

DETECT CYBERBULLYING FROM SOCIAL MEDIA ON BANGLA TEXT

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

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APPROVAL

This Project titled “DETECT CYBERBULLYING FROM SOCIAL MEDIA ON BANGLA TEXT”, submitted by **Imtiaz Ahmmed Asif**, ID No: 191-15-12508; and **Apurbo Roy**, ID No: 191-15-12598 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 29 January 2023.

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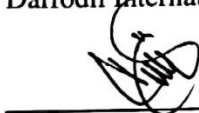
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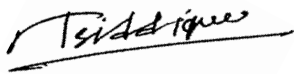


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DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Shah Md. Tanvir Siddiquee, Assistant Professor, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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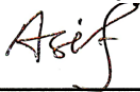


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ABSTRACT

The potential of social media is growing as more people use it every day. However, as more people use social media, bullying is also becoming more common in the comment sections of posts by well-known users and viral contents. This number of bullying texts is also increasing and it should be removed before it is displayed. In this analysis, we identify cyberbullying in Bangla texts using some natural language processing (NLP) methods and Machine learning classifier algorithms. We manually created our dataset by collecting the pure Bangla text comments from popular social media platforms like Facebook and YouTube. We get 3524 data, of which 22.1% are about bullying statements and 77.9% are not. We split the data into train dataset and test dataset groups after preprocessing them for the classifier model where train dataset contains 70% of total data and test dataset contain 30% data. Although we implement a number of algorithms, where Multinomial Naïve-Bayes (MNB) had a high accuracy rate of 78.99%, while Decision Tree Classifier had a low accuracy rate of 69.48%. On the other hand, KNeighborsClassifier required the least amount of time, 0.0018 seconds while RandomForestClassifier required the most, 1.44 seconds.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Using electronic media or devices for harass someone or some group of people is cyberbullying. Some countries laws consider it as a crime. And some countries still not consider it a crime but it is not legal in almost every country.

Nowadays we are surrounded by the internet, on this case, we can say social media. More the day is passed more people joining on the internet. According to the International Telecommunication Union (ITU), as of 2021, there were approximately 4.9 billion internet users worldwide, representing around 63% of the global population [1]. And almost 4.7 billion people use social media through the internet. Bullying commonly happens on social media. On Bangladesh, almost 49.55 million people use social media and the ratio of internet users is approximately 29.7% of the population [2]. And the number is increasing daily.

Most of the cyberbullying is happen on social media and the majority are comments. When someone doesn't like anyone's personality or the content or may envy him/her they make a bad comment because it's easy.

Cyberbullying can cause feelings of anxiety, depression, and low self-esteem, and can even lead to more serious mental health problems such as suicidal thoughts. affect learning ability can make serious mental damage, for this kind of damage people sometimes struggle to focus on work/study. Sometimes this type of bullying causes chaos in the real world.

Because there are so many users and so much data on social media, it is impossible to manually identify and delete bullies.

So, we approach 9 algorithms to detect bullying. Naive Bayes, SVM, Logistic Regression, Decision Tree, Random Forest, AdaBoostClassifier, BaggingClassifier, SGDClassifier and KNeighborsClassifier algorithms.

1.2 Motivation

Bengali has over 260 million speakers and is the 5th most widely spoken language in the world, according to data from Ethnologies, a comprehensive directory of the world's languages. And the people are also using Bangla language on social media.

When we use social media like Facebook or twitter, we see there are so many bad comments. Not only bad comments sometimes the comments are so inappropriate that cannot be tolerable. Some comments are so bad that cannot be read loud in a public place. Not because the content is bad or deserves this type of comment but because this comment is done with people like us, and making a bad comment is so easy.

So, when someone bullies others on cyberspace it also goes on their own language (which is Bangla). The speaker of the Bangla language is mostly Bangladeshi and Indian, which are not that much of a developed country, and the people here are not so literal also. People here make more wrong reaction/comment than other developed countries people (on cyberspace). But working with Bangla language haven't done that much.

So, on this area work had been done as so little amount. The reason is Bangla language doesn't have a organize public data, a number of annotated corpora, named dictionaries, and morphological analyzer [3] So there is an opportunity to work in this field.

1.3 Rationale of the Study

Cyberbullying is an issue that is on the rise and has negative, long-lasting repercussions on young people's mental health and wellbeing. Despite the fact that this problem is becoming more known worldwide, there is still a lack of information regarding the traits and effects of cyberbullying as well as efficient preventative and corrective measures.

The foundation of this study is the rising of users are increasing social media and most of them are teenagers. Cyberbullying can be varied forms and most of them are threat or mock celebrity. Bullying one person with a group. Make embarrassing of public Figure. This will affect long terms mental health conditions.

To identify bullying text, we attempt Naive Bayes, SVM, Logistic Regression, Decision Tree, Random Forest, and other algorithms using data from social media. The study's findings will be examined in order to spot patterns in cyberbullying. The establishment of evidence-based policies and procedures for avoiding and combating cyberbullying, as well as the promotion of healthy and secure online environments for everyone, are some potential effects of this study.

1.4 Research Questions

Why are cyberbullying should be removed?

Would you be able to recognize a bullying text and understand it?

What are the difficulties in cyberbullying detection procedures in a manual way?

What is the effect on the mental health of cyberbullying?

How did the dataset is organized?

How can cyberbullying be detected and prevented, and what are the most effective interventions and strategies for addressing it?

1.5 Expected Output

As a few research has performed on Bangla text previously so our approach will help to detect Bangla bullying statements from social media platforms. We used some new algorithms, so it will help to analysis more in the future. We also find out the time complexities of those algorithms which will help to recognize bullying text accurately. If they can be recognized, with a further study this can be removed or can take some action about it.

1.6 Project Management and Finance

Because of using free tools and like google-colab, Google sheet, Windows 11, Ubuntu, and python which are free to use. We don't need any financial support. Also, the data we collect for our research, it was also on the public post comment. Also, we manage our research through online communication tool, like google meet, google doc.

1.7 Report Layout

There are six complete sections. Alternate points of view of every section are talked about and each section has a few sections clarifying in subtleties. This report paper contains the accompanying substance as given

Chapter 1

In this chapter, there are some parts such as- 1.1 Discuss about Introductions, 1.2 Discuss about Motivation, 1.3 Rational of the Study, 1.4 Discuss about Research Questions, 1.5 Expected Output, 1.6 Report layout

Chapter 2

In this chapter we discuss Background Studies of the work. There are some sections like- 2.1 Preliminaries/Terminologies, 2.2 Related works, 2.3 Comparative Analysis and Summary, 2.4 Scope of the problem, 2.5 Challenges, 2.5.1 Non-Technical: Data Collection, 2.5.2 Technical: Methodology selection.

Chapter 3

In this chapter we explained the full working flow of our work and with some sections like- 3.1 Research Subject and Instrumentation, 3.2 Data Collection Procedure/Dataset Utilized, 3.3 Statistical Analysis, 3.4 Proposed Methodology/Applied Mechanism, 3.4.1 Pre-processing, 3.4.2 Algorithm Selection, 3.5 Implementation Requirements, 3.5.1 Software and Hardware, 3.5.2 Development Tools.

Chapter 4

This chapter covers Experiments and Results of the research and some relevant discussions as- 4.1 Experimental Setup, 4.2 Experimental Results & Analysis, 4.3 Discussion

Chapter 5

In this chapter, we have discussed Social Impact on our Society, Ethical Aspects in our research work like- 5.1 Impact on Society, 5.2 Ethical Aspects.

Chapter 6

In this chapter, it consists of the belief and destiny works of the studies with some sections like- 6.1 Summary of the Study, 6.2 Conclusion, 6.3 Implication for Further Study.

CHAPTER 2

BACKGROUND

2.1 Preliminaries/Terminologies

As English is the most used language in the world, considerable research has been performed on cyberbullying in this language. But in the Bangla language, only a few works have been performed to identify cyberbullying. Bangla is the primary and most used language in Bangladesh and West Bengal in India. Almost 205+ million people speak Bangla [4], around 3.05% of the world's population, and social media users are also millions of people. In 2022, there are 44.70 million Facebook users in Bangladesh, which is 26.8 percent of the total population, and there are also 34.50 million YouTube users, which is 20.6 percent of Bangladesh's total population [2]. Approximately 42 million Facebook users use the Bangla language in social media, which is almost 1.9% of Facebook users [4]. As a few works have been performed in this language, we are trying to detect cyberbullying in this language.

2.2 Related Works

A. Al-Mamun and Shahin [5] applied various supervised learning methods to detect social media bullying on Bangla text. The research was done by collecting 2400 data from Facebook and Twitter, where the data contained 10% bullying text, and applied a 10-Fold cross-validation model to test the developed models' performance, where the training and testing process was carried out in two phases. The main phases include text-based features, and both text-based features and user information in the second phase. Each data was manually labeled and performed in various supervised languages, including SVM, Naïve Bayes, J48, and KNN. SVM performed best in both stages with high accuracy.

P. Chakraborty and H. Seddiqui [6] implemented MNB, SVM, and CNN-LSTM to identify cyberbullying by collecting 5644 Bangla texts. They labeled it manually based on the comments and found that Liner SVM performed better for the balanced data and

that CNN-LSTM gives higher accuracy than other techniques when the data set increased.

SVM, Logistic Regression (LR), Random Forest and Passive Aggressive (PR) classifiers were used by R. Ghosh, S. Nowal, and Dr. G. Manju [7] to detect social media cyberbullying in Bangla text. The experiment's outcome showed that the Passive Aggressive classifier had the highest accuracy when used with N-gram level TFIDF feature extraction. However, the Support Vector Machine performed better than others using word-level feature extraction.

Md. T. Ahmed et al. [8] used SVM, Multinomial Naïve Bayes, Logistic Regression, and XGBoost to detect Bangla and Romanized Bangla cyberbullying texts by collecting 12000 texts from YouTube by preparing three datasets, where 5000 Bangla texts and 7000 Romanized Bangla texts.

Estiak Ahmed et al. [9] applied the Deep Learning approach to detect abusive Bengali texts. Collecting the public comment sections of different social media sites and online resources using language detectors, they collected 4700 data labeled by 7th different classes according to the comments. After applying the machine learning approach, they found Linear SVC with CountVectorizer achieves the highest accuracy compared to other classifiers. They compared RNN against Linear SVC TF-IDF Vectorizer and Linear SVC CountVectorizer in the Deep learning algorithm, where RNN with LSTM performs better in detecting abusive Bengali texts.

SVM and Naïve Bayes classifiers approach used by Dalvi, Chavan, and Halbe [10] to propose a model to detect and prevent Twitter cyberbullying in a particular location's real-time tweets using Twitter API. They collect data sets from datasets from various sources like Kaggle and GitHub and preprocess the data using the Natural Language Toolkit (NLTK). Unfortunately, the Nave Bayes classification performs poorly, whereas the SVM performs best.

2.3 Comparative Analysis and Summary

A few research has been performed previously. As we researched the same topics, we needed to analyze their papers and understand the algorithms for better accuracy. So we read all those papers and tried to understand their experiments and the output result. But all the previous analysis was performed by collecting the data using API, where the root syllable may be cut or separated when we remove the non-English sentences from the main text. In our experiment, we performed with only Bangla text to achieve higher accuracy in detecting the term cyberbullying in Bangla text. So, we collected the comments manually from social media, which were written in Bangla words.

TABLE 1: COMPARATIVE ANALYSIS REFERRING PAPERS ARE: PAPER 1 [5], PAPER 2 [6], PAPER 3 [8], PAPER 4 [9], PAPER 5 [7]

Index	Algorithm's	Paper 1	Paper 2	Paper 3	Paper 4	Paper 5
01	Multinomial Naive Bayes	40.98%	70%	84%	79.66%	
02	SVM	95.32%	78%	83%	80.93%	77.70%
03	Decision Tree	91.07%	-	-	-	-
04	AdaBoost Classifier	-	-	-	-	-
05	Random Forest	-	-	-	73.72%	77.10%
06	Logistic Regression	-	-	83%	77.96%	77.50%
07	SGD Classifier	-	-	-	-	-
08	KNeighbors Classifier	85.10%	77.50%	-	-	-
09	Bagging Classifier	-	-	-	-	-
10	RNN	-	-	-	82.20%	-
11	ANN	-	-	-	34.65%	-

12	Passive Aggressive Classifier	-	-	-	-	78.10%
13	XGBoost	-	-	78%	-	-

2.4 Scope of the Problem

Because, on social media, people use the short-term word and mix languages like English and Bangla. Sometimes they also use Bangla words by using non-Bangla and non-English languages properly, which we call Banglish (a Bangla word written in English). For example, ' Ami cyberbullying sanakto korte kaj kortechi (I am working for cyberbullying detection).' Sometime people use the short form of a word.

Therefore, it was challenging to understand the word and preprocess of the data in these languages. Consequently, we skipped these types of comments.

2.5 Challenges

There are two types of problems that we faced in completing this research.

- Non-Technical: Data Collection
- Technical: Methodology selection.

2.5.1 Non-Technical (Data Collection):

There were too many comments in a Facebook/YouTube post, and it was challenging to find a bullying or non-bullying statement manually. Due to the difficulty of Bangla and non-Bangla (mixed) content on social media, it is challenging to understand the pure Bangla bullying data and classify the info into bullying and non-bullying comments/conversation, it's also challenging to identify based on the post or topic, which text is bullying and which is not.

2.5.2 Technical (Methodology selection):

All previous research followed almost the same approach. Moreover, the algorithm's performance and accuracy varies due to the non-Bangla (mixed) content. An analysis reported that the supervised techniques worked effectively for the Indian Language text

classification [11] problem. Recent works for the Bangla language shows that the Support Vector Machine (SVM) works best in most of the times compared to other classifier algorithms.

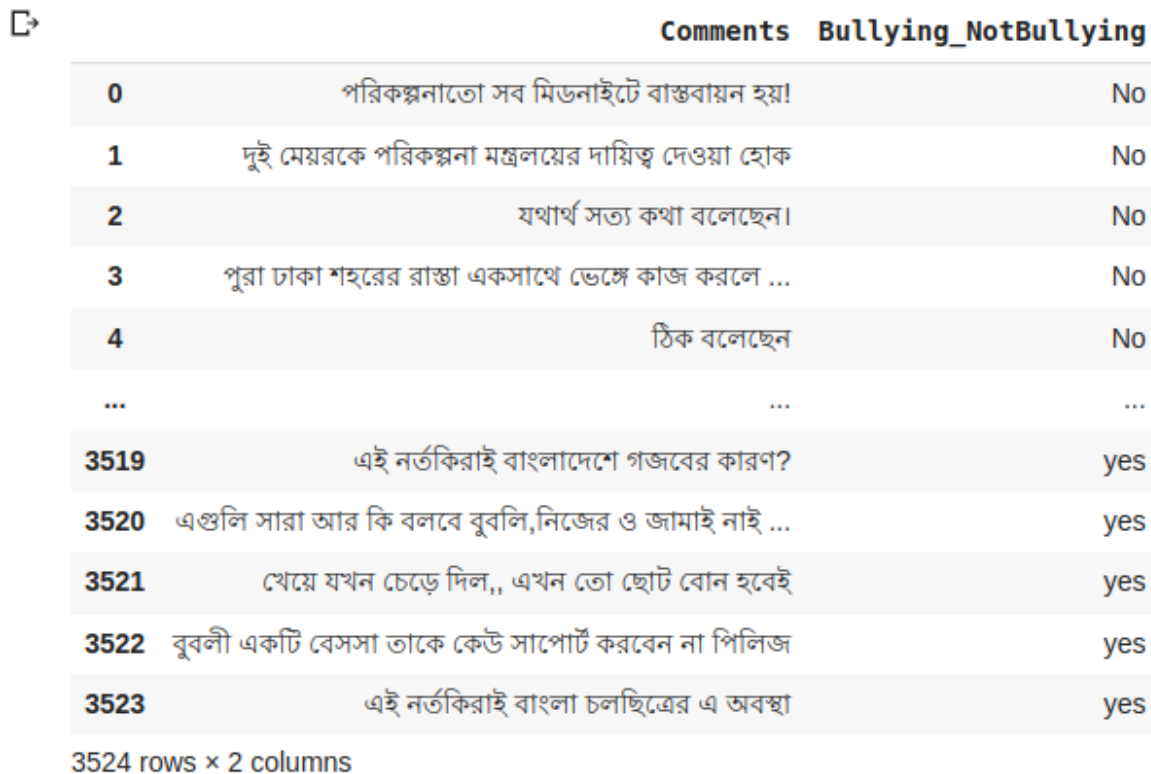
We are working on Bangla comments, which can contain new lines, emojis, mixed text, etc. So, we need to clean the data before applying the algorithms. There are some common algorithms which used previously, so we selected some of those algorithms which has better accuracy in previous research's and added some new algorithms that were not used previously.

CHAPTER 3 RESEARCH METHODOLOGY

3.1 Research Subject and Instrumentation

An analysis reported that in November 2022, in Bangladesh, Facebook and YouTube were the most popular website in Bangladesh. Where Facebook users are 91.75%, and YouTube user is 4.99% [12]. So, the conversation on those two popular social media platforms is huge. So, there are a vast number of comments.

Collecting the data was the hard part for us. Because we want that the data-set should be unique and accurate. After collecting 3524 individual comments we need the help of some prebuilt environments and supervised algorithms like google collab as an environment and some classifier algorithms to analysis the result.



	Comments	Bullying_NotBullying
0	পরিকল্পনাতো সব মিডনাইটে বাস্তবায়ন হয়!	No
1	দুই মেয়রকে পরিকল্পনা মন্ত্রলয়ের দায়িত্ব দেওয়া হোক	No
2	যথার্থ সত্য কথা বলেছেন।	No
3	পুরা ঢাকা শহরের রাস্তা একসাথে ভেঙ্গে কাজ করলে ...	No
4	ঠিক বলেছেন	No
...
3519	এই নর্তকিরাই বাংলাদেশে গজবের কারণ?	yes
3520	এগুলি সারা আর কি বলবে বুবলি,নিজের ও জামাই নাই ...	yes
3521	খেয়ে যখন চেড়ে দিল,, এখন তো ছোট বোন হবেই	yes
3522	বুবলী একটি বেসসা তাকে কেউ সাপোর্ট করবেন না পিলিজ	yes
3523	এই নর্তকিরাই বাংলা চলচ্চিত্রের এ অবস্থা	yes

3524 rows × 2 columns

Figure 3.1: Dataset sample

3.2 Data Collection Procedure/Dataset Utilized

We collected Bangla comments data manually from Facebook and YouTube. However, collecting Bangla bullying and non-bullying data from vast numbers of comments on a post where Bangla, English, and Mixed language were present was tough. So, we made a plan and a list of where we could find most Bangla comments. Most of the time, celebrities and media are the victims of cyber-billing, and making a nasty comment is very easy because of a lack of action on cyberbullying.

	A	B	C	D
		Comments	Bullying_NotBullying	PostLink
1		পরিকল্পনাতো সব মিডনাইটে বাস্তবায়ন হয়।	No	https://www.facebook.com/DailyProthomAlo
2	1	দুই মেয়রকে পরিকল্পনা মন্ত্রনয়ের দায়িত্ব দেওয়া হোক	No	https://www.facebook.com/DailyProthomAlo
3	2	যথার্থ সত্য কথা বলেছেন।	No	https://www.facebook.com/DailyProthomAlo
4	3	পুরা ঢাকা শহরের রাস্তা একসাথে ভেঙ্গে কাজ করলে জ্যাম তো লাগবেই।	No	https://www.facebook.com/DailyProthomAlo
5	4	ঠিক বলেছেন	No	https://www.facebook.com/DailyProthomAlo
6	5	মাথায় তো সারাক্ষন চুরির পরিকল্পনা	Yes	https://www.facebook.com/DailyProthomAlo
7	6	যখন একটা ছাগল বুঝতে পারে যে সে নিজে একটা লজিক্যাল প্রাণী, তখন এমনই হয়।	Yes	https://www.facebook.com/DailyProthomAlo
8	7	ধুর মিয়া আপনি কাজের চেয়ে কথা বেশি বলেন	Yes	https://www.facebook.com/DailyProthomAlo
9	8	আহারে ভোটোরবিহীন টাকলা।	Yes	https://www.facebook.com/DailyProthomAlo
10	9	ঐ এলাকায় আবার লোডশেডিং হয় নাকি??	No	https://www.facebook.com/DailyProthomAlo
11	10	হরতাল হবে ,সবাই মোনাজাত দর	No	https://www.facebook.com/DailyProthomAlo
12	11	দামড়া একটা	Yes	https://www.facebook.com/DainikJugantor
13	12	যার বুক খালি হয় সে বুঝে। আল্লাহ মা বাবাকে ধৈর্য ধরার তৌফিক দান করুক।	No	https://www.facebook.com/DainikJugantor
14	13	আসলে ঢাকার সড়কগুলোতে বাইক চালানো খুবই রিস্কের কাজ, আবার বড় বড় গাড়িগুলো সাইড তো দিতেই চায় না বরং ধাক্কা দিয়ে ফেলে দেয়। কেউ মনে করে। দুর্ঘটনায় পড়লে মানুষ আবার উদ্ধারও করতে যায় না বরং চুপ করে কেটে পড়ে।	No	https://www.facebook.com/DainikJugantor
15	14	কিছু কিছু বিষয়ে আবেগ দিয়ে কখনোই কোনো ডিসিশন নেওয়া ঠিক না, কারণ সন্তান সে তো আবেগী বয়স।	No	https://www.facebook.com/DainikJugantor
16	15	সড়ক দুর্ঘটনায় আর কত জীবন কেড়ে নিবে? এর কি শেষ নেই?	No	https://www.facebook.com/DainikJugantor
17	16	বেপরোয়া বাস আর ট্রাক ড্রাইভারদের কারণে এদেশের রাস্তা অনিরাপদ।	No	https://www.facebook.com/DainikJugantor
18	17	কবে আমরা সড়ক কে মুক্তা উৎপাদন কারখানা থেকে বিমুখী করতে পারবো? শুধু কি স্বপ্নই থেকে যাবে নিরাপদ সড়কের?	No	https://www.facebook.com/DainikJugantor
19	18	দুঃখজনক। সন্তানের সব আবদার মিটাতে নেই। হে আল্লাহ জামাত নসিব করুন।	No	https://www.facebook.com/DainikJugantor
20	19	শখ থাকা ভালো বেশি শখ ভালো না।	No	https://www.facebook.com/DainikJugantor
21	20			

Figure 3.2: Data collection in Excel File

We gathered this data from random Facebook/YouTube videos, Facebook or YouTube channel of celebrities, newspapers/media, etc with the post link. Here, we skipped these types of comments which are written in multiple languages.

3.3 Statistical Analysis

A total of 3500 Bangla data were collected, where 1622 data were from Facebook comments and 1878 data were from YouTube comments. When we collected the data, we labeled the data according to comments that were and weren't bullying. Therefore, we mark the statements as "Yes" if we find the bullying status and the statements as "No" if the data is not bullying. 22.1% of the total data were bullying data in our experiment, and 77.1% were non-bullying data.

Distribution of Comments in the Dataset

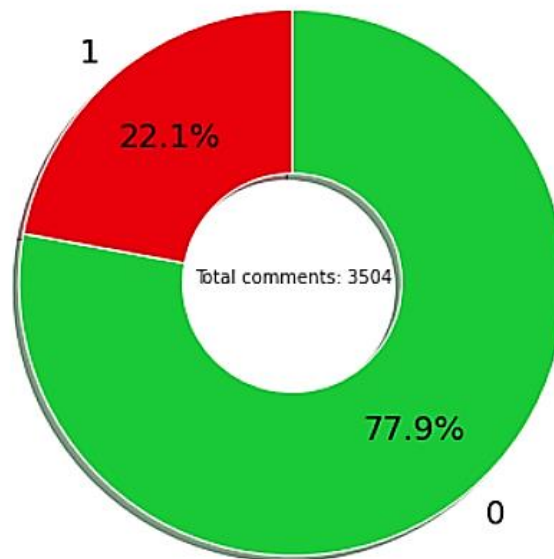


Figure 3.3: After putting the value yes = 1 and no = 0, here show that 22.1% is bullying comment and 77.9% is not bullying comment

3.4 Proposed Methodology/Applied Mechanism

Data is now new oil, but for our work, we collect 3524 unique individual comments from social media like Facebook and YouTube. We performed the task manually. And it takes a large time. That is how we ensure our data set legitimacy.

After collecting and labeling the data, it's time to analyze the result of the experiment. But our machine doesn't even understand the Bengali language, so how would he detect

the bullying and anti-bullying words? So, we needed to apply a methodology in which our machine could read the Bangla language and detect the Bangla bullying text, and then we performed some algorithms to analyze the result of our experiment.

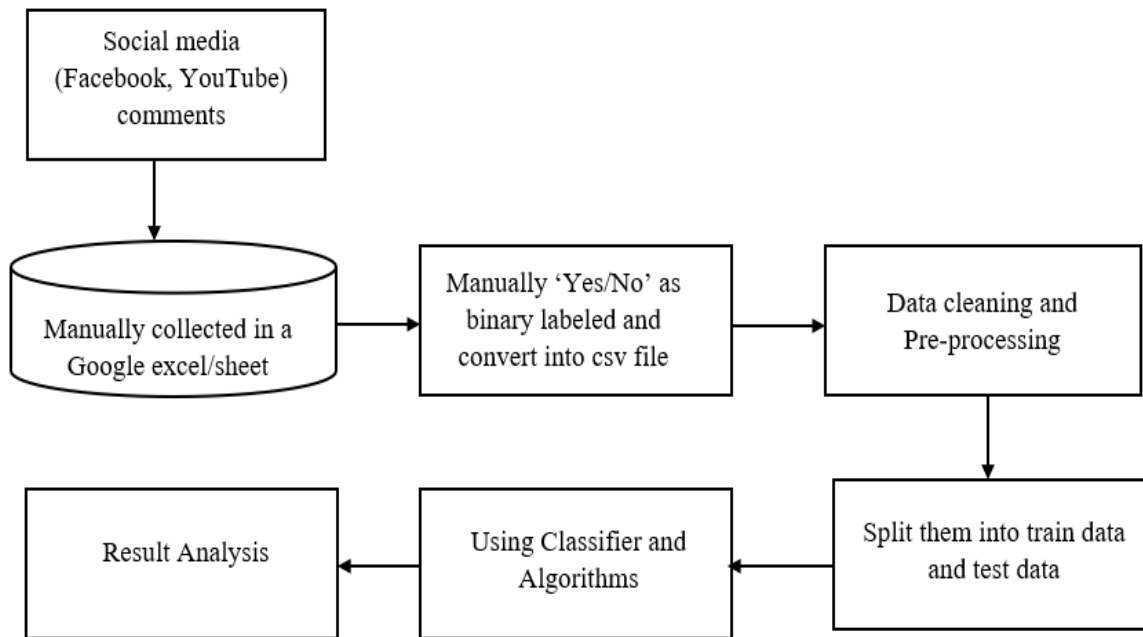


Figure 3.4: Proposed methodology

After completing the data collection process, we can divide our model into 2 main steps.

- Pre-processing.
- Algorithm's selection.

3.4.1 Pre-processing:

In this step, we prepared our dataset for performing algorithms. First, all special characters, emojis, and new lines were removed from the dataset and initialized Yes as '1' and No as '0' so that machine could understand bullying and nonbullying comments.

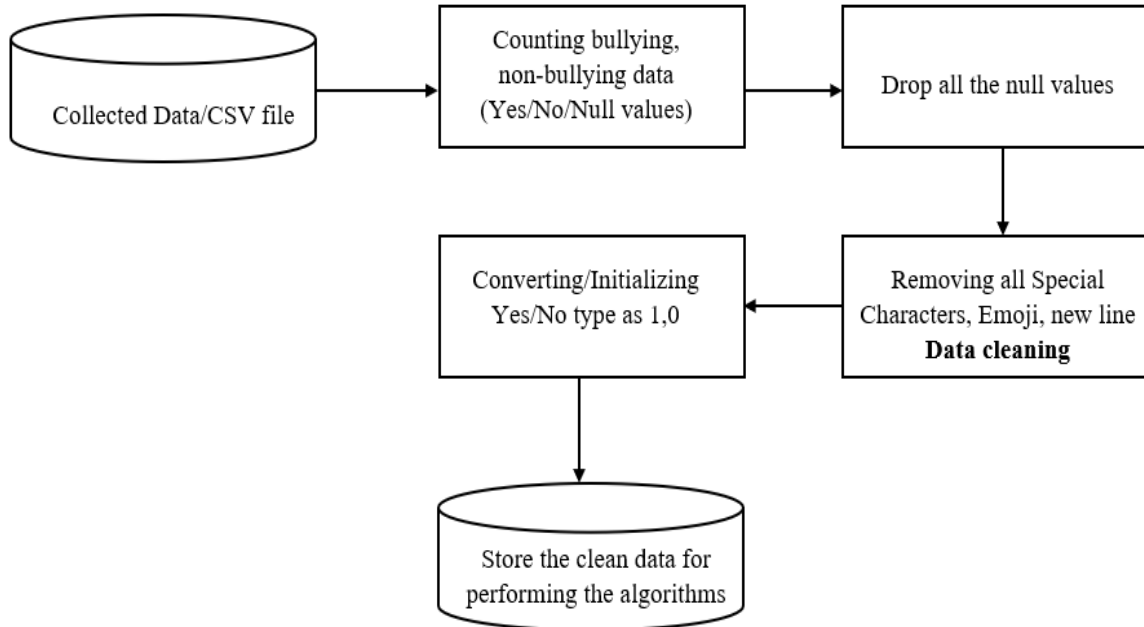


Figure 3.5: Data pre-processing steps.

3.4.2 Algorithm Selection:

In previous research, most of the time, they used the same algorithms to detect cyberbullying. We have used nine machine learning algorithms to find the best approach to detect cyberbullying.

The algorithms are:

- Multinomial Naive Bayes
- SVM
- Logistic Regression
- Decision Tree
- Random Forest
- AdaBoostClassifier
- BaggingClassifier
- SGDClassifier
- KNeighborsClassifier

We used those algorithms to detect the Bangla bullying statements where some of the algorithms never used before to detect bullying statements.

3.5 Implementation Requirements

The essential items of equipment required to construct the system and effectively run the model are listed below.

3.5.1 Software and Hardware:

- Intel Core i5 10th generation with 16GB RAM
- 256 GB SSD
- Google-Collab

3.5.2 Development Tools:

- OS (Windows 11/Ubuntu 20.04 LTS)
- Browser (Chrome)
- Python 3.7
- Sklearn
- NumPy
- bltk
- BnVec
- nltk
- Pandas.

We also need proper internet connection to run these programs. We were following our methodology and run the program on the google-collab. We load the csv file and analysis the result by using all requirements algorithms.

CHAPTER 4

EXPERIMENTAL RESULTS ANALYSIS AND DISCUSSION

4.1 Experimental Setup

Our research requires additional setup because our theory was converted into computer-readable code. As said, Python is the programming language used in our code.

To write our code, we use Google Colab. Colaboratory, often known as "Colab," is a product of Google Research. Colab is the best platform for machine learning, data analysis, and teaching since it enables anyone to create and execute arbitrary Python code in the browser. To access our collab through our google drive, we need a Gmail account. By importing the disk from Google Colab, we can access our drive and mount it at Colabe so that we may read and write on it. Some libraries that we import for our work: Sklearn, NumPy, bltk, BnVec, nltk, Pandas.

4.2 Experimental Results & Analysis

We have split the dataset into test data and training data. Test data contain 30% of the total data, and 70% are training data. After performing nine machine learning algorithms, we found that Multinomial Naïve-Bayes performs the best in detecting Bangla bullying comments from social media platforms for the test dataset. This method achieved the highest accuracy rate with 78.99%, whereas LogisticRegression is almost closer with a score of 78.61%.

↳

	Algorithm	Accuracy: Test	Precision: Test	Recall: Test	F1 Score: Test	Prediction Time
0	MultinomialNB	0.789924	0.533333	0.176991	0.265781	0.000870
1	LogisticRegression	0.786122	0.506024	0.185841	0.271845	0.000452

Figure 4.1: The accuracy rate of MNB and Logistic Regression

But the results changed when we applied those algorithms to the training dataset. For the training data, Decision-Tree Classifier and Random-Forest Classifier executed the best

results. These two methods achieved the same and highest accuracy rate of 99.02%. BaggingClassifier, Linear SVC, and SGDClassifier are also good for the training dataset, with a score of 96.28%, 91.59%, and 91.92%

	Algorithm	Accuracy: Test	Precision: Test	Recall: Test	F1 Score: Test	Prediction Time	Accuracy: Train
0	MultinomialNB	0.789924	0.533333	0.176991	0.265781	0.000870	0.847471
1	LogisticRegression	0.786122	0.506024	0.185841	0.271845	0.000452	0.864192
2	DecisionTreeClassifier	0.686312	0.285124	0.305310	0.294872	0.001827	0.990212
3	LinearSVC	0.756654	0.409639	0.300885	0.346939	0.000452	0.915987
4	AdaBoostClassifier	0.772814	0.410959	0.132743	0.200669	0.046604	0.804649
5	RandomForestClassifier	0.777567	0.471014	0.287611	0.357143	0.172440	0.990212
6	BaggingClassifier	0.750000	0.387879	0.283186	0.327366	0.023211	0.962887
7	SGDClassifier	0.752852	0.392405	0.274336	0.322917	0.002245	0.919250
8	KNeighborsClassifier	0.730038	0.338889	0.269912	0.300493	0.308010	0.803834

Figure 4.2: The highest accuracy rate of Training dataset

In the figure 4.2, we can see the Test-accuracy and Training accuracy after performing the 9 algorithms. In the training dataset the accuracy result is 99.02% which is excellent to detect bullying statements.

	Algorithm	Accuracy: Test	Precision: Test	Recall: Test	F1 Score: Test	Prediction Time	Accuracy: Train	Precision: Train	Recall: Train	F1 Score: Train	Training Time
0	MultinomialNB	0.789924	0.533333	0.176991	0.265781	0.000870	0.847471	0.811388	0.415301	0.549398	0.006613
1	LogisticRegression	0.786122	0.506024	0.185841	0.271845	0.000452	0.864192	0.875000	0.459016	0.602151	0.047739
2	DecisionTreeClassifier	0.686312	0.285124	0.305310	0.294872	0.001827	0.990212	0.998102	0.958106	0.977695	0.086465
3	LinearSVC	0.756654	0.409639	0.300885	0.346939	0.000452	0.915987	0.915254	0.688525	0.785863	0.066217
4	AdaBoostClassifier	0.772814	0.410959	0.132743	0.200669	0.046604	0.804649	0.680412	0.240437	0.355316	0.146292
5	RandomForestClassifier	0.777567	0.471014	0.287611	0.357143	0.172440	0.990212	0.994350	0.961749	0.977778	0.975671
6	BaggingClassifier	0.750000	0.387879	0.283186	0.327366	0.023211	0.962887	0.965447	0.865209	0.912584	0.650786
7	SGDClassifier	0.752852	0.392405	0.274336	0.322917	0.002245	0.919250	0.922892	0.697632	0.794606	0.012320
8	KNeighborsClassifier	0.730038	0.338889	0.269912	0.300493	0.308010	0.803834	0.583333	0.433515	0.497388	0.001662

Figure 4.3: Accuracy time, Precision time, Recall time, F1 score of our experiment

The figure 4.3 indicate all the result of accuracy, precision, recall score, prediction time and training time for the test dataset and training dataset.

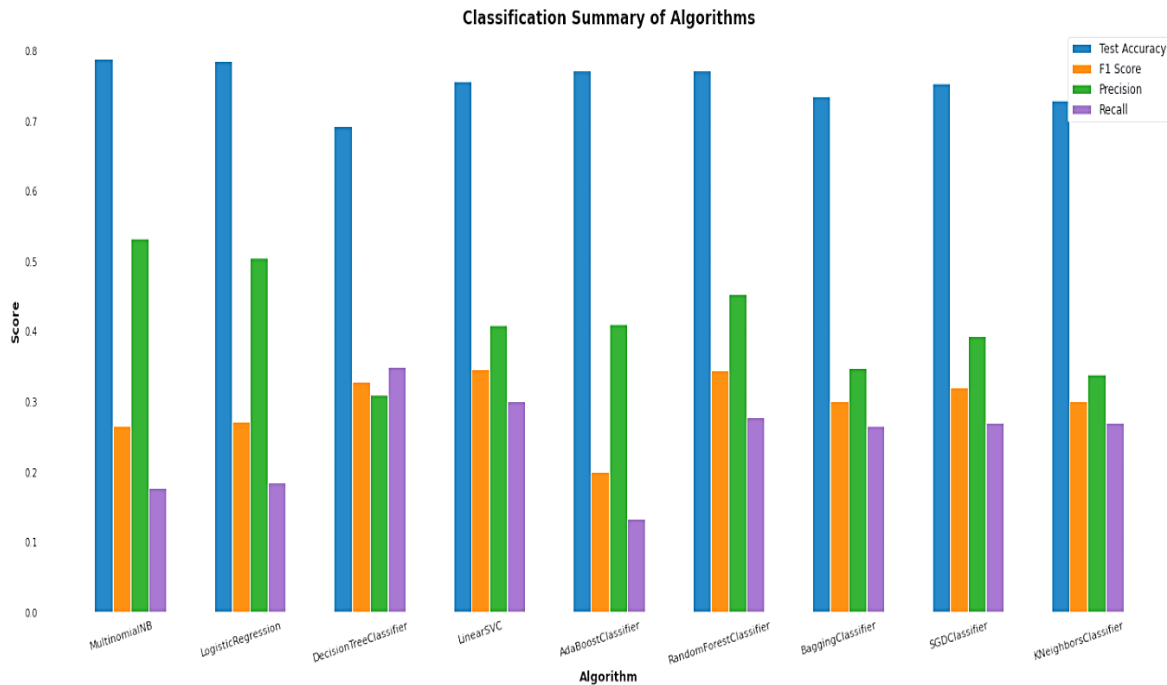


Figure 4.4: Classification summary of algorithms

The figure 4.4 indicate the result of test accuracy, F1 score, precision, recall score for test dataset. Where MNB achieved the highest test accuracy and precision score. The Logistic Regression is also achieved performing well in both scores and almost closer with MNB. On the other hand, Decision-Tree Classifier achieved the highest recall score and Random Forest classifier was achieved the highest F1 score.

Best Accuracy: 0.790 - MultinomialNB
Best F1 Score: 0.357 - RandomForestClassifier
Best Precision: 0.533 - MultinomialNB
Best Recall: 0.305 - DecisionTreeClassifier

Figure 4.5: Best Accuracy time, Precision time, recall time, F1 score of our experiment

The figure 4.4 indicate the best accuracy time, precision time, recall time, F1 score where MNB performing well in accuracy and precision Decision-Tree Classifier achieved the

highest recall score and Random Forest classifier was achieved the highest F1 score in our experiment.

We also perform the time complexity of these algorithms, where the Logistic Regression classifier performs faster than the others. The prediction time for this algorithm is 0.0005s. KNN has the worst prediction time, which is 0.3080s. Multinomial Naive Bayes is also performing well, with a score of 0.0008s

Best Prediction Time: 0.0005 - LogisticRegression
Worst Prediction Time: 0.3080 - KNeighborsClassifier

Figure 4.6: Best and worst prediction time

The KNeighbors Classifier algorithm is faster for training time with a score of 0.0017s, whereas Random Forest Classifier performed the worst performance with a score of 0.9757s. Multinomial Naive Bayes is performing 2nd best training time, with a score of 0.006613s.

Best Training Time: 0.0017 - KNeighborsClassifier
Worst Training Time: 0.9757 - RandomForestClassifier

Figure 4.7: Best and worst training time

The figure 4.7 indicate the best and the worst training time. Where KNeighbors classifier performing best with a score of 0.0017s, which is the lowest among of all algorithms. The worst training time is 0.9757s, which is achieved by Random Forest classifier.

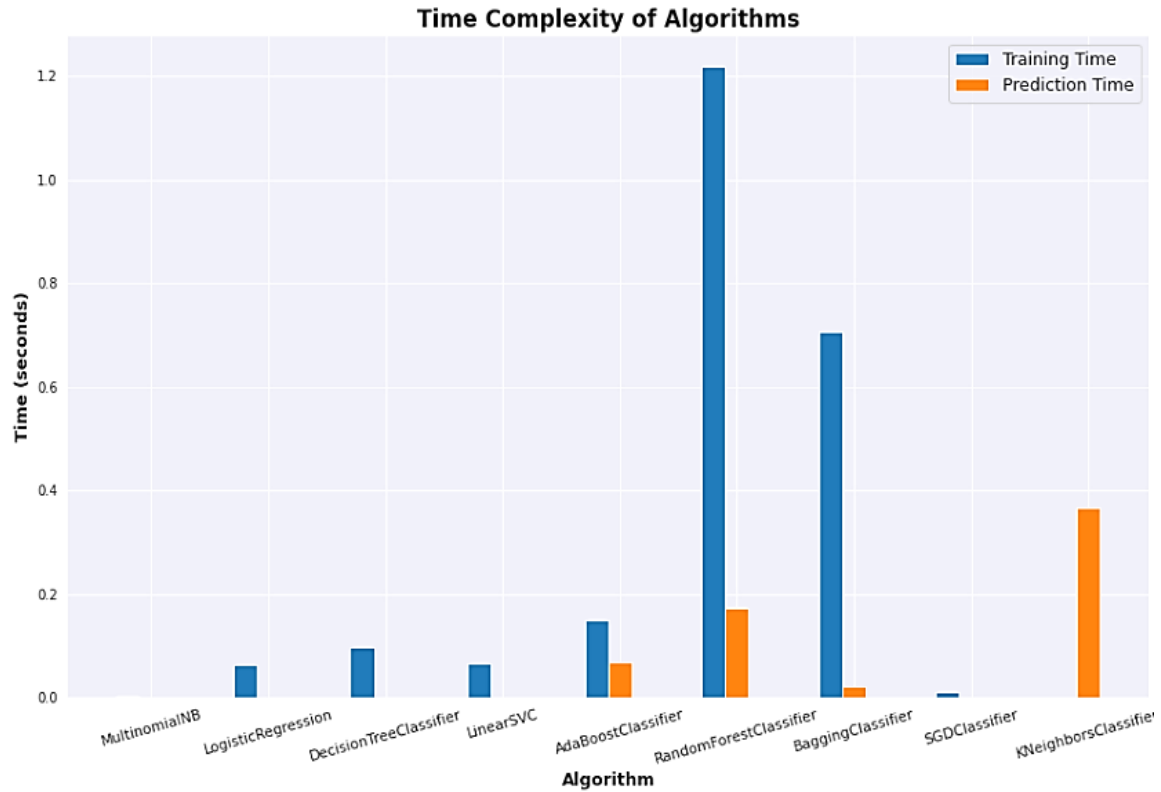


Figure 4.8: Time Complexity of the algorithms

The figure 4.7 shows the time complexities. The prediction time and training time to detect the bullying Bangla-comments of the 9 algorithms which we performed in our dataset.

4.3 Discussion

After performing nine algorithms, we found that Multinomial Naive Bayes achieved the highest accuracy rate with a score of 78.99%. It also had a good time complexity with a score of 0.006613s. Which could be the good algorithm method to detect bullying comments from social-media.

On the other hand, the other classifiers algorithms also perform well but not on both sides. For example, Logistic Regression is almost closer to MNB, with a score of 78.61%, but it has the worst training time, which is 0.04773s.

CHAPTER 5

IMPACT ON SOCIETY, ENVIRONMENT AND ETHICAL ASPECTS

5.1 Impact on Society

Cyberbullying is an online obscenity in which a victim is bullied or harassed through technology or social media by making nasty comments or posts. It can manifest itself in a variety of ways, including sending threatening or abusive messages, disseminating untrue information, or uploading humiliating or private images without permission. The victims of cyberbullying may experience severe repercussions, such as emotional discomfort, social isolation, and in severe cases, suicidal thoughts.

Researchers can contribute to the creation of a safer and more welcoming online environment by creating techniques for identifying and preventing cyberbullying. Children and teenagers, who are more prone to become victims of cyberbullying and may be more susceptible to its consequences, may find this to be especially relevant.

Reducing cyberbullying can have broader social benefits in addition to the immediate advantages for victims. We can build a more supportive and upbeat society by promoting a more positive online culture.

5.2 Impact on Environment

Our research doesn't work with direct environmental effects. But if someone in mental trauma then he / she can affect indirectly on environment like smoking cigarette effect on environment. Smoke polluted air.

On the other hand, when sarcasm is made about a religious issue in social media, it can break the order of our environment and society. Many times, conflicts arise, and mutual relations can be destroyed. Sometimes some words make us aggressive toward others. The biggest issue is language pollution which is harmful to both environment and society.

When a child grows up in an environment, he learns from the environment around him. If he grows up in an environment where language is polluted by cyberbullying, he learns those words which can affect both his environment and society in the future.

5.2 Ethical Aspects

Privacy for each person must be protected. Since everyone who says something to belittle someone acted improperly. Which cannot be shared. Because of this, we make sure not to capture his or her name. Therefore, we gather all of the data in an anonymous manner.

Also, we ensure that the data we gather is unbiased. Because some groups in our society are unfriendly to each other because of differences in politics or race. Therefore, we must verify that there shouldn't be bias in our research.

The most significant issue is that, as a result of our research, if free expression is protected, what about cyberbullying? Freedom of expression may be threatened of a person by bullying when the bully cannot be identified correctly.

As a result, when collecting data, we ensure that the statements are bullying context and also judgment based on the comments.

CHAPTER 6

SUMMARY OF THE STUDY, CONCLUSIONS AND IMPLICATION FOR FUTURE RESEARCH

6.1 Summary of the Study

As in our experiment Multinomial Naive Bayes performs excellent in detecting the bullying Bangla statements with good time complexities, so in our approach, we can make a decision that it can detect Bangla bullying statements faster and accurately.

6.2 Conclusions

Time complexity is also essential for bullying detection because every second lot of comments have been created on social media platforms. Therefore, if our algorithms perform slowly and take a lot of time to detect a single statement, the system will take a massive amount of time to scan all the comments and detect the bullying ones. In our experiment we also find out time complexities not only the common classifier we use, there are some classifiers which haven't use like AdaBoost Classifier which provide 77.2% and Bagging Classifier which provide 75.2% accuracy so we can say multinomial naive bayes (accuracy 78.9%) and logistic regression (accuracy 78.6%) are the best for detect bullying.

6.3 Implication for Further Study

Further we will collect more data from different platforms and try different classifier models for better accuracy. If we can collect data and find a better model where accuracy will 99%, we will propose to implement this on social media.

RESFERENCES

- [1] Facts and Figures 2021, available at <<<https://www.itu.int/itu-d/reports/statistics/2021/11/15/internet-use/>>>, last accessed on 05-01-2023 at 09:00 PM.
- [2] Digital 2022: Bangladesh — Data Reportable – Global Digital Insights, available at <<<https://datareportal.com/reports/digital-2022-bangladesh#>>>, last accessed on 05-01-2023 at 09:35 PM.
- [3] Mandal, Ashis Kumar, and Rikta Sen. "Supervised learning methods for Bangla web document categorization." arXiv preprint arXiv:1410.2045 (2014).
- [4] Das, Amit Kumar, et al. "Bangla hate speech detection on social media using attention-based recurrent neural network." *Journal of Intelligent Systems* 30.1 (2021): 578-591.
- [5] Akhter, Shahin. "Social media bullying detection using machine learning on Bangla text." 2018 10th International Conference on Electrical and Computer Engineering (ICECE). IEEE, 2018.
- [6] Chakraborty, Puja & Seddiqui, Hanif. (2019). An Implementation of Machine Learning and Natural Language Processing to Detect Cyber-bullying in Bengali Language.
- [7] Ghosh, Rounak, Siddhartha Nowal, and G. Manju. "Social media cyberbullying detection using machine learning in bengali language." *Int J Eng Res Technol* (2021).
- [8] Ahmed, Md Tofael, et al. "Natural language processing and machine learning based cyberbullying detection for Bangla and Romanized Bangla texts." *TELKOMNIKA (Telecommunication Computing Electronics and Control)* 20.1 (2021): 89-97.
- [9] Emon, Estiak Ahmed, et al. "A deep learning approach to detect abusive bengali text." 2019 7th International Conference on Smart Computing & Communications (ICSCC). IEEE, 2019.
- [10] Dalvi, Rahul Ramesh, Sudhanshu Baliram Chavan, and Aparna Halbe. "Detecting a Twitter cyberbullying using machine learning." 2020 4th International Conference on Intelligent Computing and Control Systems (ICICCS). IEEE, 2020.
- [11] Kaur, Jasleen & Saini, Jatinderkumar. (2015). A Study of Text Classification Natural Language Processing Algorithms for Indian Languages. *VNSGU Journal of Science and Technology*. 4. 162-167.

[12] Social media Stats Bangladesh, available at <<<https://gs.statcounter.com/social-media-stats/all/bangladesh>>>, last accessed on 05-01-2023 at 010:00 PM.

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