

EMOSIS Sentiment Analysis on Tweets with Emotion and Intensity Level Recognition Considering Ending Punctuation Marks



Ria Ambrocio Sagum, Ma. Monique L. Navarro, Arvin Jasper E. Victore

Abstract: *Sentiment Analysis is a tool used for determining the Polarity or Emotion of a Sentence. It is a field of Natural Language Processing which focuses on the study of opinions. In this study, the researchers solved one key challenge in Sentiment Analysis, which is to consider the Ending Punctuation Marks present in a sentence. Ending punctuation marks plays a significant role in Emotion Recognition and Intensity Level Recognition. The research made used of tweets expressing opinions about Philippine President Rodrigo Duterte. These downloaded tweets served as the inputs. It was initially subjected to pre-processing stage to be able to prepare the sentences for processing. A Language Model was created to serve as the classifier for determining the scores of the tweets. The scores give the polarity of the sentence. Accuracy is very important in sentiment analysis. To increase the chance of correctly identifying the polarity of the tweets, the input undergone Intensity Level Recognition which determines the intensifiers and negations within the sentences. The system was evaluated with overall performance of 80.27%.*

Keywords: *Sentiment Analysis; Emotion Recognition; Intensity Level Recognition, Polarity of sentence*

I. INTRODUCTION

The work of sentiment analysis is to determine the attitude of a speaker, writer, or author with respect to some topic or the overall contextual polarity of a document. Early works in sentiment analysis have different approaches. Turney and Pang and Lee use different methods in polarity classification of product and movie reviews. [1] [2] Typically, most data are collected from the web, through newsgroups, bulletin boards, and broadcast or printed news.

There are different approaches in sentiment analysis that also uses different features. The use of sentiment analysis is applied on classifying the polarity of text, evaluation on sarcasm, irony, and figurative languages, and also used in emotion detection. Reviews, comments, ratings, and feedbacks are the common data sets of sentiment analysis. It used to classify the phrase or text whether it is positive, negative, or neutral. Contests on the study are on those evaluating the complex sentences containing ambiguous context like sarcasm, irony, and figurative languages. While others focus on polarity, development on the study where made, digging into deeper topics like emotion detection where the emotion of the text is identified whether it is anger, disgust, fear, happiness, sadness, and surprise. [3] Challenges on sentiment analysis are still on work, and different approaches that can track the real emotion of text are one of the things that the researchers are looking into. One example is considering ending punctuation marks. Due to the liberal use of punctuation in tweets, before classification we tokenize on all whitespace and punctuation boundaries, removing URLs, punctuation, and the hash tags used to gather by topic. [4] "I am happy" is a lot different from "I am happy!!!" and the emotion in the text can be "happy" or "surprised". The degree of the emotion in the second phrase is heavier than the other. By eliminating or ignoring the ending punctuation marks, the context is changed from what the phrase is really meant to say.

Although there are studies for emotion detection, they still lack from being specific. Degree of emotion separates one sentiment from the others. Basic emotions like joy, anger, and sadness has intensity. Emotion Recognition considering ending punctuation marks will show that the real emotion is being observed and all parts of the phrase or text will be evaluated to identify the context.

II. RELATED WORKS

The Philippines is considered the social media capital of the world. According to Stockdale and McIntyre [5], 93.9% and 16.1% of the Philippine population have Facebook and Twitter accounts, respectively. This is the way Filipinos express their opinion about certain topic. They are fond of discussions and have strong interest on the current issue especially when the talks occurs in social media On Tuesday, December 6, Twitter released its first year-ender report on the Philippines.

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Filipinos engage with a variety of topics on Twitter. Emotions ran high on November 8 when the Supreme Court (SC) approved the transfer of ousted President Ferdinand Marcos' remains to the Libingan ng Bayani (Heroes' Cemetery). [6] This event was linked to president Duterte and created issues about the connection of Duterte and the Marcoses.

The ways people express their opinions and sentiments have radically changed in the past few years thanks to the advent of social networks, web communities, blogs, wikis, and other online collaborative media. [7] The concentration of knowledge from large data sets on the Web can be a key factor for evaluators over the internet. These social data remains hard to understand for computers as they are specifically meant for human consumption.

Tools on sentiment analysis are known for opinion mining. In this generation, many problems are solved in the field of sentiment analysis. As problems are solved, additional challenges rise. The following list summarizes the sub-topics that are considered to be key challenges for the SA discipline according to [8] [9] [10] [11] [12] [13] [14]: (a) Named Entity Recognition, (b) Anaphora Resolution, (c) Parsing, (d) Sarcasm & irony identification, (e) Subjectivity classification, (f) Polarity and graduality of opinions, (g) Use of abbreviations, poor spelling, punctuation or grammar, etc., (h) Sentiment (Opinion) Lexicon acquisition, (i) Negation handling, (j) Aspect-based & Comparative Sentiment Analysis, (k) Effective Classification of multiple opinions (aggregation). Opinion mining and sentiments are still on a challenge in natural language from requiring a deep understanding between explicit and implicit, regular and irregular, and syntactical and semantic language rule. These unresolved problems in NLP results a struggle on the part of researchers. Exploring certain oral or gestural clues in user comments, such as emoticons, onomatopoeic expressions for laughter, heavy punctuation marks, quotation marks and positive interjections could also be considered. [15] Sentiment analysis is also used to determine the present emotion in the detected speech quoted phrase. This should undergo text categorization before it starts its analysis part. [16]

Common emotion detection tools disregard some features of a sentence after the process of feature selection. Although many tokenizers are geared towards throwing punctuation away, for Sentiment Analysis a lot of valuable information could be deduce from them. Exclamation mark (!) puts extra emphasis on the negative / positive sentiment of the sentence, while question mark (?) can mean uncertainty (no sentiment). [16] Punctuation marks are symbols that are used to aid the clarity and comprehension of written language. Some common punctuation marks are the period, comma, question mark, exclamation point, apostrophe, quotation mark and hyphen. [18]

Disregarding ending punctuation marks on text could mislead the readers on how the text must be perceived. The sentence "I am glad to hear that" contains happy emotion, but if ending punctuation marks are considered ("I am glad to hear that!"), the emotion becomes heavier and the symbol "!" increases the sentiment value of the text.

Identifying the degree of emotion also helps in emotion detection for its precise assessment. Besides feeling something in response to some antecedent, everyone will experience different levels of intensity of the emotion that has been experienced. Three types of intensities (I) (e.g. low (L), medium (M) and high (H)) have been considered in the present task. The intensifiers may be present inside an emotional expression. The JJ (adjective) and RB (adverb) tagged elements are considered as the candidate of intensifiers. [19]

Also, punctuation marks can affect the degree or intensity of emotions. Symbols such as exclamation mark (!) and question mark (?) are often used in single or multiple numbers to emphasize emotional expressions and considered as crucial clues for identifying emotional presence. Repetitive punctuation marks strengthen and emphasize the level of emotion presented in a text. In micro-blogs, the emotional punctuation marks, such as the exclamation mark, the interrogation mark etc., usually strengthen the emotion intensities of sentences in some manner. For example, "You can't be so crazy!!!", which expresses the emotion of "anger", and the serial exclamation marks can strengthen the emotional intensities. [20]

As the social media emerge on bringing different kinds of information, people tend to develop tools that can transform given information into another kind of information. Analysis on social media is an example. Determining emotions on social media becomes an interest in Sentiment analysis. Various methods and statistical treatments are carried out to produce an analysis based on samples used but some factors are ignored. Ending punctuation marks plays an important role in delivering the state of a text by putting an emphasis on emotion and disregarding the symbols can lead into confusion, giving an incorrect analysis about the study. For now, considering ending punctuation marks on evaluation is the aid on the problem of ambiguous emotion recognition since the symbols are significant in every sentence and tells the specific sentiment by knowing the degree of emotion.

III. METHODOLOGY

The sentiment tagging to the sentences has gone through Pre-processing and Sentiment Analysis phase. The initial step was to gather the tweets that passed the Tweets Filtering Phase. Tweets related to the corresponding topic were selected and duplication of tweets was avoided. A certain hashtag was used in collecting the data. The purpose selecting a specific hashtag is to focus the scope to be discrete. After the tweets were selected, pre-processing phase prepared the variables for sentiment analysis. Pre-processing phase performed the text processing where the sentence is evaluated to obtain features such as keywords and ending punctuation marks needed in Sentiment Analysis Phase. It contains lemmatizer, stop word removal and tokenizer. The lemmatizer converted the words into their dictionary word form. It was used to avoid many forms of words that could lead into miscalculation due to the words present in training data. Stop word removal filtered out the words that have no semantic meaning.

This process is necessary for the system so that non-emotional words such as articles and conjunctions will be disregarded. The tokenizer divided the sentence into tokens. Tokens refer to the variables needed in Sentiment Analysis. Next to the pre-processing phase, features have been evaluated using Sentiment Analysis considering ending punctuation marks. This contains the Polarity and Emotion Recognition via Naïve Bayes classifier and Intensity Level Recognition. The classifier computed the probability of an input to a specific class after reading the database. The class that has the highest probability compared to other classes will be the result of Polarity and same as the process in Emotion.

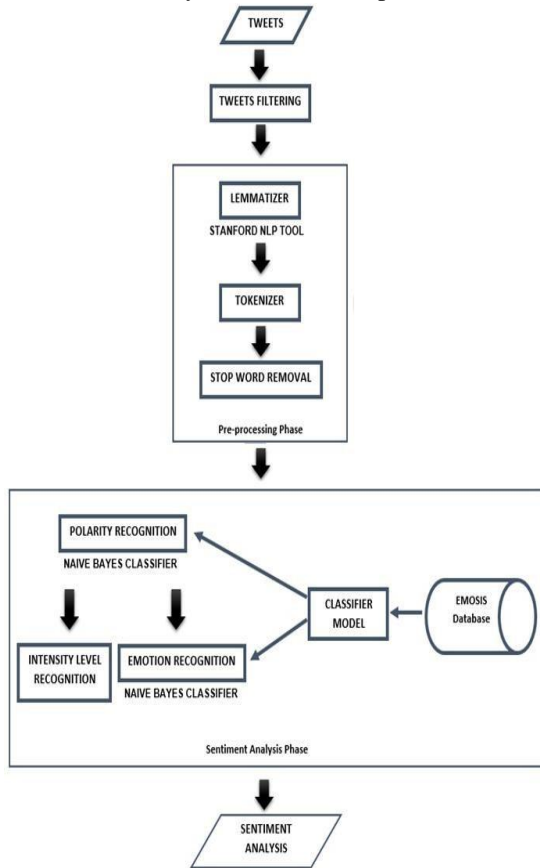


Figure 1. System Architecture of EMOSIS

The Intensity Level Recognition used the rules presented in Figure 2 for considering the words and Table 3 for considering ending punctuation marks. The output were the emotion and intensity level detected based on the processes performed. The entire process is shown in Figure 1.

(Sentence with prior tag [EW])(Example)	post tag [EW_I]
([EW])[happy]	[EW_M]
(INTFpos, [EW])[very, happy]	[EW_H]
(INTFneg, [EW])[less, surprised]	[EW_L]
(NEG, INTFpos, [EW])[not, very, happy]	[EW_M]
(NEG, INTFneg, [EW])[not, less, disappointed]	[EW_H]

Figure 2. Rules for tagging an emotional anchoring vector with intensity. [19]

Some rules (as shown in Figure 2) are applied to capture the role of different intensifiers and negations in marking the sentences with post emotion tags along with intensity. [19] In considering Ending Punctuation Marks, the researchers along with language practitioner expert, have been able to

establish some rules for tagging a sentence with intensity level shown in Table 1. In certain emotions, a single Ending Punctuation Mark denotes Normal Intensity, while in others it could be a sign of High Intensity. Duplication and combination of Ending Punctuation Marks always mean a High Intensity.

Table 1. Rules for tagging an Emotional Sentence with Intensity considering Ending Punctuation Marks

Emotion	Rules	Intensity
Happiness	Question Mark (?) > 0	Low
	Period (.) = 1	Medium
	Exclamation Mark (!) >= 1	High
Sadness	Period (.) = 1 Question Mark (?) = 1	Medium
	Exclamation Mark (!) >= 1 Question Mark (?) > 1	High
	Period (.) = 1 Question Mark (?) = 1 Exclamation Mark (!) = 1	Medium
Surprise	Exclamation Mark (!) >=1 Question Mark (?) > 1 Combination of Exclamation Mark and Question Mark (!?)	High
	Period (.) = 1 Question Mark (?) = 1 Exclamation Mark (!) = 1	Medium
	Exclamation Mark (!) >=1 Question Mark (?) > 1 Combination of Exclamation Mark and Question Mark (!?)	High
Anger	Period (.) = 1 Question Mark (?) = 1 Exclamation Mark (!) = 1	Medium
	Exclamation Mark (!) >=1 Question Mark (?) > 1 Combination of Exclamation Mark and Question Mark (!?)	High
	Period (.) = 1 Question Mark (?) = 1 Exclamation Mark (!) = 1	Medium
Disgust	Exclamation Mark (!) >=1 Question Mark (?) > 1 Combination of Exclamation Mark and Question Mark (!?)	High
	Period (.) = 1 Question Mark (?) = 1 Exclamation Mark (!) = 1	Medium
	Exclamation Mark (!) >=1 Question Mark (?) > 1 Combination of Exclamation Mark and Question Mark (!?)	High
Fear	Period (.) = 1 Question Mark (?) = 1 Exclamation Mark (!) = 1	Medium
	Exclamation Mark (!) >=1 Question Mark (?) > 1 Combination of Exclamation Mark and Question Mark (!?)	High

IV. RESULTS

A total of 600 tweets was gathered and tested. The computed Precision, Recall, and F-Measure were compared with each of the evaluation measures calculated based on the evaluation of the 3 experts. Also, the researchers showed the difference of results between considering and disregarding punctuation marks.

The results are as follows:

Table 2 shows the Pair-Wise Agreement of Emotion and Intensity Level Recognition in terms of Precision. By comparing the two approaches (considering and disregarding punctuation marks), it shows that the exactness on classification of a certain emotion was better on the process of considering punctuation marks.



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Exactness refers to how well the system performs in recognizing correct emotions.

Table 2 - Pair-Wise Agreement of Emotion and Intensity Level Recognition (Precision)

Module	a – b	a – c	a – d	average
Emotion Recognition with Ending Punctuation Marks	84.12%	74.1%	76.76%	78.33%
Intensity Level Recognition with Ending Punctuation Marks	90.02%	82.49%	83.54%	85.35%
Emotion Recognition without Ending Punctuation Marks	67.17%	73.23%	68.47%	69.62%
Intensity Level Recognition without Ending Punctuation Marks	77.15%	80.19%	71.77%	76.37%

Table 3 shows the Pair-Wise Agreement of Emotion and Intensity Level Recognition in terms of Recall. By comparing the two approaches (considering and disregarding punctuation marks), it shows that the completeness on classification of a certain emotion was better on the process of considering punctuation marks. Completeness refers to how often the system recognizes emotions.

Table 3 - Pair-Wise Agreement of Emotion and Intensity Level Recognition (Recall)

Module	a – b	a – c	a – d	average
Emotion Recognition with Ending Punctuation Marks	83.45 %	73.68%	76.57%	77.9%
Intensity Level Recognition with Ending Punctuation Marks	84.49 %	81.39%	82.03%	82.64%
Emotion Recognition without Ending Punctuation Marks	67.48 %	72.48%	67.28%	69.08%
Intensity Level Recognition without Ending Punctuation Marks	68.92 %	75.92%	66.82%	70.55%

Table 4 shows the Pair-Wise Agreement of Emotion and Intensity Level Recognition in terms of F-Measure. By comparing the two approaches (considering and disregarding punctuation marks), it shows that the overall performance on classification of a certain emotion was better on the process of considering punctuation marks. F-measure refers to the harmonic mean of Precision and Recall. This implies that

ending punctuation marks has an important role in sentiment analysis and it confuses the process when the symbols are disregarded.

Table 4 - Pair-Wise Agreement of Emotion and Intensity Level Recognition (F-Measure)

Module	a – b	a – c	a – d	average
Emotion Recognition with Ending Punctuation Marks	83.03%	74.15%	76.66%	77.95%
Intensity Level Recognition with Ending Punctuation Marks	89.34%	81.57%	80.9%	83.94%
Emotion Recognition without Ending Punctuation Marks	67.04%	72.14%	66.41%	68.53%
Intensity Level Recognition without Ending Punctuation Marks	65.55%	72.77%	63.9%	67.41%

Table 5 and 6 shows the Overall Performance of EMOSIS in considering and disregarding Ending Punctuation Marks. The 80.27% and 69.82% for Overall F-Measure of the two system shows that the recognition process has difference. It also shows that the output of recognition is better in considering Ending Punctuation Marks rather than disregarding the features.

Table 5 - Summary of Overall Performance (with Punctuation Marks)

Tweets	F-Measure
Emotion Recognition_A	77.9%
Intensity Level Recognition_A	82.64%
Overall Performance_A	80.27%

Also, after using T-test, the researchers gain a df of 298.17, t-value of 4.00, and a p that is less than 0.001.

Table 6 - Summary of Overall Performance (without Punctuation Marks)

Tweets	F-Measure
Emotion Recognition_B	69.08%
Intensity Level Recognition_B	70.55%
Overall Performance_B	69.82%

V. CONCLUSION

The Sentiment Analyzer was able to attain its goal in solving one of the key challenges in Sentiment Analysis. Also, it showed clearer interpretation on sentiments of tweets. However, there are some words that were incorrectly tagged by the program that resulted into misclassification. The researchers were able to show the difference between the approach of considering and disregarding of ending punctuation marks in Sentiment Analysis. Based on the results of evaluation, the system was consistent when the classification considered the ending punctuation marks.



The F-Measures of 80.27% and 69.82% for considering and disregarding the symbols respectively shows that there's a difference between the two classifications. Also, after obtaining a p-value that is less than alpha level used, it is confirmed that EMOSIS has a significant difference on performance compared with existing system. The study has resulted into rejection of the said hypothesis.

According to the Rating System [20], the performance of the system must be at 70% or above to say that it has a good performance. Thus, the interpretation for the system is "Satisfactory" and has a good performance.

VI. RECOMMENDATIONS

For future work, the researchers recommend to use dependency relations for better semantic analysis. In this case, the sentiment analyzer will be more precise in detecting negations. Another one is to consider emoticons since it was often used in expressing emotions. Combination of keywords, ending punctuation marks, and emoticons could lead into better performance in Sentiment Analysis. Also, it is recommended to increase the training data for a specific corpus. This will increase the knowledge base of the classifier and could lead into better classification of Polarity and Emotion.

Furthermore, as the users of twitter use certain native language, they tend to combine two different languages. Filipino people use both Filipino Language and English Language in their tweets which mean that the language they are using is "Taglish". This is a situation which the program can't handle because its scope is on English Language only.

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Ria Ambocio Sagum was born in Laguna, Philippines on August 31, 1969. She took up Bachelor in Computer Data Processing Management from the Polytechnic University of the Philippines and Professional Education in Eulogio Amang Rodriguez Institute of Science and Technology. She received her master's degree in De La Salle University in 2012 and is currently taking Doctor in Business Administration. She is an Associate Professor in the Polytechnic University of the Philippines in Sta. Mesa, Manila. Prof. Sagum has been a presenter of different conferences and is a member of the Computing Society of the Philippines and the Natural Language Processing Special Interest Group.



Ma. Monique L. Navarro was born in Caloocan City on August 8, 1995. She is a Computer Science graduate at Polytechnic University of the Philippines, Sta. Mesa, Manila, Philippines. During her last two years in college, she took a track of Computer Science Research that focuses on Natural Language Processing, Robotics and Algorithm. She works as a Software Developer at a multinational professional services company. Her works include web development, big data analysis, automation, some chatbot related and responsible for constant communications with the client. She is planning to pursue her studies and take a master's degree in the field Computer Science and hope to become a college instructor someday.



Arvin Jasper E. Victore was born in Manila on October 30, 1996. He is a graduate of Bachelor of Science in Computer Science from Polytechnic University of the Philippines, Sta. Mesa, Manila Philippines. He pursued the said course believing in himself that one day, he will be able to contribute to the field of Information Technology, specifically in Artificial Intelligence. Currently, he is a Software Engineer working at a multinational professional services company. His works focuses on Web Application Development, Natural Language Processing using Google Services, and Automation. Until now, he is looking for opportunities where he can improve his knowledge and skills via integrating his development works with Artificial Intelligence.