



Analyzing the Sentence Level Sentiment of Bengali People Through Facebook Comments

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Abstract

Of late, with immense interest in research field a bunch of studies are being conducted on sentiment analysis mostly on English. There remain some studies in Bangla sentiment analysis focusing on computational analysis without implementing any guideline. So, this study aims firstly to propose a comprehensive linguistic guideline for sentence level sentiment analysis. Secondly, annotating Facebook comments by defining the Subjective, Objective and polarities—Strongly Positive, Weakly Positive, Strongly Negative, Weakly Negative, Neutral of Bangladeshi countrymen following proposed guideline and lastly a comparative analysis of five class polarities based on three different timelines. Data were collected through Graph API from public pages and profiles and after pre-processing a total of 13,852 sentences were selected for further analysis. Total of 50 university students wherein 40 as annotators and 10 as validators allocating in 10 groups whereas each group comprised of 4 annotators and 1 validator served to annotate sentiment. These 13,852 sentences were annotated by Group-3

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of 10 groups. Kappa value of >0.80 was set for inter-annotator agreement. Result shows, the highest percentage of 27.76% Strongly Negative sentences which represents the Negativity of our society. Further studies should be done finding whys and wherefores rectifying the situation by implementing appropriate solution.

Keywords: Sentiment Analysis, Sentence level, Linguistic guideline, Bengali language, Facebook comments

INTRODUCTION

Over the last few years, sentiment analysis has drawn attention in the field of research unfolding the expressions and opinion of commons hiding in data format (Agarwal et al., 2015; Solanki, 2019). As mentioned by Mæhlum et al. (2019) detecting the pertinent sentiment-bearing sentences is the initial stage of sentiment analysis then to follow a conventional distinction as subjective and objective sentences (Wilson, 2008). However, there remains some controversy between subjective and objective sentences on bearing the sentiment while the prior one having the sentiment (Wilson, 2008) expresses personal feelings, views, or beliefs and subsequent one presents facts about the world respectively (Mæhlum et.al., 2019). Though Liu (2020) reported that not all subjective sentences express sentiment when many objective sentences do. To avoid such issues in this study we only analyze the sentiment of subjective sentences get supported from Palshikar, Apte & Pandita (2016) mentioning identification of subjective sentences being the base to dig out the sentiment. Lastly, it comes to annotate those sentences defining the polarities as positive, negative or neutral (Mohammad et al, 2016; Mohammad et al, 2015) which is similar to annotate words by detecting these sentiments along with the intensity like which word have more or least positivity or negativity (Kiritchenko & Mohammad, 2017; Kiritchenko & Mohammad, 2018).

Bangla, being the first language of Bangladesh is also the sixth most spoken language of the 268 million native speakers all around the world (Ethnologue, 2019). But, in our country sentiment analysis research being a new field attracted the automatic detection of sentiments of computational linguistics (detail description in the 2. Related Work) without implementing any scheme to follow defining subjectivity, objectivity also the polarity—Strongly Positive, Weakly Positive, Strongly Negative, Weakly Negative, Neutral.

Thus, this study aims to analyze the sentiment of Bangladeshi countrymen through Facebook comments contributing to the field of Bangla Sentiment Analysis by the following:

1. Proposing a comprehensive linguistic guideline for Bangla sentence level sentiment analysis.
2. Annotating Facebook comments by defining the subjective, objective and the polarities—Strongly Positive, Weakly Positive, Strongly Negative, Weakly Negative, Neutral of Bangladeshi countrymen following the proposed guideline.
3. Comparative analysis of five class polarities—Strongly Positive, Weakly Positive, Strongly Negative, Weakly Negative, Neutral based on three different timelines.

RELATED WORKS

Sentiment analysis being a widespread and of high applicability, the consideration needed to make it easier to choose a relevant sentiment scheme to follow to gain better-quality annotations is overlooked (Batanović, Cvetanović & Nikolić, 2020). But Mohammad (2016) proposed two sentiment annotation schemas solving some difficulties like, speaker's emotional state, sentiment towards different targets of opinion, expressions of success/failure of one side versus another, sarcastic texts, quotations, rhetorical questions and so on while one scheme is simpler namely the simple sentiment questionnaires containing five different categories—positive language, negative language, expressions of sarcasm, both positive and negative language, and neither positive language nor negative language. A study on sentiment annotation corpus of consumer reviews by Toprak, Jakob, & Gurevych (2010) followed by two phases while in first, annotation was done on those sentences which were having the relevant topic along with the expression of evaluation and in second phase all those sentences from first phase were annotated following—they are opinionated or not (expression of subjective opinion), have the polar-facts or not (factual information implying evaluation) also identifying sources (opinion holders), targets, modifiers, positive/negative polarity and strength, and anaphoric expressions. Sentences that are informative, on topic and convey some evaluation to determine the sentiment namely sentiment relevance by Scheible and Schutze (2013) tagged as subjective or objective. To annotate the polar expression of sub-sentential level a fine-grained scheme was presented by Van de Kauter, Desmet, & Hoste (2015), where explicit and implicit sentiment were differentiated; explicit sentiment conveys private states and implicit sentiment is about factual information indicating positive or negative evaluation.

A study on sentence-based annotation of a Modern Standard Arabic newswire sentiment dataset by Abdul-Mageed and Diab (2011) employed objective, subjective-positive, subjective-negative, and subjective-neutral classes and in their later paper Abdul-Mageed and Diab (2012) they eliminated the objective category by adding mixed sentiment category. Another study by Al-Twairesh et al. (2017) on annotating a corpus of tweets in the Saudi dialect of Arabic, they used five-class sentiment schema including positive, negative, mixed, neutral, and indeterminate class.

A study on multilingual Twitter sentiment on 13 European languages by Mozetič, Grčar, & Smailović (2016) used three sentiment classes—positive, negative, and neutral. A similar study by Ljajić and Marovac (2019) on Serbian corpus of tweets where they also used positive, negative, and neutral classes to evaluating several ways to handle negation.

Here, we will discuss about some studies conducted on Bangla Sentiment analysis wherein most of study are on the view of computational linguistics. As such, a study by Salehin, Miah and Islam (2020) on comparative sentiment analysis on Bengali Facebook posts where they identified the polarity as Positive, Strong Positive, Negative, Strong Negative or Neutral by automatic extraction of sentiment using Support Vector Machine (SVM), Logistic Regression, Naive Bayes and Recurrent Neural Network (RNN) achieving accuracy of 87% for SVM and 77% for Logistic Regression and 72% accuracy of RNN.

Another study by Rahman and Dey (2018) on Bangla aspect-based sentiment analysis where two Bangla datasets were presented namely Cricket and Restaurant analyzing three types of polarities—Positive, Negative and Neutral for both datasets using Support Vector Machine (SVM), Random Forest (RF) and K-nearest neighbor (KNN) algorithms achieving F1 0.34, 0.37 and 0.25 for SVM, RF and KNN of Cricket dataset respectively while for Restaurant F1 score for SVM, RF and KNN were 0.38, 0.33 and 0.42 respectively. A study on polarity detection using multinomial Naïve Bayes by Hossain, Sharif and Hoque (2020) where they introduced machine learning-based technique to detect sentiment polarities as positive or negative developing 2000 reviews on Bangla books by analyzing with several approaches like logistic regression, naïve Bayes, SVM, and SGD. Bangla sentiment analysis defining the polarities as positive, negative and neutral through transfer learning by using multi-lingual BERT a study by K. I. Islam, M. S. Islam and Amin (2020) where they fetched comments from popular Bengali newspaper sites from January 2020 to April 2020 and the results showed the higher rate of negative comment on political or sports news on the other hand comments on articles regarding religion had more positive sentiment. A different approach to analyze Bangla sentiment by M. Rahman, Haque and Z. Rahman (2020) detected sentiment as happiness, sadness/ Depression, advice, annoyance and neutral on Bangla online sports news comments using deep learning algorithms—Convolutional Neural Network (CNN), Multilayer Perceptron, Long Short-Term Memory (LSTM). And lastly, a recent study by Bhowmik et al. (2021) where they detected polarities as positive, negative and neutral on two ABSA datasets—restaurant and cricket, developed datasets by Rahman and Dey (2018) using lexicon data dictionary (LDD) and Bangla Text Sentiment Score (BTSC).

ANNOTATION SCHEME

To be a Bangla Sentiment Annotator an individual must have a better understanding of Bengali Language. As we do not have any previous study on guideline of sentiment analysis for Bengali Language, so in our current study we proposed and followed a comprehensive guideline for Bengali sentence level sentiment annotation. They are the followings:

Objective Criteria

The sentence carrying a fact or a proven, measurable, observable, and verifiable event of the world, or information other than any individual's opinion is objective sentence (Mæhlum et. al., 2019; Palshikar et al., 2016).

For example, ১৯৭১ সালে বাংলাদেশ স্বাধীনতা অর্জন করেছে।

unisso ekaṭṭor sale baŋlaðeʃ ŋad̪hi:nɔ:t̪a ɔrd̪zɔn koreʈʈhe]

(Bangladesh achieved independence in 1971.)

Subjective Criteria

The sentence carrying any individual's belief, opinion or views is subjective sentence (Mæhlum, et. al., 2019; Palshikar et al., 2016).

For example, শীতল বাতাসে গ্রামের সবুজ ধানক্ষেতের দোলা দেখার মজাই আলাদা।

[ʃitɔl bataʃe gramer ſəbu:dʒ dʃankheter dola dekhar mɔdʒai alaqɑ]

(It is differently enjoyable to see waves of paddy field in cool breeze.)

Polarity

a.

i. Neutral: Subjective sentence that doesn't convey any sentiment is Neutral (et al., 2016).

For example, আমি ভেবেছিলাম লোকটি চলে গিয়েছে।

[ami bhebetʃhilam lokti tʃole giyetʃhe]

(I thought that the man has gone.)

ii. Mixed: Presence of both sentiments—positive and negative in a sentence as explicit or implicit or having multiple polarities evaluation perplexing the annotator to annotate both as Positive or negative will be regarded as Mixed. (Mohammad, 2016; Toprak et al., 2010).

For example, 1. ছেলেটি পড়ানেখায় ভালো কিন্তু অভদ্র।

[tʃheleṭi pɔralexhay bhalo kintu ɔbhəd̪ro]

(The boy is good in study but rude.)

For example, 2. মেয়েটির বাবা নেশাইস্ত হলেও মা' অনেক ভালো।

[meyetir baba neʃagrostoθho holeo ma: ɔnek bhalo]

(Though the girl's father is intoxicated, her mother is very good.)

b. Strongly Positive: Subjective sentence conveying explicit or implicit positivity with modifiers enhancing the intensity of positivity will be regarded as Strongly Positive (Mohammad, 2016; Toprak et al., 2010).

For example, 1. তার বই এবারের বইমেলার সবচেয়ে বড় আকর্ষণ।

[tar boi ebarer boimelar ſəbtʃeye bɔro akorſon]

(His book is the biggest attraction of this book fair.)

For example, 2. আমার মায়ের হাতের পিঠা একবার খেলে যেন সারাজীবন মুখে লেগে থাকবে।

[amar maer ha:ṭer piṭha ekbaṛ khele dʒeno ſaṛadʒibon mukhe lege tʃakbe]

(The cake made by my mother is so tasty that it is not forgettable.)

Sometimes there may not remain any modifier to define as Strongly Positive.

For example, 3. এতদিনে তার কোলজুড়ে সন্তান এল।

[etodine tar kol dʒure ſɔntan elo]

(Finally, she gave birth to a baby.)

c. Weakly Positive: Subjective sentence conveying explicit or implicit positivity with no modifiers to enhance the intensity of positivity will be regarded as Weakly Positive (Mohammad, 2016; Toprak et al., 2010).

For example, 1. ছেলেটি ভালো খেলে।

[tʃeleʈi bhalo khele]

(The boy plays well)

For example, 2. মেয়েটি সুন্দর ছবি একেছে।

[meyet̪i sundor tʃobi eketʃhe]

(The girl has drawn nice picture.)

d. Strongly Negative: Subjective sentence conveying explicit or implicit negativity with modifiers enhancing the intensity of negativity will be regarded as Strongly Negative (Mohammad, 2016; Toprak et al., 2010).

For example, অসৎ সঙ্গ পেয়ে ছেলেটির জীবন একেবারে ধ্বংস হয়ে গেল।

[ɔʃʈ̪ɛt̪ʃŋgo peye tʃeleʈir dʒibon ekebare dʒhɔŋʃo hoye gelo]

(The boy's life has ruined because of bad company.)

Sometimes there may not remain any modifier to define as Strongly Negative.

For example, মেয়েটির বৃদ্ধ বাবা বিনা চিকিৎসায় মারা গেল।

[meyet̪ir brɪd̪d̪ho baba bina tʃikitʃay mara gelo]

(The girl's old father died without treatment.)

e. Weakly Negative: Subjective sentence conveying explicit or implicit negativity with no modifiers to enhance the intensity of negativity will be regarded as Weakly Negative (Mohammad, 2016; Toprak et al., 2010).

For example, 1. জিনিসপত্রের দাম দিনদিন বেড়ে চলেছে।

[dʒinispɔ:t̪er də:m d̪i:n d̪i:n berei tʃolefʃhe]

(The price of commodities are rising day by day.)

For example, 2. আবর্জনার স্তুপ থেকে দুর্গন্ধ ছড়াচ্ছে।

[abordʒɔ:nar st̪u:p t̪heke d̪urgɔnd̪ho tʃhɔratʃhe]

(Bad smell is spreading from garbage.)

Underlying Factors

The following are some underlying factors to define the subjective, objective and the polarity of sentence:

i. Dominant sentiment: Falling in one group the emotional state and opinion of the speaker, and description of the events are aimed to only identify the dominant sentiment of the sentence as reported by Mohammad (2016) speaker expressing opinion on more than one target may cause trouble to identify the dominant one.

a. When the speech or statement is someone else's, that ought to be taken as consideration to analyze sentiment.

For example, শিশুটি বলে উঠলো- আমার বাবা-মা নেই তাই ভিক্ষা করি।

[ʃiʃuṭi bole uṭhilo-amar baba-ma nei t̪ai bhikkha kori] → Negative

(The child said, I beg because I have no parents.)

ii. Habit: As a fact, habit should be considered as Objective. Or else, subjectivity will be determined relying on verbs (as usual).

For example: দাদু প্রতিদিন সকালে পত্রিকা পড়েন।

[d̪ad̪u protidin ŋkale pot̪rika p̪oren] → Objective

(Grandfather reads newspaper every morning.)

Though it seems subjective on first seen, but here habit is expressed as fact and as a habitual truth these sentences will be regarded as Objective.

For example: 1. লোকটি সচরাচর এই পথ দিয়েই যায়।

[lok̪ti ŋt̪ʃorat̪or ei pɔt̪h d̪iyei d̪ʒa:y] → Objective

(The man usually goes through this way.)

In this sentence the word ‘সচরাচর’ (usually) conveys an individual’s habit and again as a fact habit is regarded as Objective.

iii. Speaker’s view: As an annotator one must have unbiased attitude on speaker’s views or private (internal) state of mind evaluating the language being used not the views (Palshikar, Apte and Pandita, 2016). Not having any motive for behind the context or underlying factors an annotator’s role is likely to perform as machine.

For example: মাস্ক পরলেই তো আর করোনা থেকে বঁচা যায় না।

[mask porlei t̪o ar k̪orona t̪heke bâṭʃā d̪ʒa:y na] → Negative

(Corona cannot be prevented wearing mask only.)

As in this sentence the speaker is criticizing or judging something negatively so undoubtedly this sentence conveys negativity.

a. Emphasizing on the semantics context, an annotator’s role not to consider any person’s or entity’s name and background.

For example: ছেলেটি ভালো ফুটবল খেলে।

[t̪ʃelet̪i bhalo phu:t̪b̪ol k̪hele] → Positive

(The boy plays football well.)

b. High dependency or satisfaction on something will be regarded as Positive sentiment.

For example: যত খাবারই থাকুক, ভাত হাড়া আমার চলেই না।

[d̪ʒoṭo khabar-i t̪hakuk, bha:t̪ ŋhara amar ŋolei na] → Positive

(Although there is plenty of food, I want the rice most importantly.)

c. An annotator has to focus on speaker's perspectives whether that sentence conveys not justifying on annotator's personal belief or view.

For example: বিড়ি সিগারেটের ধোয়া আমার খুব ভালো লাগে।

[biri sigareter ðhoya amar khub bhalo lage] → Positive

(I like smoke of cigarettes very much.)

We will always annotate the sentences depending on the speaker's perspectives like here, liking to be smoking is likely to indicate Positive feeling.

d. Sentences conveying success or failure in regard to another side.

For example, 1. বাহ! বাংলাদেশ শ্রীলঙ্কাকে ২০ রানে হারিয়েছে।

(Bravo! Bangladesh defeated Srilangka by 20 runs.)

This sentence is positive since there remains a positive expression 'বাহ!'.

For example, 2. বাংলাদেশ কাতারের কাছে ৩ গোলে হেরেছে।

[baŋlaðeʃ kaṭarer kaṭʃe t̥in gole heretʃe] → Negative

(Bangladesh has lost to Qatar by 3 goals.)

Both sentences have the same perspective—Bangladesh and sentiment will be annotated by identifying the dominant sentiment of the sentence not how the annotator gets dominated by the statement.

iv. Sentiment of questions: All the general questions will be Neutral.

For example, 1. তুমি কি আমার সাথে যাবে?

[tumi ki amar sathe ðʒabe] → Neutral

(Will you go with me?)

But as mentioned by Mohammad (2016) some *rhetorical* questions—a question that someone asks without expecting an answer conveying frustration and disappointment can be annotated as negative.

For example, 2. ও কি মদের নেশা ছাড়বে না?

[o ki mɔðer neʃa tʃarbe na] → Weakly negative

(Won't he abstain from alcohol addiction?)

For example, 3. বাংলাদেশের বিজয়ে আমরা কি টাইগারদের অভিনন্দন জানাবো না?

[baŋlaðeʃer biðʒoye amra ki taigard̥er obhinondon ðʒanabo na] → Weakly Positive

(Won't we congratulate the tigers in the victory of Bangladesh (team)?

iv. *Comparison*, a difference between two entities, i.e, persons, objects, places, or opinion conveying subjectivity or opinion of a person also the polarity as negative, positive and neutral (Palshikar et al., 2016).

For example, 1. রাশিয়া বাংলাদেশের থেকে আয়তনে অনেক বড়।

[raʃiya baŋlaðeſer t̪heke a:y̪t̪one ɔ:nek bɔ:ro] → Objective

(Russia is larger in size than Bangladesh?)

For example, 2. তুমি তো ওর থেকে লম্বা।

[t̪umi t̪o or t̪heke lɔ:mba] → Positive

(You are taller than him.)

For example, 3. মায়ের থেকে বাবা বেশি আদর করে।

[mayer t̪heke baba bɛ:ʃi ador kɔ:re] → Positive

(Father cares more than mother.)

For example, 4. অন্যসব বিষয়ের থেকে অংকে অনেক নম্বর কম পেয়েছে।

[onno ŋɔ:b biʃ̪yer t̪heke ɔ:ŋke ɔ:nek nombor kɔ:m pey̪etʃ̪he] → Negative

(He obtained marks in math much lower than other subjects.)

v. Impact of *tense*: A major part to define polarity is the tense of that sentence (Palshikar et al., 2016). As example, when simple past sentence is a proven fact only then it is Objective.

For example, 1. বাংলাদেশ গত বিশ্বকাপে ২য় রাউন্ড পর্যন্ত গিয়েছিল।

[baŋlaðeſ gɔ:t̪o biʃ̪oka:pe d̪it̪iyo rau:nq porðɔ:nt̪o giy̪etʃ̪ilo] → Objective

(Bangladesh reached 2nd round in the last world cup.) (simple past)

But Past *tense* denoting information can be annotated as Objective and when it is future tense denoting strongness of the sentiment.

For example, 2. ছেলেটি বারবার পরীক্ষায় ফেল করে।

[t̪ʃ̪elēti barbar porikkhay p̪he:l kɔ:re] → Subjective - Negative

(The boy fails in the examination repeatedly.) (Simple present)

For example, 3. ছেলেটি আবার পরীক্ষায় ফেল করবে।

[t̪ʃ̪elēti abar porikkhay p̪hel korbe] → Subjective - Strongly Negative

(The boy will fail in the examination again.) (Simple future)

A simple future sentence always conveys the intensity of feeling of positivity or negativity.

For example, ছেলেটি পরীক্ষায় ভালো করবে।

[t̪ʃ̪elēti porikkhay b̪halo korbe] → Subjective - Strongly positive

(The boy will do well in the examination.)

vi. *Supplications and requests*: *Supplications and requests* of a sense of fostering and support can be annotated as Positive, though in some negative context many of sentences that bear positive supplications to God or positive requests to human being (Mohammad, 2016).

For example, 1. আল্লাহ আমাদের সহায় হোন।

[alla:h amader ŋ̪hay hon] → Positive

(May the Almighty help us.)

For example, 2. আসুন সকলে মিলে গাছ লাগাই পরিবেশ বঁচাই ।

[aʃu:n, ŋ̪kole mile ga:tʃ̪ lagai, poribes bâtʃ̪ai] → Positive

(Let us plant trees and protect the environment.)

For example, 3. দয়া করে এবারের মত গরীবদের সম্পদ আত্মসাধ করবেন না ।

[d̪oya kore ebarer mɔ:t̪o goribd̪er ŋ̪ompɔ:d̪ at̪toʃad̪h̪ korben na] → Negative

(Please do not embezzle wealth of the poor for this time.)

If there remains both positivity and negativity, we will find the context that conveys the relevant information.

vii. Negation of sentiment: When dominant word or phrase conveys one (primary) sentiment associated with its negative connotation (i.e., no, not), at that moment the sentence denotes the opposite of that primary sentiment.

For example, 1. এই কাজ করা উচিত নয় ।

[ei ka:t̪ʃ̪ kora utʃ̪it̪ nɔy] → Negative

(The work should not be done.)

For example, 2. কারো অঙ্গল কামনা করো না ।

[karo ɔ:mon̪gol kamona koro na] → Positive

(Do not imprecate anyone.)

Here, prefix makes the negation but double negation causes positiveness.

vii. Democratic view: Democratic view, to consider the decision what most people agree though an individual can get that sentence as the opposite.

For example, এতিম শিশুই বুঝে মা-বাবার মর্ম ।

[e:t̪im ŋ̪ʃ̪u:i bu:d̪ʒ̪he ma-babar mɔrmo] → Negative

(Only an orphan can understand the meaning of parents.)

The annotator could get this sentence's sentiment as positive but if most people label it as a negative sentiment, then label it as a negative sentiment too.

METHODOLOGY

A flow chart is presented below showing the procedures of methodology where, data inclusion and preprocessing took six months, to create a comprehensive linguistic guideline for sentence annotation it took two months and annotation took another six months.

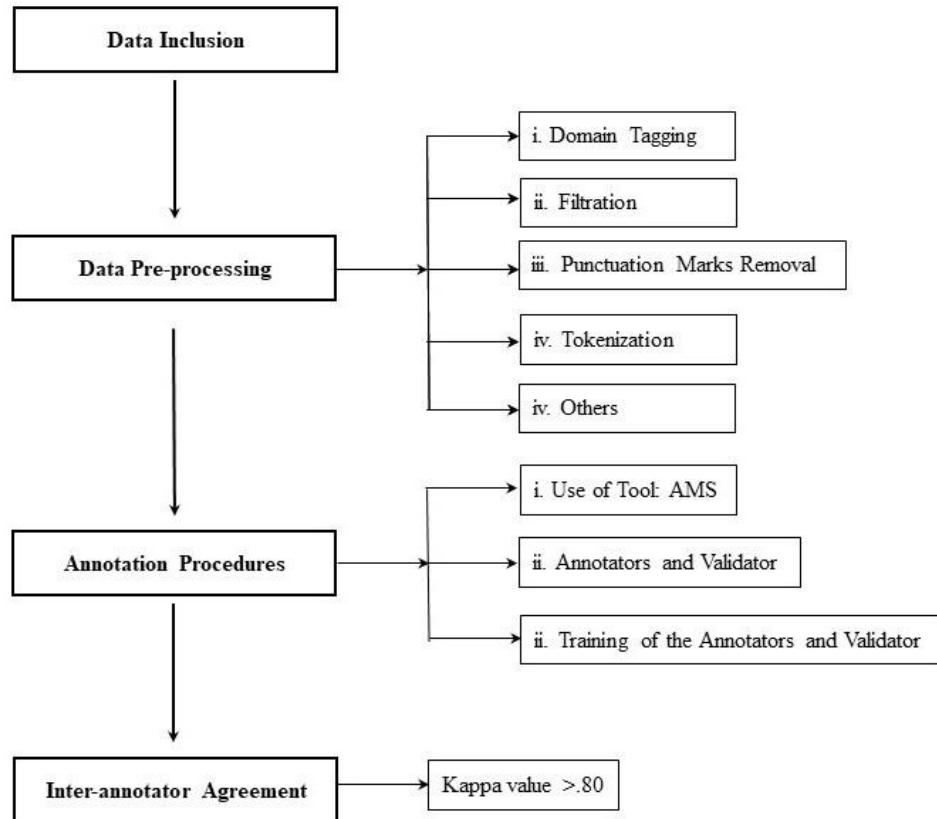


Figure 1. Methodology

Data Inclusion

Graph API was used to collect data from Facebook. Starting from January 2018 to the end of September 2020 comments from public pages were fetched.

Data Pre-processing

i. Domain Tagging: All the collected data were tagged manually by the following domains—Politics, Law and Order, Business and Economics, Science and Technology, Sports, Education, Culture, Health and Lifestyle.

ii. Filtration: Filtration was implemented manually tag as good or wrong selecting sentence—one sentence as good and more than one as wrong respectively. After that a total 13,852 sentences were filtered/selected for further processing.

iii. Punctuation Marks Removal: Punctuation marks were removed for the actual term frequency values of a text.

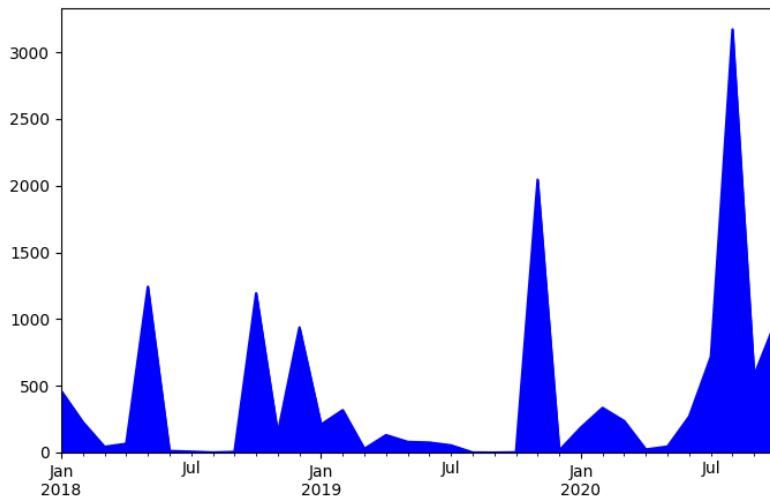


Figure 2. Data Inclusion Timeline

iv. Tokenization: Each word of a sentence being as a token, tokenization is a must to measure the term frequency and here tokenizer was used to tokenize all the collected data.

v. Others: Some other issues like, misspellings correction, removal of emoticons, unnecessary spaces, URLs, foreign letters and stickers were implemented manually.

Annotation Procedures

i. Using of Tool: To annotate sentences a developed tool namely Annotator Management System (AMS) was used where it was possible to see the entire review allowing to judge the sentences as in WebAnno used by Mæhlum et. al. (2019).

ii. Annotators and Validators: Total of 40 undergraduate students as annotators majoring in Communication Disorders and Linguistics allocating 4 in each group by developing 10 groups served to annotate data where 10 MSS/MA students as validators allocating 1 for each group majoring in Communication Disorders and Linguistics served to validate data to achieve gold standard. These 13,852 sentences were annotated and validated by one of the groups—Group 3, where each sentence was annotated by 4 of the annotators then validated by the validator only when at least 3 of the annotators had the same annotation otherwise the validator would review the sentence then annotate.

iii. Training of the Annotators and Validators: Annotators and validator were trained through a fine-grained annotation guideline described in section 2 (Annotation Scheme) under the direct supervision of a Linguist.

iv. Inter-annotator Agreement: Kappa calculation was used to judge the agreement defining the subjective, objective and the polarities—Strongly Positive, Weakly Positive, Strongly Negative, Weakly Negative and Neutral of the sentences. Annotators and validator reaching the Kappa value of >0.80 was implied for the agreement while we get informed by Abdul-Mageed and Diab (2011) achieving Kappa value of 0.823 for Objective,

Subjective-Positive, Subjective-Negative, and Subjective-Neutral classes and in another paper Abdul-Mageed and Diab (2012) they achieved Kappa values of 0.790 and 0.793 for Arabic Wikipedia talk pages and Arabic web forums respectively eradicating Objective category by introducing Mixed sentiment category. A study by Al-Twairesh et al. (2017) achieving moderate level of annotation agreement between three annotators having a Kappa value of 0.60 on five-class sentiments—positive, negative, mixed, neutral, and indeterminate class.

RESULTS

Our objective was to annotate Facebook comments by defining the subjectivity, objectivity, and the polarities—Strongly Positive (SP), Weakly Positive (WP), Strongly Negative (SN), Weakly Negative (WN), Neutral (NU) of Bangladeshi countrymen following a proposed guideline presented in 3. Annotation scheme with a comparative analysis of five class polarities based on three different timelines. By the starting of January 2018 to the end of September 2020 fetching Facebook comments from public profiles and pages, implementing filtration 13,852 sentences were selected to annotate, where firstly we differentiated those sentences into Subjective and Objective then detection of polarities—SP, WP, SN, WN, NU was made. Table 1 is presented below to show the frequency and percentage (%) of our result.

Table 1. Frequency and Percentage of Polarities

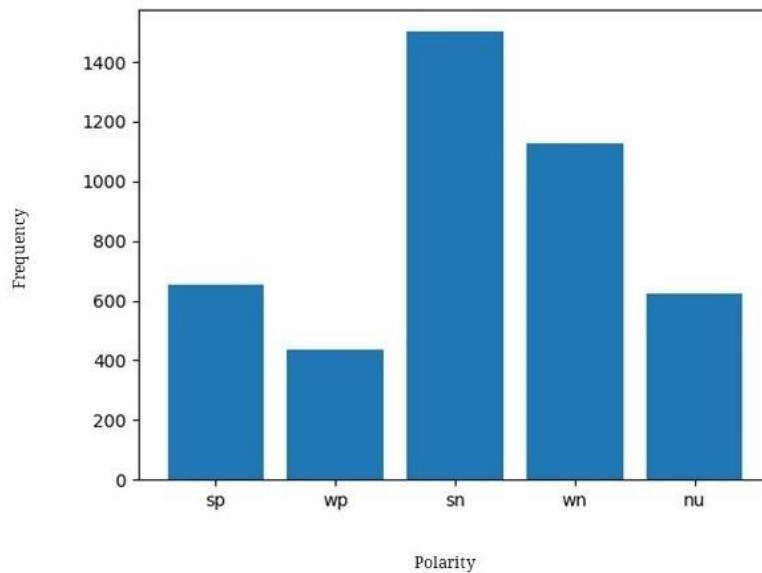
Polarity	Frequency	Percentage (%)
Strongly Positive	2050	14.80
Weakly Positive	1850	13.35
Strongly Negative	3846	27.76
Weakly Negative	3566	25.74
Neutral	2540	18.33
Total	13852	

From Table 1 we come to know that 2050 (14.80%) sentences were SP, 1850 (13.35%) sentences were WP, 3846 (27.76%) sentences were SN holding the highest rate, 3566 (25.74%) sentences were WN holding the second highest rate, and 2540 (18.33%) sentences were NU.

Reporting the polarities of 2018 timeline from the Table 2 securing the highest rate among the five polarities 34.57% (1502) sentences are SN sentence while only 15.05% (654) is SP sentences. Again, when 25.96% (1128) sentences are WN, only 10.08% (438) sentences are WP. Lastly, the percentage of Neutrality of sentences are 14.31% (622).

Table 2. Frequency and Percentage of Polarities of 2018 Timeline

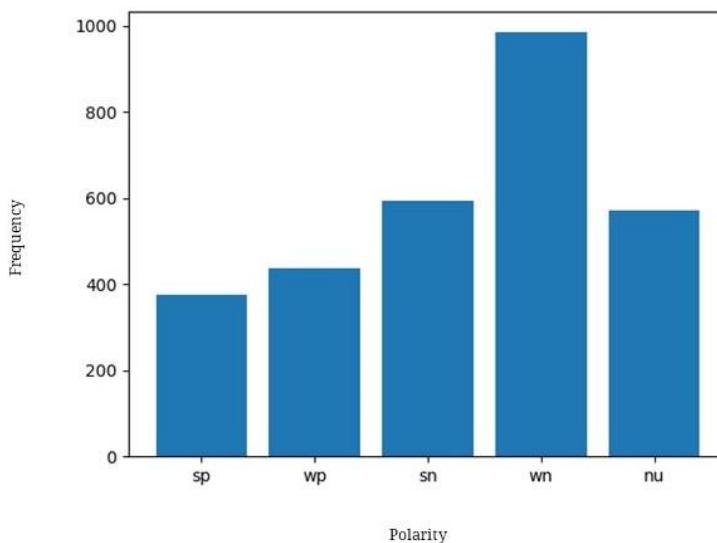
Polarity	Frequency	Percentage (%)
Strongly Positive	654	15.05
Weakly Positive	438	10.08
Strongly Negative	1502	34.57
Weakly Negative	1128	25.96
Neutral	622	14.31
Total	4344	

**Figure 3.** Polarities of 2018 Timeline

In the year of 2019, getting quiet same result as before presented in Table 3, 33.27% (985) sentences are WN while 14.72% (436) are WP. When it comes for the SP and SN, we get informed that 12.67% (375) sentences are positive, and 20.03% (593) sentences are negative. Lastly, the percentage of Neutrality of sentences are 19.29% (571).

Table 3. Frequency and Percentage of Polarities of 2019 Timeline

Polarity	Frequency	Percentage (%)
Strongly Positive	375	12.67
Weakly Positive	436	14.72
Strongly Negative	593	20.03
Weakly Negative	985	33.27
Neutral	571	19.29
Total	2960	

**Figure 4.** Polarities of 2019 Timeline

Finally, the polarities of 2020 timeline where again securing the highest rate SN sentences are of 26.74% (1751) while 15.59% (1021) are SP. Similarly, WN sentences outpaced the rate of WP sentences achieving 22.18% (1453) and 14.90% (976) respectively. And the percentage of Neutrality of sentences are 20.57% (1347).

Table 4. Frequency and Percentage of Polarities of 2020 Timeline

Polarity	Frequency	Percentage (%)
Strongly Positive	1021	15.59
Weakly Positive	976	14.90
Strongly Negative	1751	26.74
Weakly Negative	1453	22.18
Neutral	1347	20.57
Total	6548	

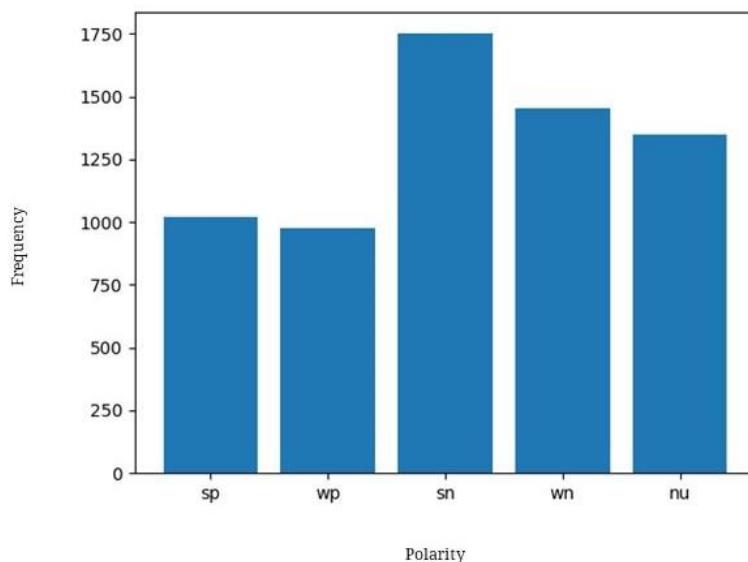


Figure 5. Polarities of 2020 Timeline

When it comes to present the annotated polarity of sentences of the year 2018, 2019 and 2020 there, we may find some trend or similarity and dissimilarity. The Table 5 presented below is of the comparison of polarities of three different timelines. The three different timelines we considered to analyze sentiment manually are presented below following the year:

Table 5. Comparison of Polarities among 2018, 2019 & 2020 timeline

Year Polarity (%)	2018	2019	2020
Strongly Positive	15.05	12.67	15.59
Weakly Positive	10.08	14.72	14.90
Strongly Negative	34.57	20.03	26.74
Weakly Negative	25.96	33.27	22.18
Neutral	14.31	19.29	20.57

As shown in Table 5 the rate of SP of 2018 decreases from 15.05% to 12.67% in the 2019 but in the year 2020 SP regains its position achieving 15.59%. WP, in the year of 2018 having 10.08% increases its rate to 14.72% and 14.90% in the year 2019 and 2020 respectively.

When we look up on the rate of SN, we get to know that in the year 2018 having 34.57% decreases to 20.03% in 2019 while in the year 2020 achieving 26.74% a higher rate than of 2019 but lower than of 2018. WN, in the year of 2018 having 25.96% increases its rate to 33.27% but in the year 2020 achieving 22.18% falls behind from the previous as lowest.

Lastly, to report the rate of Neutrality of three different timelines, in the year 2018 having 14.31% increases its rate to 19.29% and 20.57% for the year 2019 and 2020 respectively.

A comparison of polarities among the years of 2018, 2019 and 2020 timeline are presented in Table 5 and as shown in this table we are bound to say that the negativity in Bangladeshi society is on the uprise. Reporting the year 2018's where SN is on the highest rate (34.57%), then in second WN, in third SP, in fourth NU and WP is in the least. Similar scenario is also shown in the year of 2019 where WN is on the highest (33.27%), in second SN, in third NU, in fourth WP and SP is in the least. Lastly, for the year 2020, the year of deadliest severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) which is commonly known as COVID-19 (A. Remuzzi & G. Remuzzi, 2020), here as expected we have the same result as before where SN is on the highest rate (26.74%), WN in second, NU in third, SP is in fourth and WP in the least. A study of Bangla sentiment analysis on comments from popular Bengali newspaper sites by K. I. Islam, M. S. Islam and Amin (2020) where the result shows a higher rate of Negative sentiments of 24% of political news while only 10% is Positive. Same result for sports news also showing 38% of negative sentiments while only 10% is Positive which is consistent with the current study. But according to K. I. Islam, M. S. Islam and Amin (2020), when it comes for the religious news diverting the secured position of Negative as highest, the Positive sentiment has gained the that position of 50% while only 8% is negative. This may a result of religious piousness of commons of Indian subcontinent. A recent study by Bhowmik et. al. (2021) on detecting sentence polarity using two developed data sets—restaurant and cricket by Rahman and Dey (2018) where the result shows 61.58% Negative polarity on cricket data set whereas Positive was 15.60% and for the restaurant data set 62.86% was Positive polarity while 14.08% was Negative.

CONCLUSION

Facebook, being one of the most popular social networks becomes an integral part of our daily living holds a leading part of our society outrunning the traditional social boundaries all around the world including Bangladesh. As a social being, human have the capacity to judge the social circumstances based on positivity, negativity or neutrality and as mentioned before Facebook being a part of our society, people share their views, thoughts or opinions here by sharing post or commenting. In this study we consider comments of Facebook of public pages and profiles in Bangladesh analyzing those comments that denote people's views, thoughts or opinions expressing sentiments as

Strongly Positive, Weakly Positive, Strongly Negative, Weakly Negative and Neutral. Relying on our proposed annotation scheme firstly to define subjectivity and objectivity then to detect the five class polarities our result shows containing of 3846 sentences of 13,852 holding the highest percentage of 27.76%, Strongly Negative sentences are on the lead indicating the firm position of Negativity in our society. However, further study should be done empathizing the social aspect of sentiment by finding the reasons behind also to pave the way to divert our negativity to positive.

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REFERENCES

- Abdul-Mageed, M., Diab M. 2011. Subjectivity and sentiment annotation of modern standard arabic newswire. In *Proceedings of the 5th Linguistic Annotation Workshop*, 110–118.
- Agarwal, B., Mittal, N., Bansal, P., & Garg, S. 2015. Sentiment analysis using common-sense and context information. *Computational Intelligence and Neuroscience*, 2015, 715730.
- Al-Twairesh, N., Al-Khalifa, H., Al-Salman, A., & Al-Ohali, Y. 2017. AraSenTi-Tweet: A corpus for arabic sentiment analysis of saudi tweets. *Procedia Computer Science*, 117, 63–72.
- Batanović, V., Cvetanović, M., & Nikolić, B. 2020. A versatile framework for resource-limited sentiment articulation, annotation, and analysis of short texts. *PLoS One*, 15(11).
- Bhowmik, N. R., Arifuzzaman, M., Mondal, M. R. H., & Islam, M. S. 2021. Bangla text sentiment analysis using supervised machine learning with extended lexicon dictionary. *Natural Language Processing Research*, 1(3–4), 34.
- Hossain, E., Sharif, O., & Hoque, M. M. 2020. Sentiment Polarity Detection on Bengali Book Reviews Using Multinomial Naive Bayes. *arXiv preprint arXiv:2007.02758*.
- Islam, K. I., Islam, M., & Amin, M. R. 2020. Sentiment analysis in Bengali via transfer learning using multi-lingual BERT. *arXiv preprint arXiv:2012.07538*.
- Kiritchenko, S., & Mohammad, S. M. 2017. Capturing reliable fine-grained sentiment associations by crowdsourcing and best-worst scaling. *arXiv preprint arXiv:1712.01741*.
- Kiritchenko, S., & Mohammad, S. M. 2018. Sentiment composition of words with opposing polarities. *arXiv preprint arXiv:1805.04542*.
- Liu, B. 2020. *Sentiment analysis: Mining opinions, sentiments, and emotions*. Cambridge university press.
- Ljajic, A., & Marovac, U. 2019. Improving sentiment analysis for twitter data by handling negation rules in the serbian language. *Computer Science and Information Systems*, 16(1), 289–311.

- Mæhlum, P., Barnes, J. C., Øvrelid, L., & Velldal, E. 2019. Annotating evaluative sentences for sentiment analysis: a dataset for Norwegian. In *Linköping Electronic Conference Proceedings* (pp. 121-130). Linköping University Electronic Press.
- Mohammad, S., Kiritchenko, S., Sobhani, P., Zhu, X., & Cherry, C. 2016. Semeval-2016 task 6: Detecting stance in tweets. In *Proceedings of the 10th International Workshop on Semantic Evaluation (SemEval-2016)* (pp. 31-41).
- Mohammad, S. 2016. A practical guide to sentiment annotation: Challenges and solutions. In *Proceedings of the 7th workshop on computational approaches to subjectivity, sentiment and social media analysis* (pp. 174-179).
- Mohammad, S. M., Zhu, X., Kiritchenko, S., & Martin, J. 2015. Sentiment, emotion, purpose, and style in electoral tweets. *Information Processing & Management*, 51(4), 480-499.
- Mozetić, I., Grčar, M., & Smailović, J. 2016. Multilingual Twitter sentiment classification: The role of human annotators. *PloS one*, 11(5), e0155036.
- Palshikar, G., Apte, M., Pandita, D., & Singh, V. 2016. Learning to identify subjective sentences. In *Proceedings of the 13th International Conference on Natural Language Processing* (pp. 239-248).
- Rahman, M., Haque, S., & Rahman, Z. 2020. Identifying and categorizing opinions expressed in Bangla sentences using deep learning technique. *International Journal of Computer Applications*, 176(17), 13-17.
- Remuzzi, A., & Remuzzi, G. 2020. COVID-19 and Italy: what next? *Lancet*, 395(10231), 1225-1228.
- Rahman, M., & Kumar Dey, E. 2018. Datasets for Aspect-Based sentiment analysis in bangla and its baseline evaluation. *Data*, 3(2), 15.
- Salehin, S. S., Miah, R., & Islam, M. S. 2020. A Comparative Sentiment Analysis On Bengali Facebook Posts. In *Proceedings of the International Conference on Computing Advancements* (pp. 1-8).
- Solanki, M. S. 2019. Sentiment analysis of text using rule based and natural language toolkit. *International Journal of Innovative Technology and Exploring Engineering (IJITEE)*, 8(12S).
- Scheible, C., & Schütze, H. 2013. Sentiment relevance. In *Proceedings of the 51st Annual Meeting of the Association for Computational Linguistics (Volume 1: Long Papers)* (pp. 954-963).
- Toprak, C., Jakob, N., & Gurevych, I. 2010. Sentence and expression level annotation of opinions in user-generated discourse. In *Proceedings of the 48th Annual Meeting of the Association for Computational Linguistics* (pp. 575-584).
- Van de Kauter, M., Desmet, B., & Hoste, V. 2015. The good, the bad and the implicit: a comprehensive approach to annotating explicit and implicit sentiment. *Language resources and evaluation*, 49(3), 685-720.
- Ethnologue. 2019. *What are the top 200 most spoken languages?*
- Wilson, T. 2008. Annotating Subjective Content in Meetings. In *LREC*.