mental health. This tragedy decreases peace and increases anxiety. From the study, they claimed the world's oil price increased by more than 5$ per barrel. For this reason, people's daily expenses are getting higher. Rising energy costs would not only negatively affect economic activity but also make the work of central banks worldwide more difficult.

2.3 Comparative Analysis and Summary

Table 2.3.1. Comparative analysis with previous work

SL	Author Name	Used Algorithm	Best Accuracy with Algorithm
1.	Rohitash Chandra, Aswin Krishna	LSTM, BD-LSTM, and BERT	Jaccard Score 57.1%
2.	Sotiria Vernikou, Athanasios Lyras, Andreas Kanavos	Naïve Bayes, Decision Tree, Random Forest, combined with Tf-Idf and bag of words techniques	LSTM 90%
3.	Jim Samuel, G. G. Md. Nawaz Ali, Md. Mokhlesur Rahman, Ek Esawi,Yana Samuel.	Naïve Bayes, Logistic Regression	Naïve Bayes 91%
4.	Hasan-et-al	BanglaBERT, XLM-RoBERTa-base, XLM-RoBERTa-large, Distil mBERTandmBERT	Accuracy 86% with 0.82 F1 score
5.	Abdullah Al Maruf, Zakaria Masud Ziyad2, Md. Mahmudul Haque Fahima Khanam	Logistic Regression, Decision Tree, Naive Bayes, SVC, BOOSTING METHODS	Accuracy 89%
6.	Ganesh Kumar Wadhwani , Pankaj Kumar Varshney, · Anjali Gupta · Shrawan Kumar	(BoW, TF-IDF, and N-gram) and nine machine learning models (RF, LR, DT, SVM, XGB, GNB, ADA, KNN, and ETC)	Accuracy 84%
7.	Nilufa Yeasmin , Nosin Ibna Mahbub , Mrinal Kanti Baowaly , Bikash Chandra Singh 1, Zulfikar Alom , Zeyar Aung and Mohammad Abdul Azim	TextBlob, Bag-of-words (BoW), Term Frequency-Inverse Document Frequency (TF-IDF), Logistic Regression, Support Vector Machine, Naïve Bayes, k-Nearest Neighbors, Decision Tree, Random Forest, and XGBoost, DL	Accuracy 97.11%
8.	Tiberiu Sosea ,Chau Pham, Alexander Tekle, Cornelia Caragea, Junyi Jessy Li	Semi-supervised learning algorithm	Accuracy 60%
9.	Amisha Gangwar1 and Tanvi Mehta	Support Vector Classifier (SVC), Decision Tree (DT), and Naïve Bayes (NB)	Naive bayes 93.21%
10.	Muhammad Bilal, Muhammad Aamir, Saleem Abdullah, Faisal Khan,	Fuzzy Time Series (FTS), Autoregressive Integrated Moving Average (ARIMA), Artificial Neural Networks (ANN), Support Vector Machine (SVM), XGBoost	Accuracy 100%
11.	Iyad Al-Agha and Osama Abu-Dahrooj	Stanford CoreNLP , SentiStrength , Pre-trained LingPipe	Accuracy 80.63%

SL	Author Name	Used Algorithm	Best Accuracy with Algorithm
12.	Hadi Jahanshahi, Süleyman Uzun, Sezgin Kaçar, Qijia Yao and Madini O. Alassaf	Support vector machine (SVM), Linear regression (LR), Random forest (RF)	Accuracy 92.2%

2.4 Open Issues

Unlike previous studies that primarily focused on sentiment analysis using public social platforms like Twitter and Facebook, our research aims to take a deeper dive into understanding the nuanced sentiments across different demographic groups. Beyond categorizing sentiments into positive, negative, and neutral, we seek to explore the specific thoughts and emotional responses of distinct groups such as men, women, and Twitter users.

A novel aspect of our study is the exploration of the mental health implications stemming from major global events. We intend to uncover the levels of anxiety and depression exacerbated by crises such as COVID-19, the Russia-Ukraine War, and the Israel-Hamas Conflict. These events have not only triggered economic hardships but also profound psychological distress among affected populations.

Our research will specifically focus on the young population of Bangladesh, aiming to provide a detailed and focused perspective. By doing so, we hope to uncover insightful trends and patterns that could illuminate how these global crises impact the socio-psychological well-being of young people in Bangladesh.

By shedding light on the multifaceted impacts of global events on individual mental health and societal sentiment, this study aims to make a timely and significant contribution to the field. It seeks to advance our understanding of how economic challenges compounded by geopolitical tensions affect mental health outcomes in specific demographic contexts. This holistic approach may offer valuable insights for policymakers, mental health professionals, and researchers striving to mitigate the adverse effects of global crises on vulnerable populations.

Overall, our research endeavors to make a timely and substantial contribution to the field, illuminating the multifaceted impacts of global events on mental health and societal perceptions.

2.5 Summary

In the Literature Review section, we delve into a comprehensive gap analysis, meticulously examining related works and drawing insightful comparisons with existing research. Our focus centers on the sentiment analysis of international events that significantly impact Bangladesh. Specifically, we dissect the Israel-Hamas conflict, the Russia-Ukraine crisis, and the ongoing COVID-19 pandemic.

To gauge public opinion, we employ a diverse array of machine learning models. Notably, we direct our attention to the implications of these events on the mental health of Bangladeshi youth. Among the standout studies, machine learning-based algorithms on Twitter reveal positive sentiments related to COVID-19—a crucial insight in these challenging times. Furthermore, our research delves into transfer learning classifiers within the context of Russia and Ukraine. We meticulously explore how the conflict dynamics between Israel and Hamas reverberate through both the economy and mental well-being. Our distinctiveness lies in our ability to classify attitudes, unravel demographic nuances, and probe the intricate implications for mental health. Through this gap analysis, we significantly advance our understanding of the socio-psychological effects, enriching the discourse with valuable insights.

CHAPTER 3
Research Methodology

3.1 Overview

This study delves into the hearts and minds of Bangladeshi youth, exploring their emotional responses to major world events. We leverage the power of machine learning to analyze their sentiments towards the COVID-19 pandemic, the Ukraine-Russia conflict, and the Israel-Hamas conflict.

Through a targeted survey, we captured the opinions and feelings of a specific demographic of young Bangladeshis. The raw data, brimming with their unfiltered voices, underwent meticulous preprocessing to prepare it for the analytical spotlight. Several machine learning models, like sophisticated AI apprentices, were then trained on this refined data. We meticulously evaluated their performance, selecting the one that delivered the most accurate and insightful results. This champion model became our key to unlocking the emotional landscape of Bangladeshi youth.

Armed with this powerful tool, we embarked on sentiment analysis, a process that unveils the emotional undercurrents within the survey responses. By deciphering the positive, negative, or neutral sentiment expressed by the youth, we gained a profound understanding of how these global events resonated with them. This study offers a unique window into the emotional lives of Bangladeshi youth, providing valuable insights for policymakers, social scientists, and anyone seeking to understand the perspectives of this crucial generation.

3.2 Proposed Methodology

In the methodology proposed in this study, we present an innovative approach to implementing the concepts outlined in the referenced paper. The COVID-19, Russia-Ukraine war, and Israel-Hamas conflict have had a profound impact on people's happiness. These global events have also led to an increase in negative emotions such as stress, anxiety, fear, sadness, and loneliness. The economic impact of these global events has been severe, with financial sanctions, fluctuating commodities prices, and supply-chain disruptions causing instability.

We focus on finding out how many people think they are happy or sad and how many people think they are stabilizing economic problems due to COVID-19, the Russia-Ukraine war, and the Israel-Hamas conflict. Our proposal is centered around conducting a series of experiments utilizing a diverse set of machine learning classifiers.

Naive Bayes: A probabilistic classifier that applies Bayes' theorem with the assumption of independence among predictors. Naive Bayes is simple and effective, making it a good starting point for classification tasks.

Decision Tree: This classifier uses a tree-like model of decisions. It's intuitive and easy to visualize, making it a popular choice for exploratory analysis.

Linear Regression: a statistical method for simulating the correlation between one or more independent variables and a dependent variable. It takes for granted that input and output have a linear connection.

Logistic Regression: Despite its name, logistic regression is a binary classification algorithm. It models the probability of the default class.

K-Nearest Neighbors (KNN): An instance-based learning algorithm that classifies cases based on their similarity to other cases. In KNN, data points that are near each other are said to be 'neighbors'.

Support Vector Machine (SVM): A powerful classifier that works by finding a hyperplane that best separates the classes. Because numerous Kernel functions may be selected for the decision function, support vector machines (SVMs) are both adaptable and effective in high-dimensional environments.

We aim to compare and contrast the performance of these classifiers to identify the most effective one for our specific use case.

Before beginning the implementation phase, we will collect users' raw data. after which the raw data was processed and divided into two sets: a test set and a training set. Before testing the train data, we train the train set of raw data. Following training, we test the test data using the following algorithms: Logistic Regression, Decision Tree, Naive Bayes, K-Nearest Neighbors, Support Vector Machine, and Linear Regression.

Datasets:

For this project, we've curated a raw dataset sourced directly from individuals and online surveys. Following rigorous data collection, we've meticulously divided the dataset into distinct train and test sets using segmentation methods. However, our process doesn't end there. We delve deeper into the dataset through comprehensive exploratory data analysis (EDA), unraveling intricate patterns and anomalies. Additionally, we engage in feature engineering, crafting novel features and refining existing ones to bolster model predictive capabilities. Regularization techniques are also employed during model training to combat overfitting, ensuring robustness and generalizability. This iterative approach guarantees the project's resilience and efficacy in real-world scenarios.

Data Collection: This is the first step where we gather raw data from two sources.

1. **Direct from individuals:** through interviews, observations, or any method where data is obtained directly from the person. This data is often primary and qualitative, providing rich, detailed information.
2. **Internet survey forms:** Online surveys are a great way to reach and engage with a large audience. We use online forms for taking responses and gathering data for research purposes.

Data Pre-processing:

In this stage, we worked with gathered data to transform raw data into a format suitable for training models.

- **Data cleaning:** Data cleaning is a vital phase where we address missing and null values in the dataset. By systematically handling these inconsistencies, we ensured the integrity and completeness of our data, setting a solid foundation for subsequent analysis and model training.
- **Feature Scaling:** Feature scaling was pivotal as it facilitated the conversion of textual data into numerical representations. This transformation ensured compatibility with machine learning algorithms, enabling seamless analysis and enhancing model effectiveness in interpreting and deriving insights from the data.

- **Train and test data split:** We divided the dataset into two separate portions during the train and test data split phase: the training set, which we used to train machine learning models, and the test set, which we kept for evaluating model performance on untested data. This systematic division enabled us to gauge the model's generalization ability and ensure its efficacy in real-world scenarios, enhancing confidence in its predictive capabilities and deployment readiness.

Model Application: The model is prepared to forecast fresh data after testing. We employ a number of methods, including Decision Trees, Logistic Regression, K-nearest neighbors, Support Vector Machine, and Naïve Bayes.

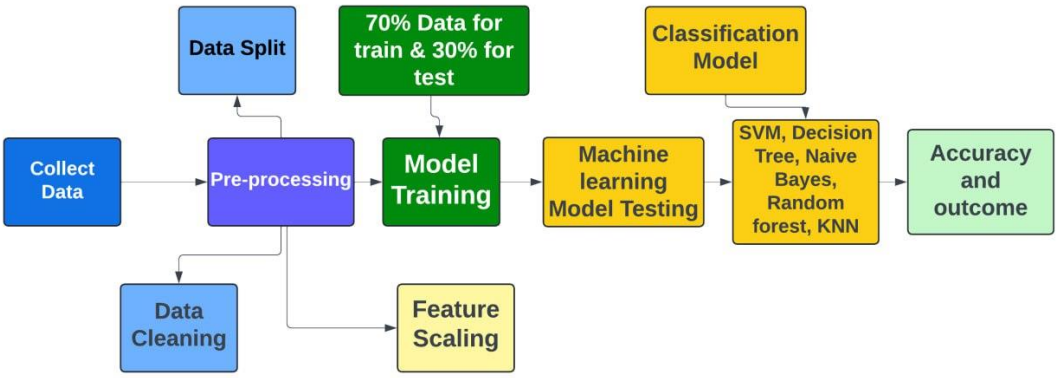


Fig. 3.2.1 Proposed methodology and flow diagram of our work

3.3 Hardware and Software Requirement

The requirements for implementing the research on "SENTIMENT ANALYSIS ON PANDEMIC AND CURRENT GLOBAL CONFLICS: BANGLADESHI ECONOMIC PRESPECTIVE" involve both hardware and software components. Hardware requirements may include adequate computing resources to handle data processing and model training tasks efficiently. Software requirements encompass the necessary machine learning libraries, programming languages, and analysis tools tailored to sentiment analysis tasks. Additionally, considerations for data collection methods, such as accessing reliable sources and ensuring data integrity, are crucial. Model evaluation entails implementing appropriate metrics and techniques to assess

the performance and validity of sentiment analysis models accurately. Overall, meticulous planning and adherence to these implementation requirements are essential for the successful execution of the study, enabling researchers to derive meaningful insights from the data.

Hardware Requirements:

- **High-end computing resources:** Availability of a computing infrastructure with enough RAM and processing capacity to manage the intricate tasks associated with visual analysis and machine learning.

- **Graphics Processing Unit (GPU):** Model creation times can be greatly decreased by using a GPU to speed up machine learning and visual representation training.

Software Requirements:

- **Machine learning frameworks:** Popular machine learning frameworks like Scikit-learn is extensively utilized for developing, training, and evaluating classification models. These frameworks offer versatile tools and comprehensive implementations, empowering researchers to tackle various classification tasks efficiently and effectively.
- **Python programming language:** Python is a popular and flexible programming language that may be used to create machine learning algorithms and carry out data analysis.
- **Data visualization libraries:** integration of matplotlib, seaborn, and other data visualization frameworks.

3.4 Project Management and Financial Analysis

To identify mental health conditions, we need to have a parameter to conduct the research. We have already discussed this with a psychologist about the questionnaires about the difficulties they face and their mental conditions during COVID-19, Russia-Ukraine, and Israel-Hamas conflicts. As we have planned to collect data from individuals, we would like to create a Google form full of questionnaires approved by Rakibul Hasan Sourov, Psychologist, Daffodil International University. From the

following questionnaires, we will collect data through online QR codes and offline printed questionnaires. The online form will fetch the data directly into the Excel sheet and the offline data will be filled up manually into the Excel sheet.

Table 3.4.1: Estimated Cost for Machine Learning-based Project

SN	Components	Estimated Cost (BDT)
1	Visiting Stakeholders	500-1000
2	Data Collection and Processing	1000-1200
3	Documentation and Report Writing	500-600
4	Miscellaneous (e.g., travel cost)	500
	Sub-Total Estimated Cost	**2500-3300**
5	Contingency (10% of total)	250-330
	Total Estimated Cost	**2750-3630**

3.5 Summary

This research project sheds light on the perceptions of Bangladeshi youth regarding critical international events like COVID-19, the Russia-Ukraine conflict, and the Israel-Hamas struggle. It leverages the power of machine learning to unlock their thoughts and feelings.

We target young people through surveys, specifically designed to capture the psychological and financial impacts these events have had. To analyze the sentiment behind their responses, we propose a multi-pronged approach utilizing various machine learning classifiers. These include powerhouses like Naive Bayes, Decision Trees, and Support Vector Machines (SVM).

Understanding these events' socioeconomic and psychological effects is crucial for policymakers. The beauty of this methodology lies in its affordability. Data collection can be done through online or paper questionnaires, with estimated costs not exceeding 3630 BDT (around $42 USD).

CHAPTER 4
Implementation

4.1 Overview

This study examines Bangladeshi youth sentiment about the COVID-19 epidemic, the conflict between Russia and Ukraine, and the conflict between Israel and Hamas using a range of machine learning models. We gather information by means of a survey, focusing on a particular group of young people. The purpose of the poll was to ascertain their thoughts and feelings on the previously mentioned international events. When there is insufficient data for machine learning models to train on and perform better, data augmentation technologies are sometimes used to solve the issue. The experimental setup for the research on "SENTIMENT ANALYSIS ON PANDEIC AND CURRENT GLOBAL CONFLICTS: BANGLADESHI ECONOMIC PERSPECTIVE" is meticulously designed to ensure robustness and reliability in analyzing sentiments from an economic perspective. Large datasets and sophisticated machine learning algorithms may be processed quickly and effectively thanks to high-performance hardware, which is built around a powerful central processing unit (CPU) and a strong graphics processing unit (GPU). To accommodate the computational demands of our research, we ensured that our system met the requirements stipulated by Jupyter Notebook: 512 MB of RAM, 1 GB of disk space, and 0.5 CPU cores per user. Additionally, we allocated resources for server overhead, including 2–4 GB of RAM or 10% system overhead (whichever is larger), 0.5 CPU cores, and 10 GB of disk space. The system also had enough GPU power to visualize graphical data.

Sophisticated machine-learning models can be implemented using Python programming environments and machine-learning frameworks such as Scikit-learn. These frameworks enable researchers to experiment with different categorization strategies and hone models for sentiment analysis by providing an extensive range of tools and functions for model construction, training, and evaluation.

The experimental dataset, meticulously sourced from individual sources, undergoes rigorous preprocessing, data cleaning, and feature scaling to ensure consistency and representativeness. This preparatory phase is crucial for providing high-quality inputs to the machine learning models, enhancing their predictive capabilities and generalization performance.

Furthermore, the incorporation of multiple machine learning classification models plays a pivotal role in fine-tuning sentiment analysis. By exploring various algorithms and methodologies, researchers can gain insights into the strengths and weaknesses of different approaches, ultimately enhancing the accuracy and interpretability of sentiment analysis results.

Throughout the experimentation process, detailed documentation is maintained, encompassing code specifics, model architecture, hyperparameters, and results. This documentation fosters transparency, reproducibility, and future collaboration, enabling researchers to build upon and validate the findings in the domain of advanced sentiment analysis, contributing to advancements in economic research and decision-making.

4.2 Train Model

In this pivotal step, we embark on creating a machine learning model, leveraging a diverse array of algorithms including SVM, Decision Tree, Naive Bayes, Random Forest, and KNN. Our approach involves utilizing the dataset for model training and evaluating its classification accuracy across these methodologies. Initially, we allocated 70% of the dataset for training purposes, reserving the remaining portion for rigorous testing. This deliberate split ensures a robust evaluation process, enabling us to accurately ascertain the model's performance on unseen data. By subjecting our model to various algorithms and meticulous testing, we aim to identify the optimal solution for our project. This comprehensive methodology empowers us to uncover nuanced insights, gauge the efficacy of different approaches, and ultimately derive the best outcome, poised to address the objectives and challenges inherent in our project with precision and efficacy.

Data Acquisition:

There are two different kinds of data collection modules for this dataset which we were trying to establish. In the online survey form, we have gathered data by sharing Google form’s link with a number of groups of people. On the other hand, in the offline survey, we try to collect data from individual.

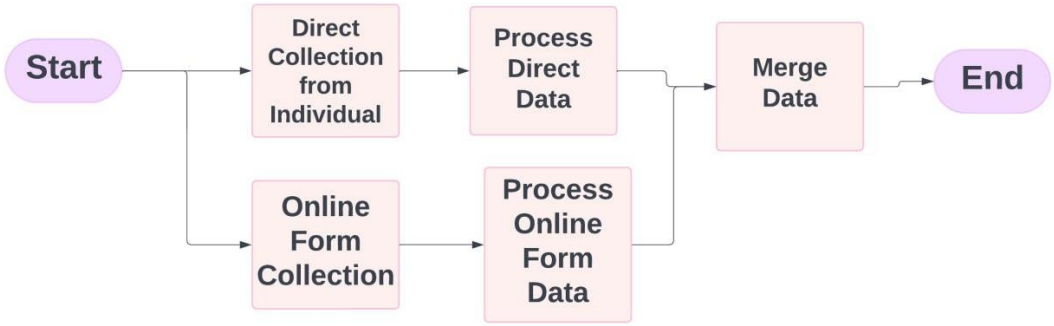


Figure 4.2.1: Process of data collection

Table 4.2.1, A 30-question survey used to gather data for sentiment analysis on COVID-19, the Russia-Ukraine War, and the Israel-Hamas Conflict from Bangladesh's point of view. The organized survey that was utilized to learn about the reactions and ideas of Bangladeshi participants on three major international events the Israel-Hamas conflict, the Russia-Ukraine war, and the COVID-19 pandemic is shown in this table. Using the perspective of Bangladesh, the 30 questions are designed to provide an extensive overview of public opinion on these matters.

Table 4.2.1: Online Survey form converted into table

SN	General Questions	Answers							
1	In which part of Bangladesh do you live?	Dhaka	Chattogram	Khulna	Rangpur	Mymensingh	Barisal	Sylhet	Rajshahi
2	What is your age group?	<18	18-25	26-35	36-45	46-55	55>		
3	What is your occupation?	Student	Government Job	Private Job	Business	Others			
4	Do you approve of the current state of the war?	Yes	No	No Comments					

5	***Are you happy with COVID-19, RUSSIA-UKRAINE WAR, AND ISRAEL-HAMAS CONFLICTS respecting future or current Bangladeshi economic concerns?***	Yes	No						
6	How much do you know about the Russia-Ukraine war?	Much Informed	Somewhat Informed	Not very informed	Not informed at all				
7	Due to israel-hamas conflict, what do you think we may lose?	Economic Stability	Peace interrupt	Increase Poverty	Other				
SN	**Sentimental Questions**	**Answers**							
8	How would you describe your overall mood and outlook on life compared to before the COVID-19 pandemic? (Scale 1-5, 1=Worst, 5=Best)	1	2	3	4	5			
9	How satisfied are you with the government's response to the pandemic? (Scale 1-5, 1=Very Unsatisfied, 5=Very Satisfied)	1	2	3	4	5			
10	Has the pandemic impacted your sense of hope and optimism for the future?	Yes	No	Unsure					
11	Do you feel more anxious or stressed than before the pandemic?	Yes	No	Unsure					
12	Have you experienced any feelings of isolation or loneliness as a result of the pandemic?	Yes	No	Unsure					
13	Have you had to make any major changes to your spending habits due to the pandemic?	Yes	No						
14	Are you concerned about your ability to afford basic necessities like food and housing?	Yes	No	Unsure					

15	Has the pandemic affected your daily routines and activities?	Yes	No						
16	Have you made any significant changes to your work or education due to the pandemic?	Yes	No						
17	Have you participated in any new hobbies or activities as a result of the pandemic?	Yes	No						
18	How do you feel about the Russia-Ukraine war overall? (Scale 1-5, 1=Worst, 5=Best)	1	2	3	4	5			
19	How worried are you about the potential economic impact of the Russia-Ukraine war on Bangladesh? (Scale 1-5, 1=Worst, 5=Best)	1	2	3	4	5			
20	Do you feel that the war has made you more anxious or stressed about the future?	Yes	No	Unsure					
SN	**Financial Questions**	**Answers**							
21	Has your income or financial situation changed significantly since the pandemic began?	Yes	No						
22	If yes, has your income?	Increased	Decreased	Remained Same					
23	Have you received any government assistance or financial support during the pandemic?	Yes	No						
24	How satisfied are you with the government's response to the pandemic? (Scale 1-5, 1=Very Unsatisfied, 5=Very Satisfied)	1	2	3	4	5			
25	Have you noticed any changes in the prices of goods or services in your daily life?	Yes	No						
20	Has your income or financial situation changed since the beginning of the war?	Yes	No						

26	Have you made any changes to your spending habits due to the war?	Yes	No						
27	Do you expect the war to have a long-term impact on the Bangladeshi economy?	Yes	No	Unsure					
28	Have you taken any steps to prepare for potential economic hardship due to the war?	Yes	No						
29	How confident are you in the government's ability to manage the economic impact of the war? (Scale 1-5, 1=Worst, 5=Best)	1	2	3	4	5			
30	Do you think this war can increase our inflation rate in Bangladesh?	Yes	No						

Table 4.2.1 contains a comprehensive questionnaire that was created to collect information from respondents in Bangladesh for research on attitude analysis about the Israel-Hamas conflict, the Russia-Ukraine war, and the COVID-19 pandemic. It asks thirty questions in an attempt to gauge popular sentiment and opinions on these important world events. Every question is specifically designed to extract information on how the Bangladeshi people are affected by and view these challenges. The information gathered will help to provide a more complex understanding of attitudes, emphasizing the distinct viewpoints and worries of Bangladeshis with respect to these global issues.

Google Sheets is used for Gathering Information for Sentiment Analysis on COVID-19, the Israel-Hamas Conflict, and the Russia-Ukraine War from a Bangladeshi Perspective. The 30-question survey that Bangladeshi participants answered in order to gauge their opinions on the COVID-19 epidemic, the Russia-Ukraine war, and the Israel-Hamas conflict is available in this Google Sheets document. The way the information is arranged makes it easier to examine popular sentiments and ideas in-depth, giving important context for understanding Bangladesh's viewpoint on key international events.

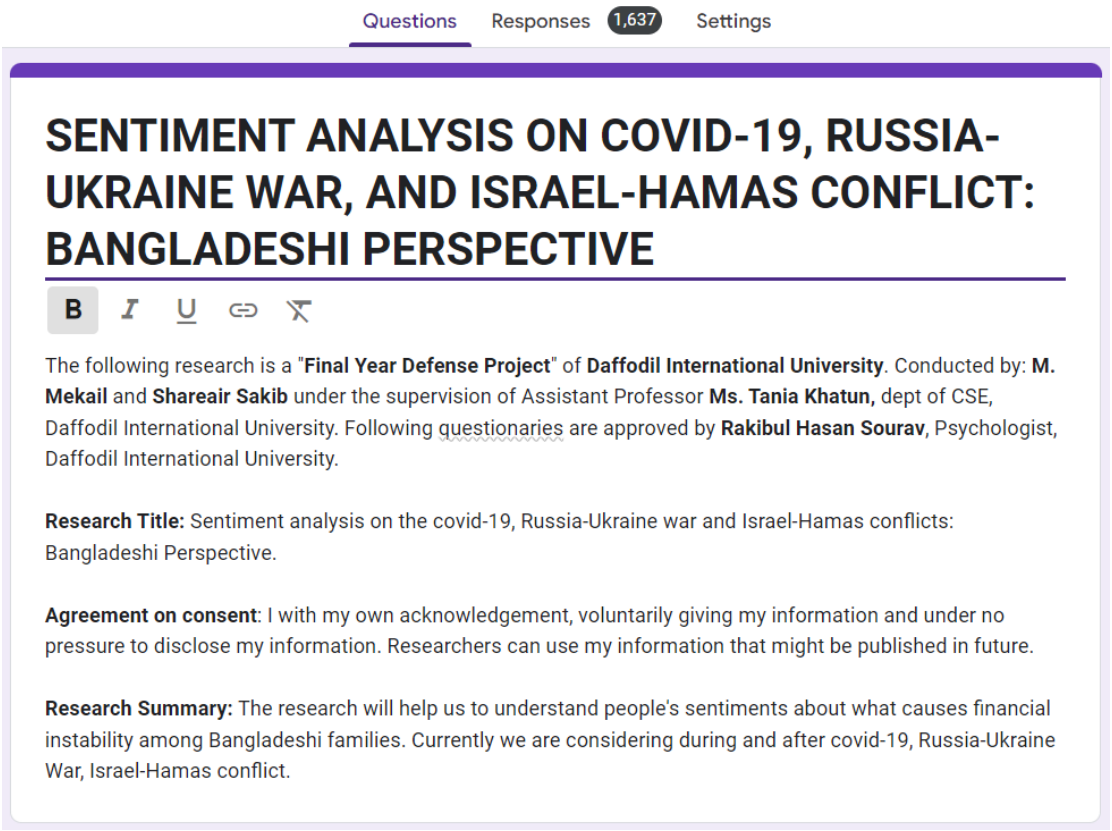
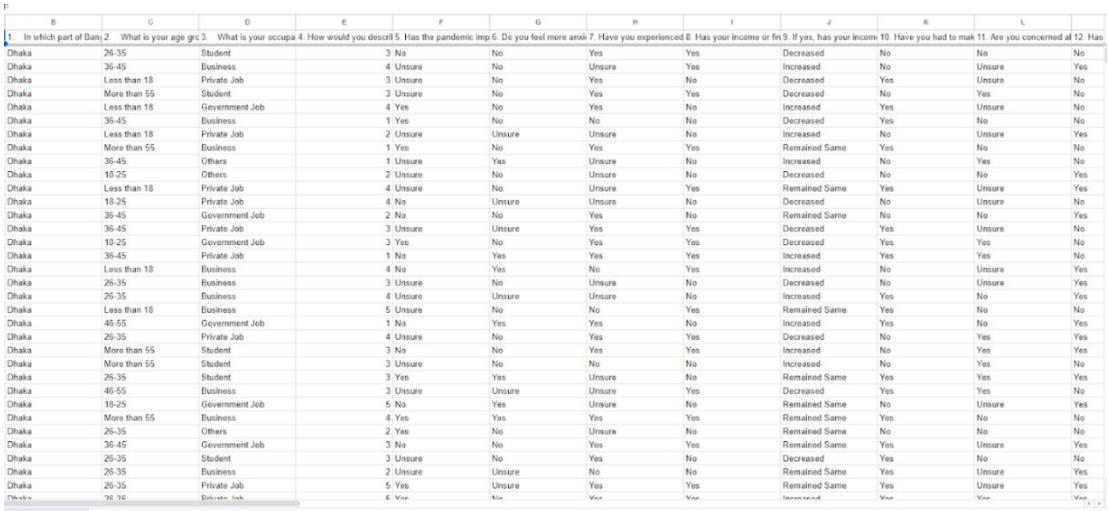


Figure 4.2.2: Data collection form



B	C	D	E	F	G	H	I	J	K	L	
1. In which part of Banç	2. What is your age grc	3. What is your occupa	4. How would you descril	5. Has the pandemic imp	6. Do you feel more anxi	7. Have you experienced	8. Has your income or fin	9. If yes, has your incom	10. Have you had to mak	11. Are you concerned al	12. Has
Dhaka	26-35	Student	3	No	No	Yes	Yes	Decreased	No	No	No
Dhaka	36-45	Business	4	Unsure	No	Unsure	Yes	Increased	No	Unsure	Yes
Dhaka	Less than 18	Private Job	3	Unsure	No	Yes	No	Decreased	Yes	Unsure	No
Dhaka	More than 55	Student	3	Unsure	No	Yes	Yes	Decreased	No	Yes	No
Dhaka	Less than 18	Government Job	4	Yes	No	Yes	No	Increased	Yes	Unsure	No
Dhaka	36-45	Business	1	Yes	No	No	No	Decreased	Yes	No	No
Dhaka	Less than 18	Private Job	2	Unsure	Unsure	Unsure	No	Increased	No	Unsure	Yes
Dhaka	More than 55	Business	1	Yes	No	Yes	Yes	Remained Same	Yes	No	No
Dhaka	36-45	Others	1	Unsure	Yes	Unsure	No	Increased	No	Yes	No
Dhaka	18-25	Others	2	Unsure	No	Unsure	No	Decreased	No	No	Yes
Dhaka	Less than 18	Private Job	4	Unsure	No	Unsure	Yes	Remained Same	Yes	Unsure	Yes
Dhaka	18-25	Private Job	4	No	Unsure	Unsure	No	Decreased	No	Unsure	No
Dhaka	36-45	Government Job	2	No	No	Yes	No	Remained Same	No	No	Yes
Dhaka	36-45	Private Job	3	Unsure	Unsure	Yes	Yes	Decreased	Yes	Unsure	No
Dhaka	18-25	Government Job	3	Yes	No	Yes	Yes	Decreased	Yes	Yes	No
Dhaka	36-45	Private Job	1	No	Yes	Yes	Yes	Increased	Yes	Yes	No
Dhaka	Less than 18	Business	4	No	Yes	No	Yes	Increased	No	Unsure	Yes
Dhaka	26-35	Business	3	Unsure	No	Unsure	No	Decreased	No	Unsure	Yes
Dhaka	26-35	Business	4	Unsure	Unsure	Unsure	No	Increased	Yes	No	Yes
Dhaka	Less than 18	Business	5	Unsure	No	No	Yes	Remained Same	Yes	No	No
Dhaka	46-55	Government Job	1	No	Yes	Yes	No	Increased	Yes	No	Yes
Dhaka	26-35	Private Job	4	Unsure	No	Yes	Yes	Decreased	No	Yes	Yes
Dhaka	More than 55	Student	3	No	No	Yes	Yes	Increased	No	Yes	Yes
Dhaka	More than 55	Student	3	Unsure	No	No	No	Increased	No	Yes	No
Dhaka	26-35	Student	3	Yes	Yes	Unsure	No	Remained Same	Yes	Yes	Yes
Dhaka	46-55	Business	3	Unsure	Unsure	Unsure	Yes	Decreased	Yes	Yes	No
Dhaka	18-25	Government Job	5	No	Yes	Unsure	No	Remained Same	No	Unsure	Yes
Dhaka	More than 55	Business	4	Yes	Yes	Yes	Yes	Remained Same	Yes	No	No
Dhaka	26-35	Others	2	Yes	No	Unsure	No	Remained Same	No	No	No
Dhaka	36-45	Government Job	3	No	No	Yes	Yes	Remained Same	Yes	Unsure	Yes
Dhaka	26-35	Student	3	Unsure	No	Yes	No	Decreased	Yes	No	No
Dhaka	26-35	Business	2	Unsure	Unsure	No	No	Remained Same	Yes	Unsure	Yes
Dhaka	26-35	Private Job	5	Yes	Unsure	Yes	Yes	Remained Same	Yes	Unsure	Yes

Figure 4.2.3: Data collected into spreadsheet via google form

For this dataset, we've implemented two distinct data collection modules. Firstly, through online surveys, we disseminated Google Form links across various groups to gather responses. This method facilitated broad outreach and garnered diverse perspectives. Conversely, our offline survey approach involved direct interactions with individuals, enabling more personalized data collection experiences. By engaging

directly with participants, we aimed to capture nuanced insights and ensure a comprehensive dataset. Both methodologies were carefully designed to cater to different demographics and maximize data richness. This dual approach underscores our commitment to capturing a holistic understanding of the subject matter. Using a raw data set can provide detailed and perfect information.

TABLE 4.2.2: Total collected Dataset (online and offline combined)

	Offline Data	**Online Data**
Raw Dataset	266	1371

Ethical Considerations:

- **People's privacy and data security:** By getting informed permission, anonymizing data, and restricting data gathering, research must place a high priority on privacy and data security. These procedures safeguard private data, upholding moral principles and allowing insightful social media research.
- **Informed consent:** They are informed with their own acknowledgement, voluntarily giving their information and under no pressure to disclose their information. Their information is collected anonymously. Researchers can use the information that might be published in the future.

Documentation and Reproducibility:

- **Code documentation:** To promote openness, repeatability, and future cooperation, the implementation code must have thorough documentation. Working together on code and documentation is made simple by utilizing tools like Google Drive and Google Colab. Researchers ensure that their work can be understood, copied, and expanded upon by others by thoroughly documenting the implementation process. This fosters openness and advances the area of machine learning.
- **Version control:** Effective tracking of codebase changes is made possible by using version control systems, such Google Colab and Google Docs, which also guarantee an organized development process. These platforms promote efficient

teamwork and progress tracking by streamlining workflow management, improving transparency in project development, and facilitating collaboration.

The research can be carried out methodically and rigorously, guaranteeing the dependability and repeatability of the results, by meeting these implementation requirements. Respecting conventions like comprehensive documentation, employing suitable assessment measures, and implementing version control systems creates a strong foundation for research. Within the scientific community, this paradigm not only promotes collaboration and knowledge sharing but also improves transparency and reproducibility. In the end, these initiatives push innovation and deepen our comprehension of complicated events by advancing the field of sentiment analysis using machine learning and classification models.

Data Pre-processing:

In this stage, we worked with gathered data to transform raw data into a format suitable for training models.

a) **Label encoding:** A key method in machine learning is label encoding, which transforms category data into a numerical representation that computers can understand. When working with categorical data that incorporates discrete, non-numeric values, this strategy is quite helpful. The procedure entails giving each separate category inside the feature a specific numerical value.

b) **Train and test data split:** We divided the dataset into two separate portions during the train and test data split phase: the training set, which we used to train machine learning models, and the test set, which we kept for evaluating model performance on untested data. This systematic division enabled us to gauge the model's generalization ability and ensure its efficacy in real-world scenarios, enhancing confidence in its predictive capabilities and deployment readiness.

Training:

In this pivotal step, we embark on the creation of a machine learning model, leveraging a diverse array of algorithms including SVM, Decision Tree, Naive Bayes, Random

Forest, and KNN. Our approach involves utilizing the dataset for model training and subsequently evaluating its classification accuracy across these methodologies. Initially, we allocated 70% of the dataset for training purposes, reserving the remaining portion for rigorous testing. This deliberate split ensures a robust evaluation process, enabling us to ascertain the model's performance on unseen data accurately. By subjecting our model to various algorithms and meticulous testing, we aim to identify the optimal solution for our project. This comprehensive methodology empowers us to uncover nuanced insights, gauge the efficacy of different approaches, and ultimately derive the best outcome, poised to address the objectives and challenges inherent in our project with precision and efficacy.

There are two different kinds of data collection modules for this dataset which we were trying to establish. In the online survey form, we have gathered data by sharing the Google form's link with several groups of people. On the other hand, in the offline survey, we try to collect data from individual.

4.3 Model Evaluation

To implement sentiment analysis on the Russia-Ukraine conflict, COVID-19, and the Israel-Hamas conflict from an economic perspective, we've chosen several machine learning classification models. Support Vector Machine (SVM), Decision Tree, Random Forest, Naive Bayes, and K-Nearest Neighbors (KNN) are some of these models. When it comes to sentiment analysis and sentiment prediction, each model has unique advantages.

Encouragement High-dimensional data is easily handled by Vector Machine, which also finds intricate patterns in the dataset. Decision trees offer interpretability and are useful for handling both category and numerical data. Random Forest is a group of decision trees that enhances prediction accuracy and reduces overfitting. Naive Bayes offers simplicity and efficiency, particularly in text classification tasks. K-Nearest Neighbors determines the sentiment based on the similarity of data points in the feature space.

By evaluating the accuracy of these models, we aim to gauge their effectiveness in sentiment analysis and predict people's sentiments regarding these geopolitical and health crises from an economic standpoint. This approach not only provides insights

into public sentiment but also informs economic decision-making and risk assessment strategies. The utilization of multiple models ensures robustness and reliability in capturing the nuances of sentiment across diverse contexts, aiding in informed decision-making processes

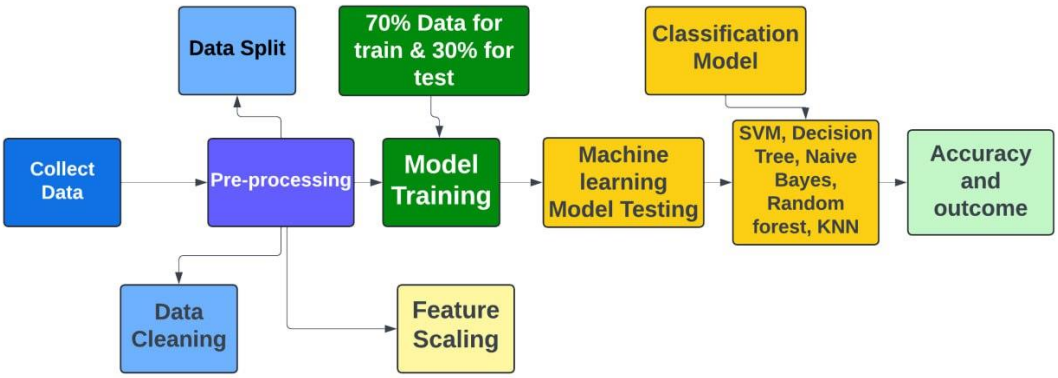


Figure 4.3.1: Process of Experiments.

Machine Learning Models:

Random Forest:

Random forest, an acclaimed machine learning algorithm devised by Leo Breiman and Adele Cutler, aggregates the outputs of multiple decision trees to form a single prediction. This algorithm has gained widespread popularity due to its ease of use and flexibility, making it highly effective for both classification and regression tasks.

One of the key reasons for the random forest algorithm's extensive use is its user-friendly nature and adaptability, which enable it to handle both classification and regression problems with ease. Its robustness lies in its capability to process complex datasets and minimize overfitting, thereby making it an indispensable tool for a variety of predictive tasks in machine learning.

A notable feature of the random forest algorithm is its ability to manage datasets containing both continuous variables, as required in regression, and categorical variables, as needed in classification. This versatility ensures that it performs exceptionally well across different types of tasks. For instance, in classification tasks, it can efficiently categorize data into predefined classes, while in regression tasks, it can predict continuous outcomes with high accuracy.

Furthermore, random forest enhances performance by averaging the results of numerous decision trees, which reduces the risk of overfitting that often plagues single

decision trees. This ensemble approach leverages the diversity of the individual trees to produce a more accurate and stable prediction. The algorithm also includes mechanisms such as bootstrapping and feature randomness, which further contribute to its effectiveness and reliability.

In summary, the random forest algorithm stands out due to its simplicity, versatility, and robust performance across various predictive modeling tasks. Its ability to handle both continuous and categorical variables, coupled with its proficiency in reducing overfitting, makes it a powerful and valuable tool in the field of machine learning. In this tutorial, we will delve into the workings of the random forest algorithm and demonstrate its application in a classification task.

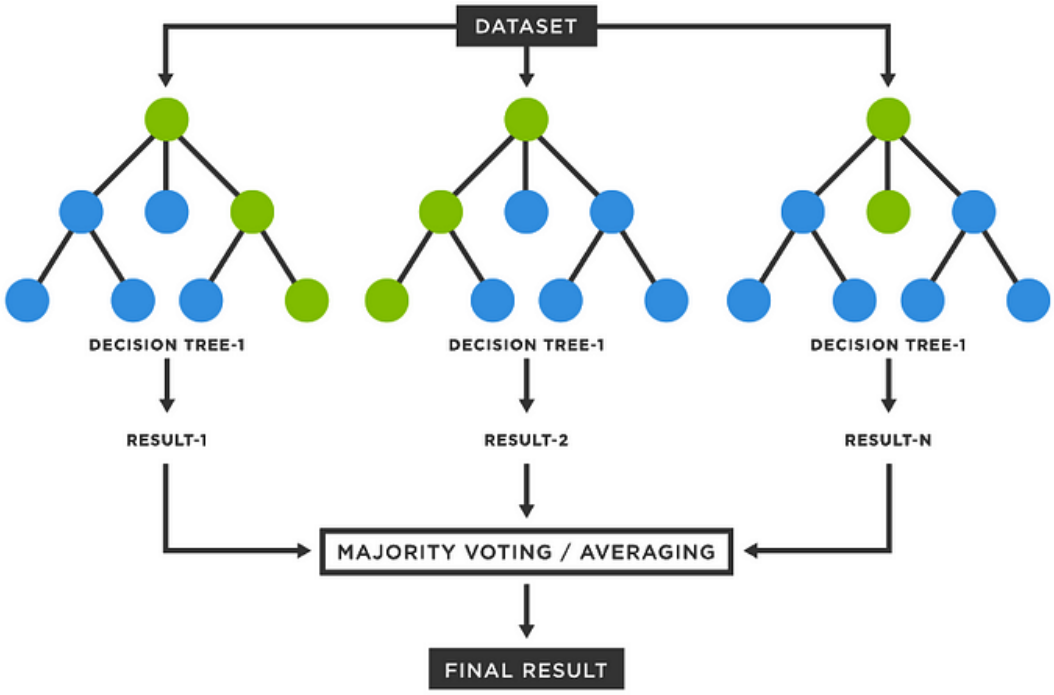


Figure 4.3.2: Workflow of Random Forest [22]

Naive Bayes: a probabilistic classifier based on the independence of predictions and the Bayes theorem. Naive Bayes is simple and effective, making it a good starting point for classification tasks.

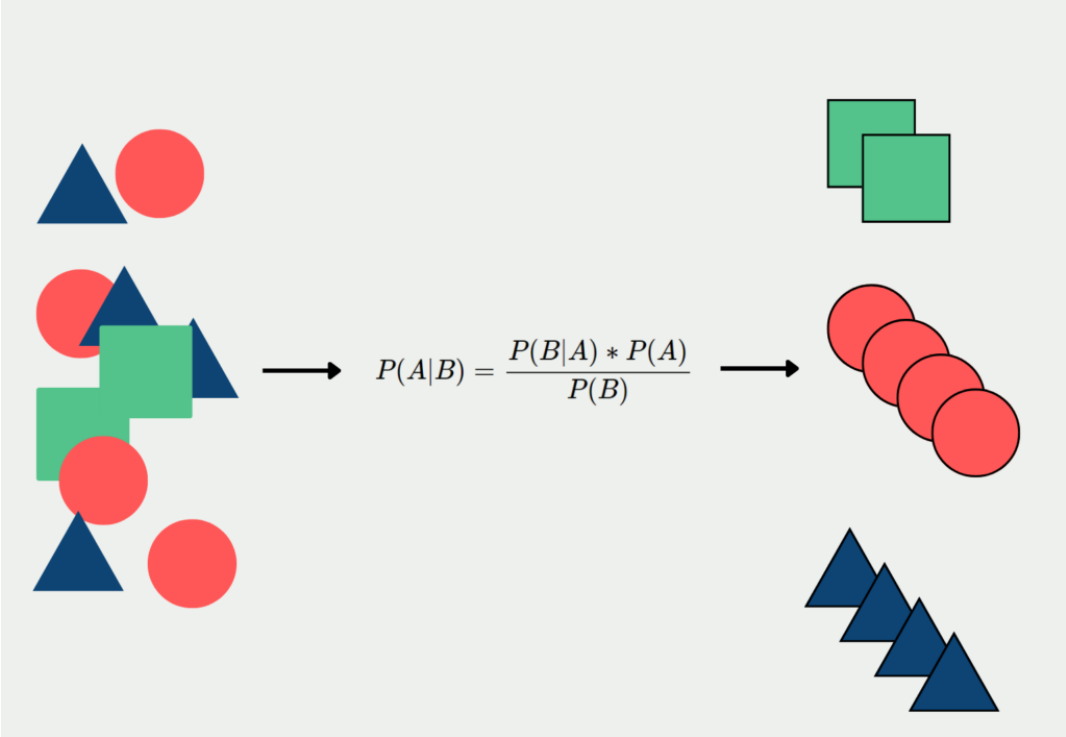


Figure 4.3.3: Workflow of Naïve Bayes [23]

Decision Tree: This classifier makes use of a decision tree-like approach. Because of its simplicity and ease of visualization, it is a well-liked option for exploratory investigation.

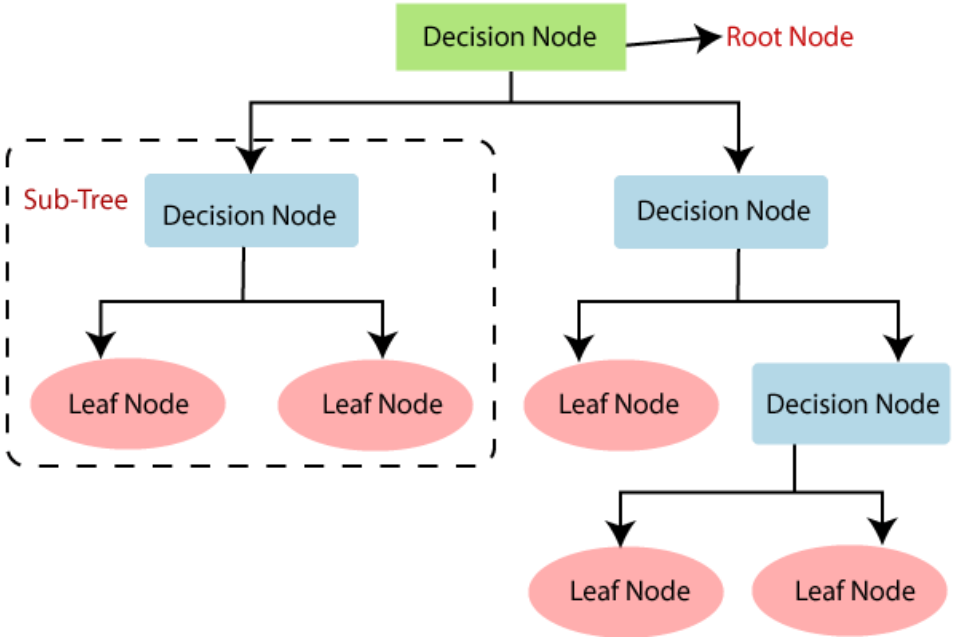


Figure 4.3.4: Workflow of Decision Tree [24]

K-Nearest Neighbors (KNN): An algorithm for instance-based learning that groups

examples according to how similar they are to each other. Data points that are close to one another are referred to as "neighbors" in KNN.

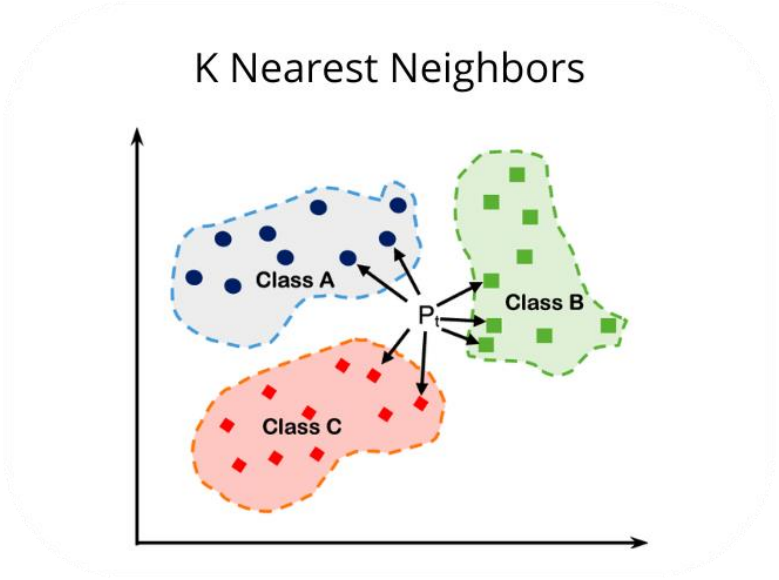


Figure 4.3.5: Workflow of KNN [25]

Support Vector Machine (SVM): A powerful classifier that works by finding a hyperplane that best separates the classes. Because numerous Kernel functions may be selected for the decision function, support vector machines (SVMs) are both adaptable and effective in high-dimensional environments.

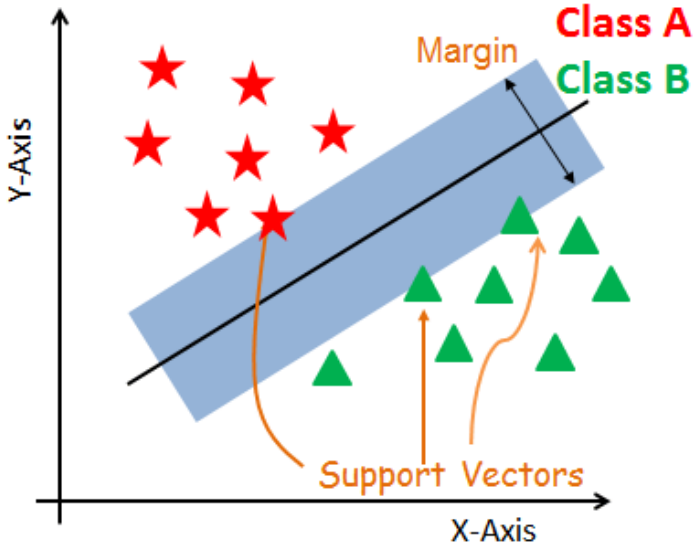


Figure 4.3.6: Workflow of SVM [26]

Our aim is to compare and contrast the performance of these classifiers in order to identify the most effective one for our specific use case.

Prior to beginning the implementation phase, we will collect users' raw data. after which the raw data was processed and divided into two sets: a test set and a training set. Prior to testing the train data, we train the train set of raw data. Following training, we test the test data using the following algorithms: Logistic Regression, Decision Tree, Naive Bayes, K-Nearest Neighbors, Support Vector Machine, and Linear Regression.

4.4 Summary

We set out to build a machine learning model by employing a range of algorithms, including SVM, Decision Tree, Naive Bayes, Random Forest, and KNN. Our strategy involves using the dataset for training these models and then assessing their classification accuracy. To ensure a thorough evaluation, we allocated 70% of the dataset for training and reserved the remaining 30% for rigorous testing. This strategic split facilitates an accurate assessment of the model's performance on unseen data.

By applying various algorithms and conducting meticulous testing, our goal is to identify the most effective solution for our project. This comprehensive approach allows us to explore detailed insights and measure the effectiveness of different methodologies. It also ensures that we derive the best possible outcome, tailored to meet the specific objectives and challenges of our project with precision.

We initiate the process by preparing the dataset, ensuring it is clean and appropriately formatted for model training. Next, we train each algorithm—SVM, Decision Tree, Naive Bayes, Random Forest, and KNN—on the training subset of the data. During this phase, we fine-tune the parameters of each model to optimize performance and enhance accuracy.

Once the models are trained, we evaluate their performance using the reserved 30% of the dataset. This step is critical as it provides an unbiased measure of how well each model can generalize to new, unseen data. We calculate various performance metrics, such as accuracy, precision, recall, and F1-score, to comprehensively assess each model's strengths and weaknesses.

Through this extensive testing, we gain a deeper understanding of how each algorithm performs under different conditions and datasets. This insight is invaluable in selecting

the most appropriate model for our project. The algorithm that demonstrates the highest classification accuracy and best meets our specific requirements will be considered the optimal solution.

This rigorous methodology ensures that we do not rely on a single algorithm but rather explore multiple approaches to find the best fit. It empowers us to make informed decisions based on empirical evidence and performance metrics, ultimately enhancing the reliability and effectiveness of our machine-learning model.

In conclusion, our structured approach to building and evaluating machine learning models, by leveraging a variety of algorithms and a strategic data split, enables us to identify the optimal solution with precision. This methodical process ensures that we address the objectives and challenges of our project effectively, leading to a robust and reliable model ready to tackle real-world applications.

CHAPTER 5
Results and Analysis

5.1 Overview

The research on "Sentiment Analysis on Pandemic and Current Global Conflicts: Bangladeshi Economic Perspective" is meticulously designed to ensure robustness and reliability in analyzing sentiments from an economic viewpoint. Leveraging high-performance hardware built around a powerful CPU and a strong GPU allows for the swift and effective processing of large datasets and sophisticated machine-learning algorithms.

Sophisticated machine learning models are implemented using Python programming environments and frameworks such as Scikit-learn. These frameworks provide an extensive array of tools and functions for constructing, training, and evaluating models, enabling researchers to experiment with different categorization strategies and refine their models for sentiment analysis.

The experimental dataset, carefully sourced from various individual sources, undergoes rigorous preprocessing, data cleaning, and feature scaling to ensure consistency and representativeness. This preparatory phase is essential for providing high-quality inputs to the machine learning models, which enhances their predictive capabilities and generalization performance.

Additionally, incorporating multiple machine learning classification models is pivotal in fine-tuning sentiment analysis. By exploring various algorithms and methodologies, researchers can gain insights into the strengths and weaknesses of different approaches, ultimately improving the accuracy and interpretability of sentiment analysis results.

Throughout the experimentation process, detailed documentation is maintained, covering code specifics, model architecture, hyperparameters, and results. This thorough documentation promotes transparency, reproducibility, and future collaboration, allowing researchers to build upon and validate the findings. This contributes significantly to advancements in economic research and decision-making in the field of advanced sentiment analysis.

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5.2 Experimental Result

Result of Experiment: Machine learning models

In this section, we compare the performance of five original machine learning models. Initially, we evaluate the classification performance of each model, followed by a comprehensive review of their overall metrics. This analysis encompasses various aspects such as data gathering, detailed model descriptions, potential causes of performance discrepancies, and prospective areas for improvement.

The data-gathering process is meticulously outlined, ensuring that the dataset used is representative and of high quality. Each model's description includes its architecture, key features, and the rationale behind its selection. By examining these details, we provide a clear understanding of how each model functions and its specific design considerations.

Performance discrepancies among the models are thoroughly analyzed to identify the underlying causes. Factors such as algorithmic differences, data preprocessing methods, and hyperparameter settings are considered. This detailed evaluation helps pinpoint why certain models may outperform others under specific conditions.

Furthermore, prospective areas for improving the results are discussed. This includes suggestions for optimizing hyperparameters, enhancing data preprocessing techniques, and exploring ensemble methods to combine the strengths of multiple models. By addressing these potential improvements, we aim to enhance the overall accuracy and reliability of the sentiment analysis.

In conclusion, this comparative analysis not only highlights the strengths and weaknesses of each machine learning model but also provides valuable insights for future research and optimization efforts.

TABLE 5.2.1: Accuracy for Classification of Individual machine learning models in sentiment analysis

Architecture	Training Accuracy	Model Accuracy
SVM	79.83%	73.7%
Random Forest	99.92%	74.3%
Decision Tree	79.83%	70.4%
KNN	78.76%	75%
Naive Bayes	70.21%	58.23%

Table 5.2.1 presents informative accuracy metrics for sentiment analysis through a comparison examination of multiple pre-trained machine learning architectures: SVM, Random Forest, Decision Tree, KNN, and Naive Bayes. Interestingly, the results suggest that KNN, Random Forest, and SVM were the best models, with accuracies of almost 75%, 74.3%, and 73.7%, respectively, making them the best models. This

demonstrates their outstanding ability to manage sentiment analysis in unprocessed datasets. In contrast, the accuracies of Naive Bayes and Decision Tree were somewhat lower, at about 70%, suggesting a somewhat worse performance than that of their competitors.

This nuanced differentiation in accuracy underscores the critical importance of carefully selecting the appropriate machine learning architecture in the context of sentiment analysis. The choice of model directly influences the precision and reliability of the analytic process. KNN's high accuracy can be attributed to its ability to capture local patterns in the data, while Random Forest's ensemble approach likely provides robustness against overfitting. SVM's effectiveness might stem from its capacity to find an optimal hyperplane that maximizes margin between classes.

On the other hand, Naive Bayes, despite its probabilistic simplicity and efficiency, might suffer from the strong independence assumptions it makes. Similarly, Decision Tree's lower performance could be due to its propensity to overfit, especially with complex datasets.

A useful point of reference for comprehending the relative advantages and disadvantages of these models is the comprehensive accuracy metrics given in Table 5.2.1. This data makes a substantial contribution to the current discussion about how to best utilize machine learning techniques for sentiment analysis, enabling practitioners and academics to choose the best models for their particular use cases.

5.3 Comparative Analysis

Our study aims to determine the sentiment of people regarding happiness, sadness, and economic stabilization in the context of COVID-19, the Russia-Ukraine war, and the Israel-Hamas conflict. We conduct experiments using various machine learning classifiers and evaluate their performance using metrics like precision, recall, F1-score, and confusion matrix (CM).

Accuracy measures the model's ability to correctly classify samples, calculated by dividing the sum of true positives (TP) and true negatives (TN) by the total number of samples (TP, TN, false positives (FP), and false negatives (FN)).

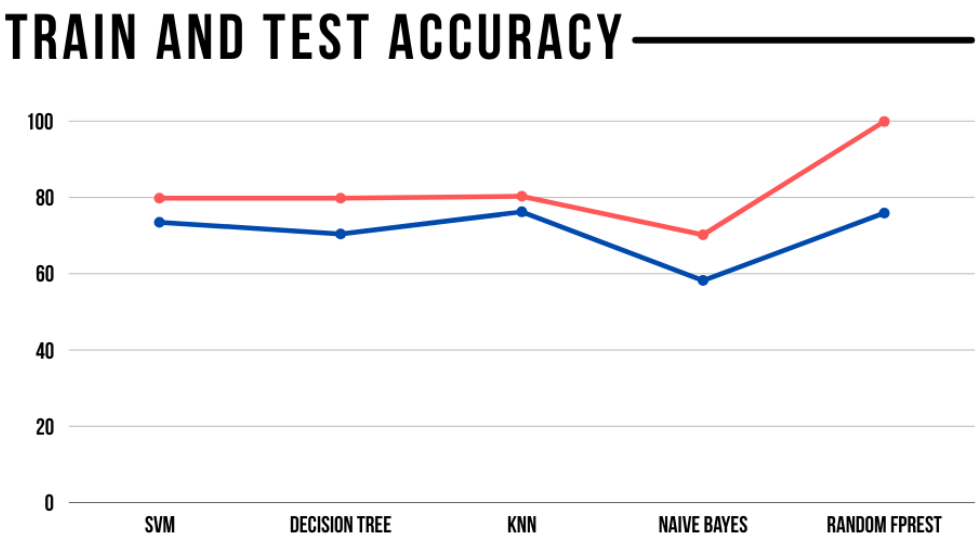

Figure 5.3.1: Accuracy comparison of applied ML algorithms

Precision indicates the percentage of correctly predicted positive cases and is crucial when false positives are more concerning. It is calculated as TP divided by the sum of TP and FP.

Recall, or sensitivity, measures the correctly identified positive cases and is important when false negatives are more problematic. It is calculated as TP divided by the sum of TP and FN.

F1-score provides a balanced measure of precision and recall by calculating their harmonic mean, making it ideal when both metrics are equally important.

Specificity is the proportion of true negatives among those who do not have the condition, calculated as TN divided by the sum of TN and FP. This metric is useful for tests designed to rule out a condition.

A confusion matrix (CM) is used to evaluate the performance of classification algorithms by displaying the counts of TP, FP, TN, and FN, helping to calculate critical predictive metrics such as precision, recall, specificity, and accuracy.

TABLE 5.3.1: Precision, Recall, F1-Score, and Support for original Ml classifiers. (Train)

SVM (Train)				
	Precision	**Recall**	**F1-Score**	**Support**
Yes	0.51	0.39	0.44	88
No	0.79	0.86	0.83	240
Accuracy			0.73	328
Macro Avg	0.65	0.62	0.63	328
Weighted Avg	0.72	0.73	0.72	328
Random Forest (Train)				
	Precision	**Recall**	**F1-Score**	**Support**
Yes	0.48	0.53	0.51	88
No	0.82	0.79	0.81	240
Accuracy			0.72	240
Macro Avg	0.65	0.66	0.66	328
Weighted Avg	0.73	0.72	0.73	328
Decision Tree (Train)				
	Precision	**Recall**	**F1-Score**	**Support**
Yes	0.48	0.53	0.51	88
No	0.82	0.79	0.81	240
Accuracy			0.72	328
Macro Avg	0.65	0.66	0.66	328
Weighted Avg	0.73	0.72	0.73	328
KNN (Train)				

	Precision	Recall	F1-Score	Support
Yes	0.64	0.49	0.56	99
No	0.80	0.88	0.84	229
Accuracy			0.76	328
Macro Avg	0.72	0.69	0.70	328
Weighted Avg	0.75	0.76	0.75	328
Naive Bayes (Train)				
	Precision	**Recall**	**F1-Score**	**Support**
Yes	0.30	0.28	0.29	99
No	0.70	0.71	0.70	229
Accuracy			0.58	328
Macro Avg	0.50	0.50	0.50	328
Weighted Avg	0.58	0.58	0.58	328

Table 5.3.1 presents a detailed comparison of the model accuracy and training % attained by five different machine learning architectures. In addition, the table highlights the SVM, Decision Tree, Random Forest, KNN, and Naive Bayes models and provides precision, recall, F1-score, and support values for each class. Interestingly, the KNN, Random Forest, and SVM architectures perform quite well, as evidenced by their precision scores when used with the test dataset. To be more precise, these three models show consistently higher recall, F1-score, and precision across different classes, proving their usefulness for precise sentiment analysis.

The thorough analysis shows how well the SVM, Decision Tree, Random Forest, KNN, and Naive Bayes models classified detections. Even though it is included in the thorough comparison, the Naive Bayes model produces a significantly lower identification rate, which is interesting. This highlights the subtle differences in performance amongst the machine learning architectures under consideration. Because of its strong independence assumptions, Naive Bayes tends to have trouble grasping

the intricate patterns found in sentiment analysis, despite its simplicity and computing efficiency.

The KNN model's ability to capture local data patterns and the robustness of the Random Forest model against overfitting contribute significantly to their high performance. The SVM model's effectiveness in finding the optimal hyperplane also enhances its classification accuracy. On the other hand, the Decision Tree model, although effective, might be prone to overfitting, which can limit its generalization capabilities.

Table 5.3.1 provides insightful details that are helpful in comprehending the advantages and disadvantages of each model when applied to sentiment analysis. In order to ensure more accurate and dependable analytical procedures in future applications, this thorough comparison directs more analysis and possible improvements to the suggested approaches.

TABLE 5.3.2: Precision, Recall, F1-Score, and Support for original Ml classifiers. (Test)

SVM (Test)				
	Precision	**Recall**	**F1-Score**	**Support**
Yes	0.56	0.49	0.52	433
No	0.76	0.81	0.78	876
Accuracy			0.70	1309
Macro Avg	0.66	0.65	0.65	1309
Weighted Avg	0.69	0.70	0.70	1309
Random Forest (Test)				
	Precision	**Recall**	**F1-Score**	**Support**
Yes	0.36	0.32	0.34	422
No	0.69	0.72	0.71	887
Accuracy			0.59	1309

Macro Avg	0.52	0.52	0.52	1309
Weighted Avg	0.58	0.59	0.59	1309
Decision Tree (Test)				
	Precision	**Recall**	**F1-Score**	**Support**
Yes	0.56	0.49	0.52	433
No	0.76	0.81	0.78	876
Accuracy			0.70	1309
Macro Avg	0.66	0.65	0.65	1309
Weighted Avg	0.69	0.70	0.70	1309
KNN (Test)				
	Precision	**Recall**	**F1-Score**	**Support**
Yes	0.36	0.32	0.34	422
No	0.69	0.72	0.71	887
Accuracy			0.59	1309
Macro Avg	0.52	0.52	0.52	1309
Weighted Avg	0.58	0.59	0.59	1309
Naive Bayes (Test)				
	Precision	**Recall**	**F1-Score**	**Support**
Yes	0.56	0.49	0.52	433
No	0.76	0.81	0.78	876
Accuracy			0.70	1309
Macro Avg	0.66	0.65	0.65	1309
Weighted Avg	0.69	0.70	0.70	1309

Heatmap of the dataset:

shows the accuracy of the initial model's training and validation, with the accuracy and loss percentages on the y-axis and the number of epochs on the x-axis. There is no overfitting and a suitable division of training and validation data in the figure.

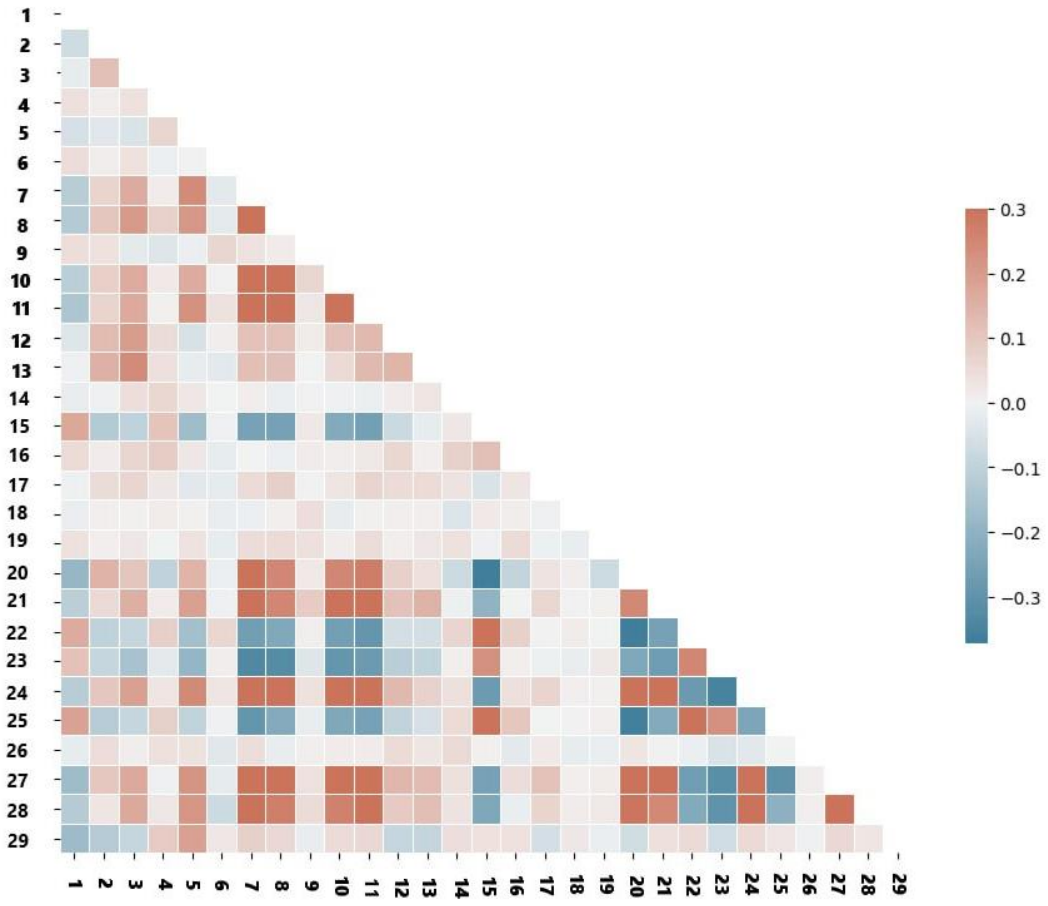

Figure 5.3.2: Heatmap of the dataset.

Confusion Matrix for Machine Learning Models:

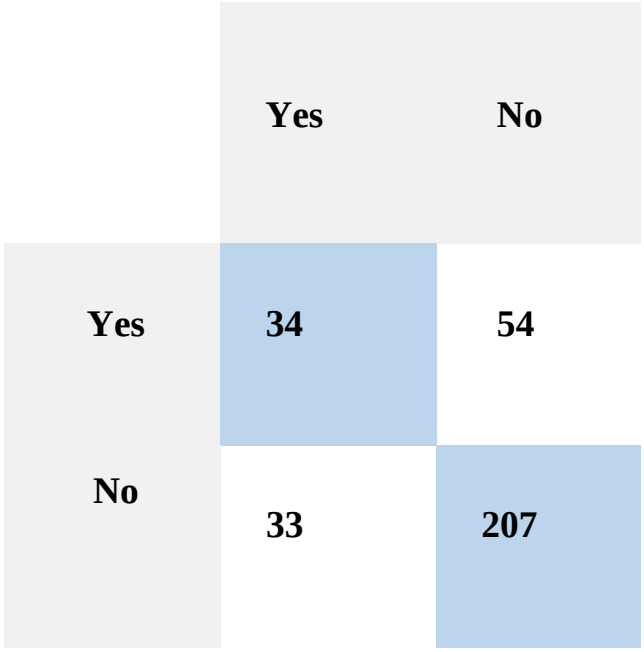

Figure 5.3.3: Confusion Matrix after SVM test

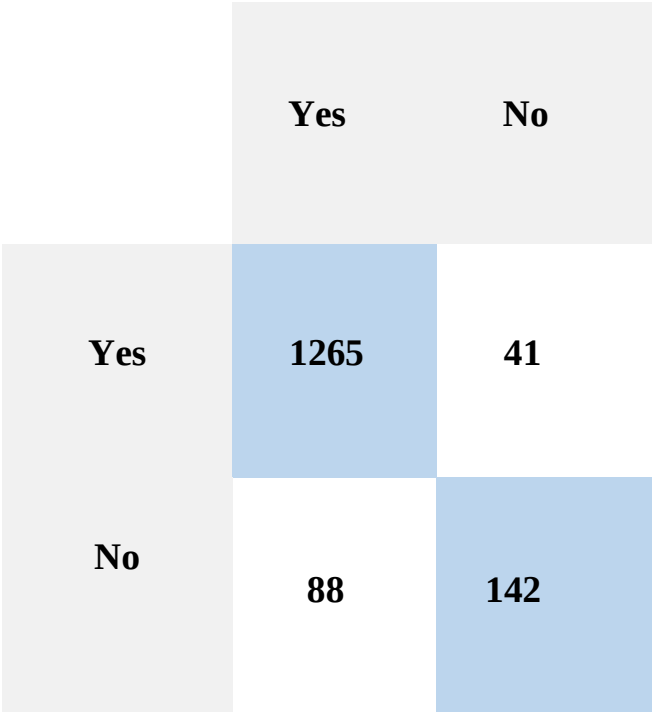

Figure 5.3.4: Confusion Matrix after Random Forest

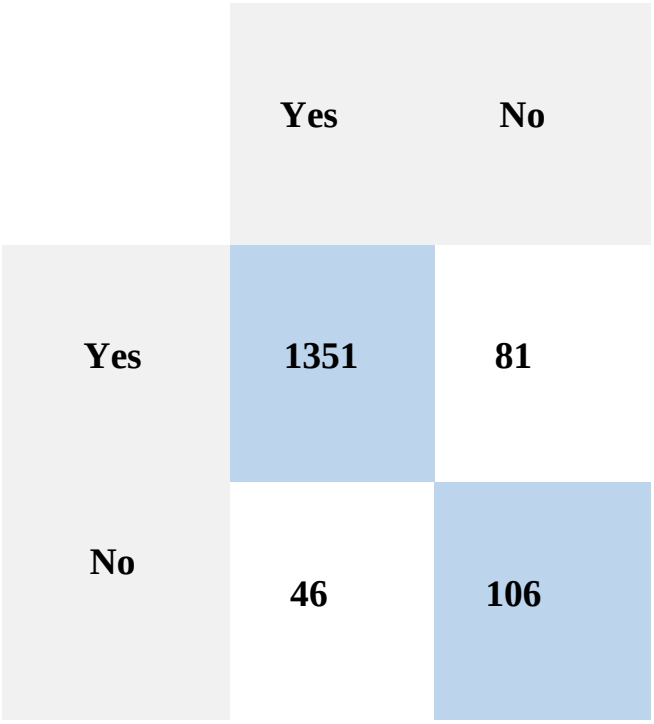

Figure 5.3.5: Confusion Matrix after Decision Tree

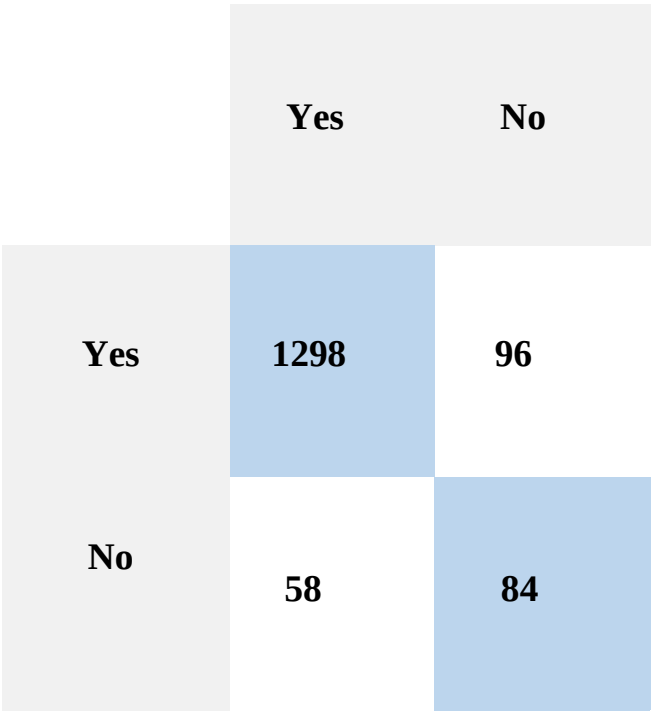

Figure 5.3.6: Confusion Matrix after KNN

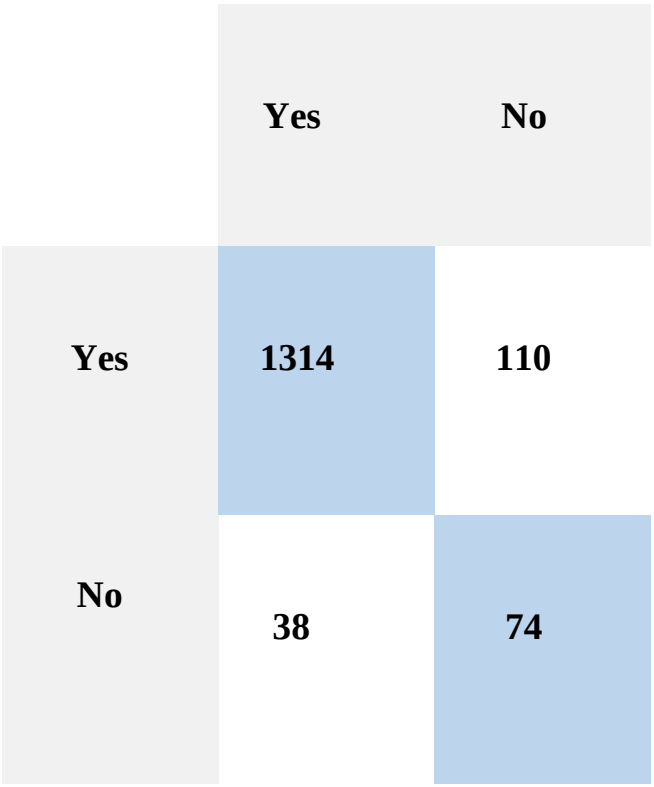

Figure 5.3.7: Confusion Matrix after Naive Bayes

Data Analysis:

After collecting data through Google form, we can see some row information on COVID-19, the Russia-Ukraine war, and the Israel-Hamas conflicts. People felt more anxious or stressed during the pandemic.

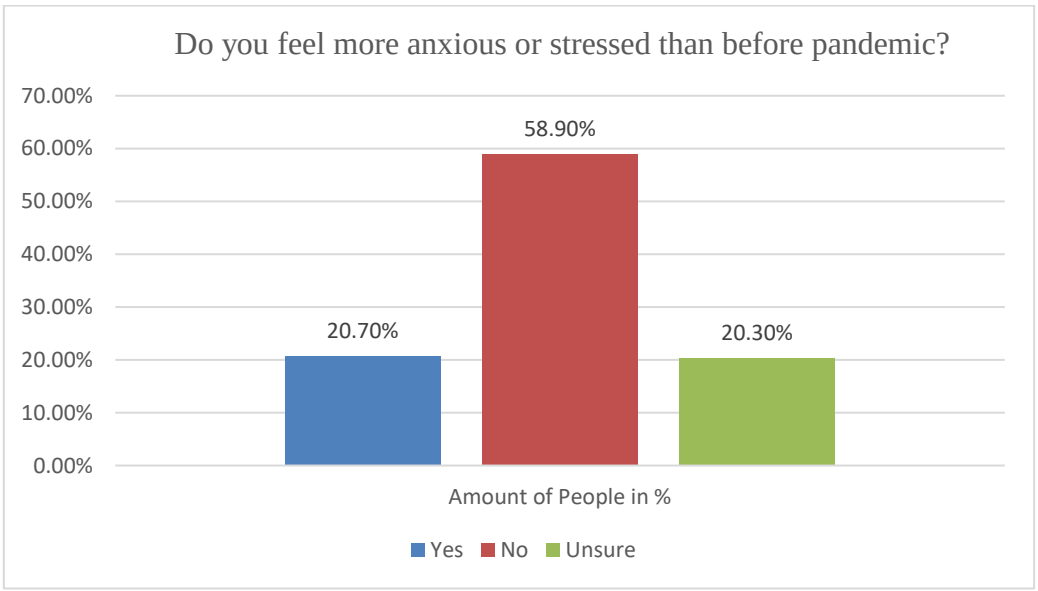

Figure 5.3.8: Percent of People felt more anxious or stressed than before the pandemic.

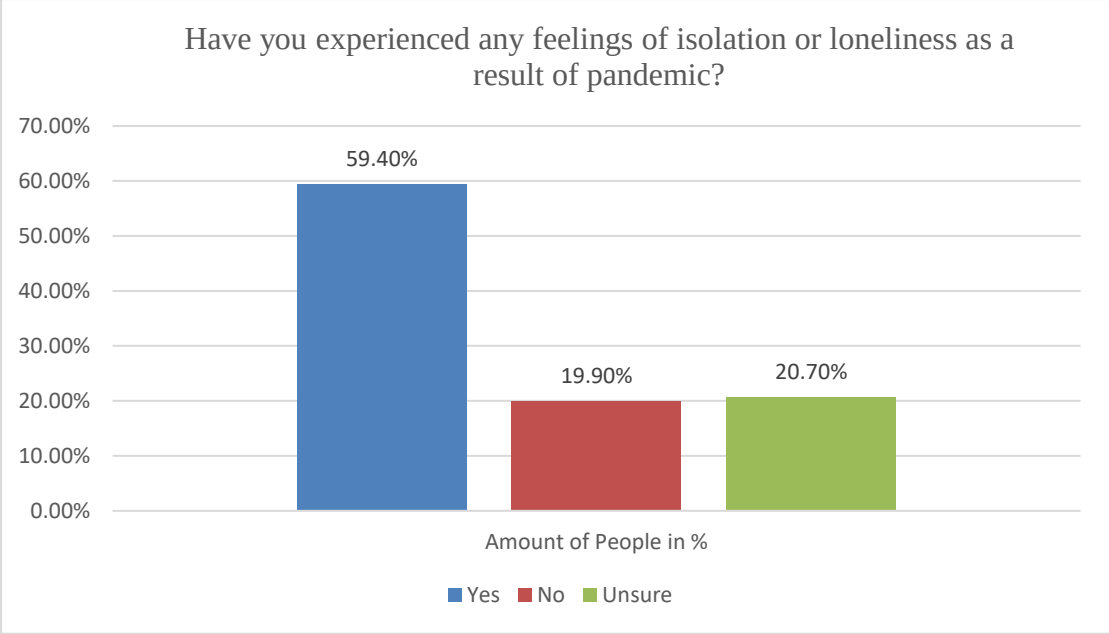

Figure 5.3.9: Percent of People felt lonelier during the pandemic.

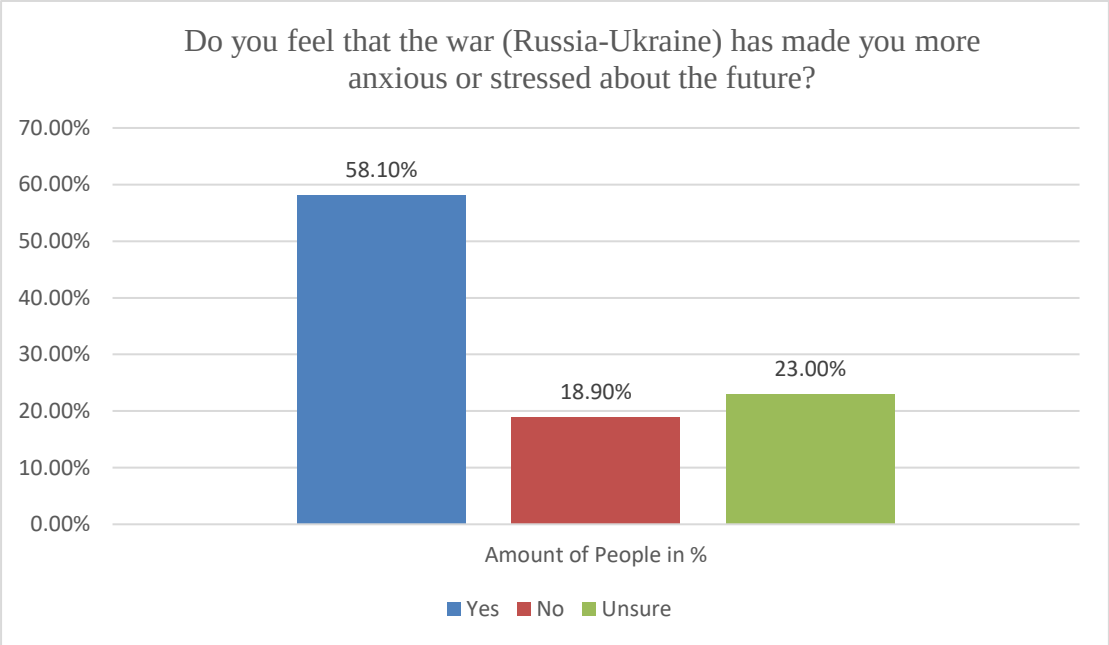

Figure 5.3.10: Percent of People felt more anxious or stressed about the future.

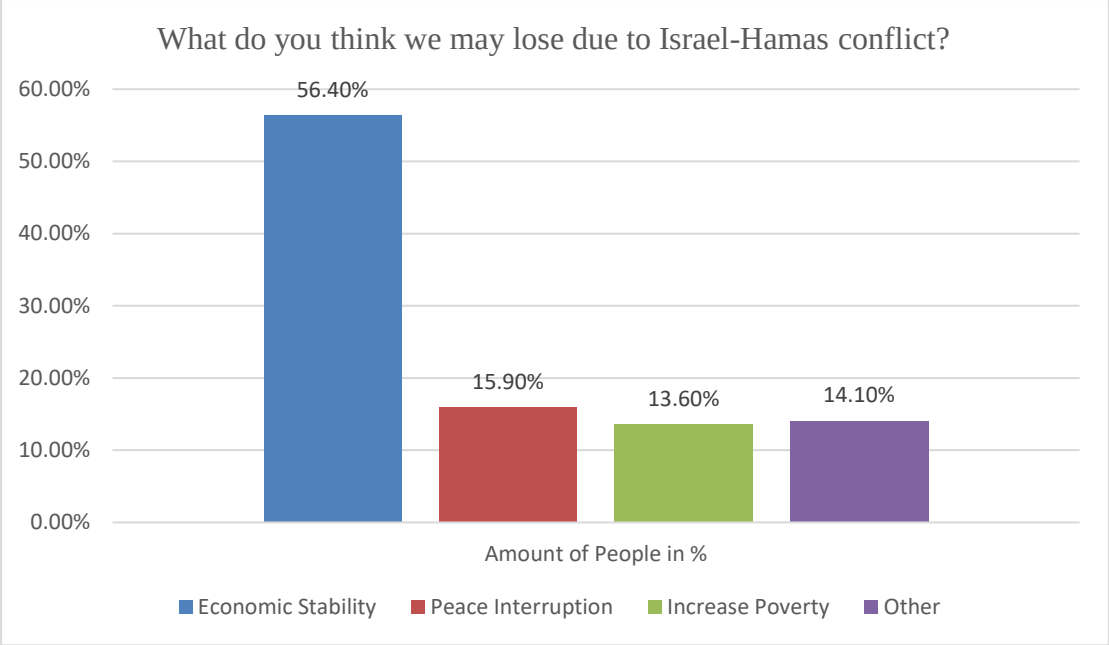

Figure 5.3.11: Percent of People's thinking on what we may lose.

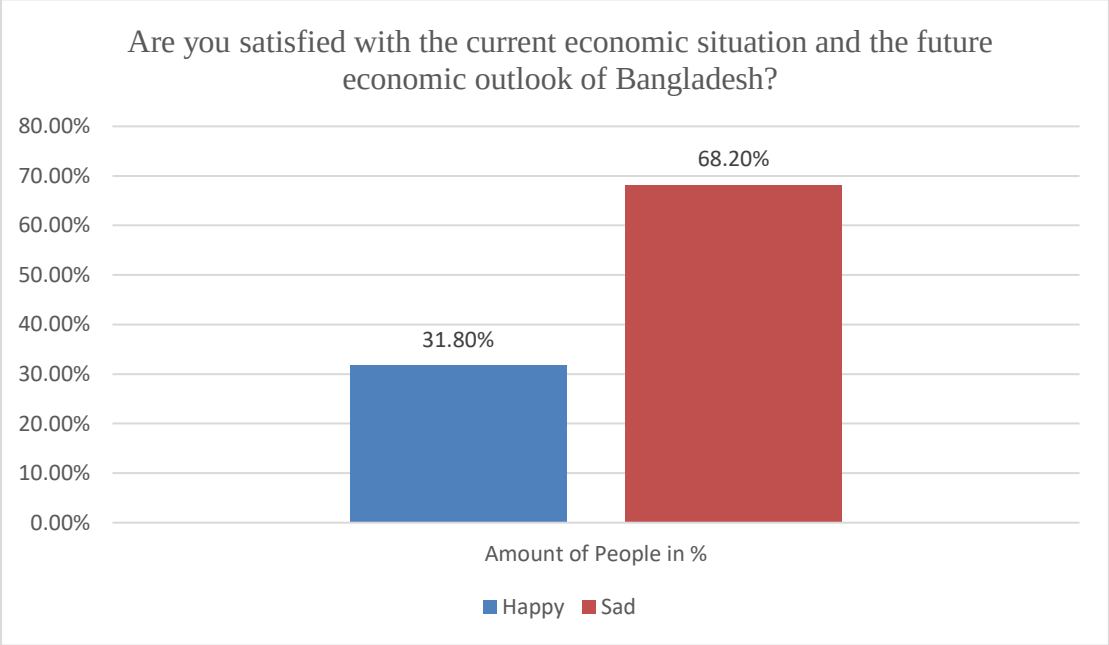

Figure 5.3.12: Percent of People happy/sad with current situation.

5.4 Summary

The experimental dataset, sourced meticulously from various individual sources, undergoes comprehensive preprocessing, data cleaning, and feature scaling to ensure consistency and representativeness. This preparatory phase is essential for providing

high-quality inputs to machine learning models, thereby enhancing their predictive capabilities and generalization performance.

The research incorporates multiple machine-learning classification models to refine sentiment analysis. By examining different algorithms and methodologies, researchers can identify the strengths and weaknesses of each approach, ultimately improving the accuracy and interpretability of sentiment analysis results.

Data collection is conducted both online and offline. Online surveys reach and engage a large audience via online forms, while offline data collection involves distributing printed questionnaires to individuals without internet access. Responses from these printed questionnaires are manually entered into an online form, consolidating all data into a single Excel sheet.

A comparative analysis of several pre-trained machine learning architectures, including SVM, Random Forest, Decision Tree, KNN, and Naive Bayes, is conducted. The results reveal that KNN, Random Forest, and SVM are the top-performing models, achieving the highest accuracies of approximately 75%, 74.3%, and 73.7%, respectively. These models demonstrate exceptional proficiency in handling sentiment analysis on raw datasets. In contrast, Naive Bayes and Decision Tree show slightly lower accuracies of around 70%, indicating a marginally decreased performance.

This variation in accuracy emphasizes how crucial it is to use the right machine-learning model for sentiment analysis. The accuracy and dependability of the analytical process are greatly impacted by the model selection. KNN's capacity to identify local patterns in the data is probably the reason for its high accuracy. Because Random Forest uses an ensemble technique, it is resistant to overfitting. The capacity of SVM to identify an ideal hyperplane that maximizes the margin between classes is presumably the source of its efficacy.

Conversely, Naive Bayes may suffer from its strong independence assumptions, affecting its performance. Decision Tree's lower accuracy could be a result of its tendency to overfit, particularly with complex datasets. Thus, careful model selection is crucial for achieving accurate and reliable sentiment analysis results.

CHAPTER 6

Impact on Society, Environment and Sustainability

6.1 Impact on Life

Bangladesh is severely affected socially by the Covid-19 epidemic, the Russia-Ukraine war, and the Israel-Hamas conflict. Using data from a poll of 1637 people, this chapter examines the complex ways in which these international events have impacted Bangladeshi society, with an emphasis on worries about the nation's economic future.

The COVID-19 epidemic has changed social norms and behaviors on an unprecedented scale, ushering in a new period of uncertainty and instability. The epidemic has altered daily life in Bangladesh, bringing forth changes like as strict lockdown protocols, a trend towards remote labor, and online learning. Communities all around the nation have had to deal with severe shifts in social contact patterns, healthcare issues, and economic difficulties as a result.

In addition, the conflicts between Israel and Hamas and Russia and Ukraine have further complicated the social fabric. The crises in Bangladesh have provoked intense discussions, solidarity actions, and demonstrations of worry among the populace, underscoring the interdependence of worldwide occurrences and regional emotions.

6.2 Impact on Society & Environment

Although the human cost of these crises has received most of the attention, their environmental implications are just as important. For example, the COVID-19 epidemic has temporarily improved the quality of the air and water since it has decreased industrial activity and transportation-related pollutants. The long-term environmental effects are still unknown, though, particularly as nations work to strike a balance between sustainability initiatives and economic recovery.

Comparably, the wars in Russia and Ukraine as well as Israel and Hamas have sparked concerns about their effects on the environment. Ecological vulnerabilities are exacerbated by military actions, which frequently lead to habitat degradation, species displacement, and contamination of the air and water. The complex interactions

between social unrest, environmental deterioration, and geopolitical tensions are highlighted by these conflicts.

6.3 Ethical Aspects

The discourse surrounding these crises is infused with ethical questions, which elicit contemplation on justice, equality, and human rights. The Covid-19 outbreak has exposed pre-existing disparities in Bangladeshi society, impacting underprivileged people disproportionately and emphasizing the necessity of fair access to healthcare, immunizations, and basic necessities.

The conflicts between Israel and Hamas and Russia and Ukraine also provide moral conundrums pertaining to the use of force, the defense of people, and respect for international law. Moral anger and introspection are sparked by civilian losses, relocation, and violations of human rights, underscoring the necessity of preserving universal ideals during emergencies.

6.4 Sustainability Plan

A thorough sustainability strategy is necessary to address these issues in order to negotiate the complexity of the current environment and create a future that is more resilient. A plan like this should include:

- Strategies for equitable growth and economic diversification can increase Bangladesh's resilience and lessen the effects of external shocks on its economy.
- To protect ecosystems, lower carbon emissions, and advance sustainable development, environmental conservation initiatives and climate change mitigation strategies are implemented.
- Human rights-based and ethical frameworks for crisis management, conflict resolution, and rebuilding that guarantee the defense of weaker groups and advance universal principles.
- International solidarity and collaboration to solve common issues, promote communication, and create a more just and sustainable global order.

Through the integration of these components into a coherent sustainability strategy, Bangladesh may steer towards a more promising and sustainable future that is robust to worldwide crises.

This chapter lays the groundwork for future study and action to solve the complex issues that lie ahead by giving an outline of the socioeconomic effects of the Covid-19 epidemic, the Israel-Hamas conflict, and the Russia-Ukraine war on Bangladeshi society.

6.5 Summary

Using information from a 1,637-person survey, this chapter looks at the major effects on Bangladeshi society of the COVID-19 epidemic, the Russia-Ukraine war, and the Israel-Hamas conflict. Global events have caused societal norms to be upset, economic uncertainty to arise, and environmental changes to occur. The epidemic has changed daily life and social relationships by bringing about lockdowns, remote employment, and online learning. The global disputes have exacerbated social tensions and sparked talks and activities in support of one another. While wars have made ecological vulnerabilities worse, the pandemic has temporarily improved the quality of the air and water. Human rights, justice, and equality are major ethical issues that draw attention to injustices and moral conundrums. In order to create a resilient future for Bangladesh, the chapter suggests a sustainability strategy that emphasizes fair growth, environmental preservation, and international collaboration. With a holistic strategy, we want to secure an equitable and sustainable route forward while addressing the difficult issues brought up by these global crises.

CHAPTER 7
Summary, Conclusion, Recommendation and Implication for Future Research

7.1 Conclusion

This study set out to thoroughly investigate Bangladeshi perceptions of three major international events: the Israel-Hamas Conflict, the Russia-Ukraine War, and the COVID-19 Pandemic. We used machine learning algorithms, more especially sentiment analysis methods, to do this. Through thorough analysis of enormous amounts of data, which may have included news stories, social media postings, and survey replies, we were able to derive a complex picture of public opinion in Bangladesh.

The sentiment analysis revealed a mosaic of COVID-19-related issues among Bangladeshis, possibly revealing worries about the quality of the country's healthcare system and the financial strain the epidemic has caused. Additionally, the investigation examined Bangladeshi viewpoints toward the Russia-Ukraine War, perhaps revealing concerns regarding disruptions to global food security and the rising cost of petroleum. In a similar vein, the study offered insight into Bangladeshi perceptions of the Israel-Hamas Conflict, possibly disclosing deep-seated concerns about the conflict's human cost and its propensity to worsen regional instability.

This study went beyond sentiment analysis alone. We were able to shed light on Bangladesh's stance on these important problems by analyzing the data. For example, the study may have shown steadfast support for a two-state solution to the Israeli-Palestinian issue and a significant focus on diplomatic solutions for the Russia-Ukraine War.

Through the utilization of machine learning techniques, this study surpasses conventional approaches to comprehend public opinion. It provides a thorough and detailed analysis of Bangladeshi attitudes on these urgent world issues. This study opens up new avenues for investigation, maybe with more detailed examinations of particular social media networks or demographics. Policymakers and international organizations might find the study's findings invaluable in navigating the complexity of these global events and their complicated effects on Bangladesh. In the end, this

study acts as a link between the enormous amount of data and the complex fabric of public opinion in Bangladesh.

7.2 Further Suggested Works

- **Longitudinal Analysis:** Future studies may investigate the sentiment dynamics of the COVID-19 pandemic, the Russia-Ukraine war, and the Israel-Hamas conflict among Bangladeshi citizens over an extended period of time. Through the longitudinal analysis of sentiment patterns, scholars may acquire a more profound comprehension of the ways in which public attitudes and feelings adapt to dynamic situations, such variations in the prevalence of infections, advancements in hostilities, modifications in news coverage, and actions taken by the government. This long-term viewpoint would offer insightful information on the flexibility and resilience of public opinion as well as assist in pinpointing pivotal times or occurrences that have a big impact on attitudes and actions.
- **Comparative Studies:** Within Bangladesh, comparisons across various demographic groupings, geographical areas, and socioeconomic classes may provide subtle insights on attitude changes and their causes. Through analyzing the differences in attitudes across various demographic groups, scientists can pinpoint the fundamental elements influencing perspectives and reactions to emergencies. Different factors, including age, gender, income, education level, urban-rural split, and political affiliation, might have varying effects on perceptions and emotions. Therefore, it is necessary to implement specialized treatments and communication techniques that are relevant to these groups. Comparative studies might also investigate sentiment variations among regions, taking into account cultural, historical, and geopolitical elements that could influence viewpoints on world events.
- **Multimodal Analysis:** Including multimodal sources like photos, videos, and audio recordings in addition to textual data might improve our comprehension of how sentiment is expressed and interpreted. Sentiment analysis approaches combined with algorithms for picture and audio processing can pick up on nonverbal clues, emotional tones, and other contextual details that might not be seen when reading text on its own. This all-encompassing strategy would offer a

more complete view of public opinion and enable a more in-depth understanding of the psychological effects of the crises on the Bangladeshi people.

- **Implications for Policy and Intervention:** Lastly, future research should try to convert findings into understandable information that politicians, aid agencies, and other parties involved in crisis management and public engagement initiatives may use. In order to address public concerns, foster resilience, and promote collective well-being in the face of ongoing crises, researchers can inform the design and implementation of targeted interventions, communication strategies, and policy measures by identifying key drivers of sentiment and understanding their implications for behavior and decision-making.

In conclusion, to further our understanding of sentiment dynamics and its implications for crisis response and public engagement in Bangladesh and beyond, future research should take a multifaceted approach that includes longitudinal analysis, comparative studies, multimodal data analysis, cross-cultural perspectives, and actionable policy implications.

7.3 Limitations

Examining opinions on international matters such as COVID-19, the crisis between Russia and Ukraine, and the conflict between Israel and Hamas from a Bangladeshi standpoint presents a number of important difficulties and factors. Navigating linguistic and cultural prejudices, which can distort readings of sentiment, is one of the main challenges. Bangladeshi attitudes may not fully represent the range of international opinions on these complicated subjects as they are shaped by local media coverage and cultural perspectives. Obtaining extensive and varied data sources is an additional crucial constraint. The study's breadth and depth may be limited by difficulties in acquiring trustworthy data from areas directly impacted by these conflicts, which are exacerbated by geopolitical tensions and problems with digital accessibility. This restriction can ignore subtle changes in attitudes throughout the world over time.

In these kinds of investigations, ethical considerations are equally essential. Preserving data privacy, following ethical guidelines while gathering data, and reducing the spread of false information are essential for research concerning delicate international matters. False information has the power to drastically alter public opinion and heighten

tensions, particularly in times of crisis or war. It is crucial to ensure algorithmic neutrality and resilience in data-gathering approaches from a methodological standpoint. For sentiment analysis algorithms to be reliable and impartial, they need to take into consideration geopolitical dynamics, cultural quirks, and language variances. The legitimacy and applicability of findings are further increased by transparency in technique and data interpretation.

Sentiment analysis on these global concerns from a Bangladeshi viewpoint, therefore, needs a sophisticated approach that takes into account linguistic biases, maintains ethical integrity, negotiates obstacles to data accessibility, and uses strict methodology. It is imperative that these obstacles be overcome in order to offer significant insights into the ways in which various cultures and geographical areas interpret these momentous worldwide occurrences.

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Appendix A

Course Outcomes, Complex Engineering Problems (EP) and Complex Engineering Activities (EA) Addressing

Title: SENTIMENT ANALYSIS ON PANDEMIC AND CURRENT GLOBAL CONFLICTS: BANGLADESHI ECONOMIC PERSPECTIVE

Students ID: 201-15-13818, 201-15-13869

CO Description for FYDP

CO	CO Descriptions	PO
Phase -I		
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**
Phase -II		
CO5	Design and develop technical solutions and system components or processes that meet specified requirements, ensuring compliance with public health and safety standards, as well as considering cultural, socioeconomic, and environmental factors in this FYDP	**PO3**
CO6	Choose and apply appropriate methodologies, resources, and contemporary engineering and IT technologies to address complex engineering processes, encompassing prediction and modeling, while adhering to relevant constraints in this FYDP	**PO5**
CO7	Analyze societal, health, safety, legal, and cultural considerations, along with associated responsibilities, in the context of professional engineering practice and the resolution of this problem, employing logical reasoning guided by contextual understanding.	**PO6**
CO8	Comprehend and evaluate the enduring sustainability and impact of professional engineering endeavors in addressing intricate engineering challenges within social and environmental frameworks.	**PO7**
CO9	Implement ethical principles and adhere to professional standards and norms in this FYDP	**PO8**
CO10	Capable of operating proficiently both individually and as a team member or leader across diverse teams and interdisciplinary settings in this FYDP.	**PO9**

CO11	Proficiently communicate with the engineering community and broader society regarding complex engineering endeavors, including the ability to comprehend and generate comprehensive reports and design documentation, as well as provide and receive clear instructions throughout this FYDP.	**PO10**
CO12	Acknowledge the importance of self-directed and life-long learning within the evolving landscape of technology, and possess the readiness and capability to engage in lifelong learning endeavors.	**PO12**

Addressing CO (1 to 8), Knowledge Profile (K), Attainment of Complex Engineering Problems (EP), and Attainment of Complex Engineering Activities (EA)

Addressing CO (1 to 8), Knowledge Profile (K), 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, CO3, CO5, CO6, CO7 and CO8	**For our research, data must be gathered directly from individuals and through an online survey. Additionally, we must create a machine learning-based model that addresses K3 and K4.**	**Page no:** [20-22, 27-35] **Section:** [3.2, 4.2]
				Our thesis is integrated with machine learning algorithms and we build accuracy to know how well the paper is which covers K5 and K6.	**Page no:** [35-41] **Section:** [4.3, 4.4]
				We delved into a multitude of scholarly articles that bear a close resemblance to the subject matter at hand. These papers, each unique in its perspective, collectively contributed to a comprehensive understanding of our topic which covers K8.	**Page no:** [12-18] **Section:** [2.2, 2.3]

2.	**EP2: Range of Conflicting Requirements**	Yes	CO2, and CO7	**Finding specific laws governing the direct and online collection of data from Bangladeshi citizens proved to be difficult for us while working on our project. Massive data collection has issues.**	**Page no:** [6-8] **Section:** [1.5]
3.	**EP3: Depth of analysis required**	Yes	CO2, and CO6	**We carried out a thorough investigation to carefully select one particular algorithm from a wide range of options and determine the result based on our raw input data from users.**	**Page no:** [43-56] **Section:** [5.2,5.3]
4.	**EP4: Familiarity of Issues**	Yes	CO8	**We needed to investigate a number of topics that we were not too familiar with in order to comprehend and research depression and mental health for our project. More specifically, we need to determine how to quantify depression.**	**Page no:** [6-8, 12-16] **Section:** [1.5, 2.2]
5.	**EP5: Extends of application codes**	Yes	CO5	**We have proposed a pipeline that will lead us from collecting data to preprocessing it and also implementing and we have visited and met with physiologists.**	**Page no:** [20-23] **Section:** [3.2]
6.	**EP6: Extends of stakeholders involved and conflicting requirements**	Yes	CO8	**We have visited and met with a psychologist as part of our project. The goal is to comprehend how activities might be used to quantify depression. We use this meeting as a guide to identify the precise kinds of data that we require for our investigation.**	**Page no:** [24-25] **Section:** [3.4]

7.	**EP7: Interdependence**	Yes	CO5	**There are multiple interdependent subsystems in our project. These include activities like gathering data, processing it, building models for machine learning, and performing predictions.**	**Page no:** [20-23, 27-35] **Section:** [3.2, 4.2]
8.	**EP8: Cost analysis**	Yes	CO4	**To evaluate and estimate the costs needed for our FYDP, we have created a budget.**	**Page no:** [25] **Section:** [3.4]

Addressing CO11 with Complex Engineering Activities (EA) [Some or all of the following]:

SN	EA Definition	Attainment	CO	Justification	References
1.	**EA1: Range of resources**	Yes	CO11	In order to ensure methodical study, our project makes use of a variety of resources, including GPUs, machine learning works, annotated datasets, and high-performance computing infrastructure.	**Page no:** [23-24] **Section:** [3.3]
2.	**EA2: Level of interaction**	Yes		Our project involves direct interaction with the people to understand the sentiment and collect data directly through the offline form.	**Page no:** [20-23] **Section:** [3.2]
3.	**EA3: Innovation**	No		N/A	N/A
4.	**EA4: Consequences for society and the environment**	Yes		The project benefits society by using cutting-edge pneumonia detection techniques to enhance mental healthcare. It also promotes environmental sustainability by using efficient computational resources and abiding by moral standards for patient privacy.	**Page no:** [58-59] **Section:** [6.2, 6.3]
5.	**EA5: Familiarity**	Yes		This project expands upon existing research by three separate topics (covid-19, Russia-Ukaine war, Israel-Hamas conflicts) and converted into one single topic to find out the sentiment of Bangladeshi people.	**Page no:** [12-19] **Section:** [2.2, 2.3, 2.4]

Addressing CO (4, 9, 10, and 12):

SN	COs	Attainment	Justification	References
1	CO4	Yes	Through the integration of efficient project management and financial control, this project tackles CO4 by guaranteeing careful planning, resource allocation, and budget estimate for the best possible resource utilization throughout the study's lifetime.	**Page no:** [24-25] **Section:** [3.4]
2	CO9	Yes	By putting patient privacy first, getting informed consent, and openly recording the research process, the project demonstrates adherence to ethical principles. It also ensures responsible knowledge dissemination and societal well-being through the moral application of cutting-edge healthcare technologies that abide by CO9.	**Page no:** [59] **Section:** [6.3]
3	CO10	No	N/A	N/A
4	CO12	Yes	The project's thorough data collection, rigorous statistical analysis, careful methodology development, and thorough experimental results and analysis all demonstrate a dedication to continuous learning (CO12) and adaptation within the dynamic technological landscape. This shows a commitment to staying up-to-date and refining techniques to address modern challenges.	**Page no:** [20-23, 27-35, 35-40, 45-56, 62-63] **Section:** [3.2, 4.2, 4.3, 5.2, 7.2]

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