Sentimental Analysis of Sexual Harassment as a Health and Development Issue Using Machine Learning Techniques

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ABSTRACT

People share their opinions on different Social media platforms. Twitter is one of these where people can share their ideas, opinions on a topic, and life experiences with limited characters. In this paper, the Twitter dataset of the #MeToo hashtag from the year 2017 to 2020 is used to analyze the sentiments of people about women's issues which are very critical issues in our society so, a total of 1,15,575 tweets are collected from the data world website and also collected Twitter scraper using the python programming language and then applied Text Blob tool to labeled tweets as positive, negative and neutral and after that build the model using machine learning techniques. Four different classifiers Support Vector Machine, Naive Bayes, Logistic Regression, and Random Forest Classifier were implemented to analyze sentiment efficiently. Further, compared these four models had been done to prove highly effective and accurate based on the analysis of feelings and opinions regarding women's issues on the #MeToo hashtag.

1. INTRODUCTION

Twitter is the most popular platform among numerous microblogging platforms that are available on the internet nowadays. On Twitter, people share their opinions, ideas, and messages with a limit of 280 characters called "tweets". Twitter provides a platform to spread information worldwide. Millions of tweets are posted on Twitter every day from all over the world. Each tweet expresses an opinion and opinion on the topic. These tweets help to carry out social awareness, product promotion, social issues, and health issues. People share their feelings. A lot of research on sentiment analysis is done through tweets. This paper, analyze the sentiments of sexual harassment of woman which is a very critical issue in the World.

 This paper collects the tweets from the metoo movement, this movement was started in 2006 by Tarana Burke. the aim of this movement is the help survivors of sexual harassment. To analyze the women's opinions on mishappening women's, these unfortunate incidents affect the physical and mental health of women, in this research work, around 1,15,575 tweets from the year 2017 to 2020, have been collected more precise and complete data from the data world website also collect the data using Twitter scraper to analyze people's opinions towards #MeToo hashtag using machine learning techniques. So, this paper collect the dataset from the year 2017 to 2020, shown in figure 1.
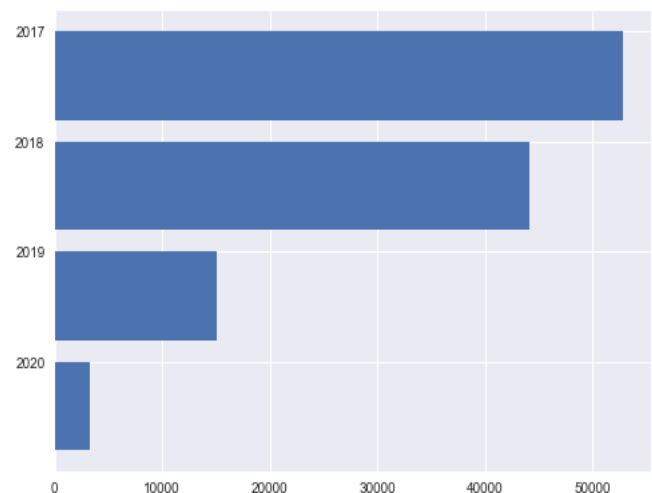
Fig. 1 Collection of tweets as per year

   In Fig. 1. Displays tweets data collected from the year 2017 to the year 2020, to analyze the women's condition on the globe within four years. Maximum tweets data are collected from the year 2017.
 The Tweets dataset is saved as a CSV file and then the pre-process of these tweet datasets is done using the NLTK library in the python programming language to remove the unnecessary disturbance/ noise from the dataset, because data-cleaning is the most important step to enhance the efficiency to label each tweet. After cleaning and dataset, labeled each tweet using Text Blob as, negative, positive

and neutral tweets and then four different classifiers are applied to build models and compare the performance and accuracy of models with each other. Also, the Matplotlib library using python programming is used to plot the results into a visualization

To train the dataset TfidfVectorizer is applied. Dataset is split into 80-20 ratios for training and testing the dataset. The four different classifiers are applied to build the models and compared to check the accuracy of the model. The new feature set was extracted from the dataset using TfidVectorizer methods. The models of sentiment analysis are made based on a Support Vector Machine, Logistic Regression Naive Bayes, and Random Forest Classifier to compare the accuracy of diverse models to enhance the performance of different classifiers.
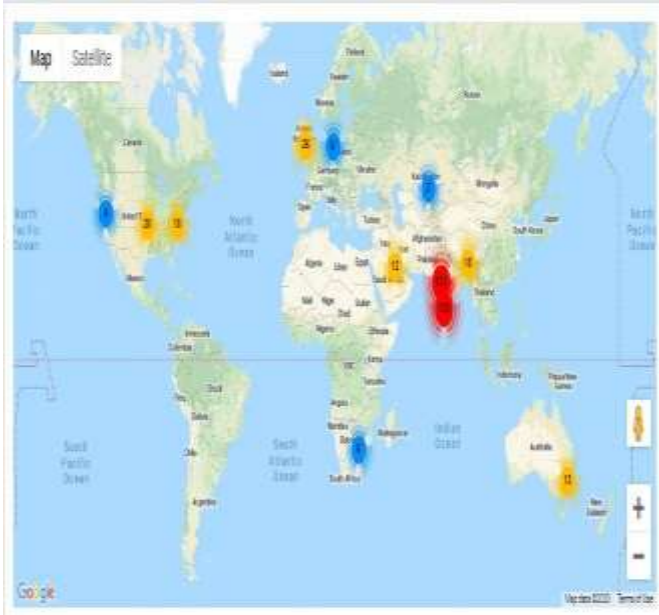
Fig. 2 World Map of data description

This paper also showed the area of different countries from all over the world where women are harassed and posts tweets by women related to women's issues are shown in Map in fig. 2.

2. EXISTING WORKS

Sentiment Analysis is an analysis that analyzes people's reviews, opinions, exchange ideas, and life experiences. Most people use Twitter to post opinions with limited characters. Researchers used various techniques to analyze these tweets as positive, negative, and neutral.

This paper [1] shows people's opinions, choices, and feelings about and analyzes the effects of social media on society. [2] This paper analyzes the tweets from the #metoo movement from different countries. [3] this study uses data mining techniques and supervised learning algorithms such as support vector machines and naive Bayes for the analysis of the sentiments as positive, negative, and neutral and to build the prediction model. [4] The sentiment analysis during elections was also done using Supervised Machine-learning algorithms. Analyzes customer reviews, comments, and opinions about products, and events. Rule-based methods are used for

sentiment analysis as positive, negative, or neutral. The accuracy of the proposed method at the feedback level is 97.8% and 86.6% at the sentence level[5]. [6] This paper emphasizes sentiment analysis and opinion mining for social multimedia. In this study, 100 articles are covered from 2008–2018. This paper analyzes customer reviews. [7] This paper analyzes fake reviews by using K-Means clustering. [8] This paper analyzes sentiments of live applications that are happening in real-time environments using machine learning approaches. [9] This paper discusses the different approaches and classification tools for sentiment analysis and analyzes the sentiments of the public, politics, business, and finance. [10] this paper is based on a study on Sexual Assault as Reported in the New York Times through #metoo movement. [11] This paper analyzes 3,750 tweets from the #metoo movement. The accuracy of this research study is 90%.

Mcdonald's and KFC restaurant data was collected and Different machine learning algorithms were used to analyze the opinions of their customers. Different researchers used techniques and tools to analyze the sentiments [12]. [13] This paper used the Apache-Hadoop framework with its lexicon-based sentiment prediction algorithm and Stanford core NLP library with the Recursive Neural Tensor Network (RNTN) model to detect sentiments from forum discussion posts. [14] discussed Childhood sexual abuse in their research study. [15] conducted a comprehensive survey on sentiment analysis and opinion mining for social multimedia. This study highlighted the importance of sentiment analysis in understanding the emotions and opinions expressed on social media platforms, which are often used to discuss and raise awareness about sexual harassment. The author emphasized the role of machine learning in processing vast amounts of social media data to gauge public sentiment.

Focused on predicting engagement in the movement based on the sentiment expressed on Twitter in [16]. Presented a study that incorporated sentiment analysis into a cross-media analysis framework in [17]. Explored sentiment classification from online customer reviews, a technique that can be adapted to analyze sentiments related to sexual harassment. While the primary focus was on customer reviews, the study demonstrated the potential of machine learning techniques in categorizing sentiments, which can be extended to analyze social media discussions on the topic.

Discussed machine learning and its applications in [18]. Explored about fintech opportunities in india in [19]. This study applied machine learning algorithms to analyze online conversations related to sexual harassment. The research reveals the sentiments expressed in online discussions, offering insights into public awareness and sentiment levels [20]. The study provides valuable insights into the emotional dimensions of discussions on this subject [21]. This research focused on analyzing sentiment trends in news articles related to sexual harassment incidents [22].

Their research illuminates the changing sentiment landscape during social movements and the role of social

media in raising awareness in [23]. [24] This study delved into sentiment analysis of tweets related to sexual harassment using machine learning techniques [25]. The research examined public sentiment regarding sexual harassment, offering insights into this critical issue [26].

Table. 1 Comparative table

| Sr. No.	Author	Techniques/ Methodology	Limitations /Comparison
1.	U. K. Sridevi et.al [27]	Logistic Regression, Decision Tree, and Random Forest algorithms were used	Only three classification algorithms were used to find the results.
2.	Nehal Mamgain et . al [28]	Machine learning algorithms like NB and SVM and an ANN model have used	Comparatively fewer algorithms and models are used. SVM attained 83% accuracy and dataset is also quite small.
3.	Sahar A. El_Rahman [29]	BM, Naïve Bayes, SVM, Maxtent Decision Tree Random Forest are used	Fewer Algorithms are used for data classification, data set is also quite small.
4.	AnaReyes et. al [30]	supervised Vector Machine (SVM) Small data set used	Support Vector Machine is used for data classification. Data analyses were done on a smaller dataset.
5.	Tuesta, Ivonne et. al [31]	BERT models (SpanBERT, BETO, multilingual BERT)	BERT Models are used to analyze the smaller dataset of Spanish tweets

3. PROPOSED APPROACHES FOR SENTIMENT ANALYSIS

The feature extraction method is used for the categorization of the sentiment of each tweet as positive, negative, and neutral. Different classifiers are used to enhance the accuracy of these models such as Logistic Regression (LR), Naive Bayes (NB), Support Vector Machine (SVM), and Random Forest Classifier (RF) classifiers. The feature extraction and feature selection method increases the performance of the model. Also using the BOW (bag of words) and TFIDF.

3.1 Pre-Processing of Dataset

a. The users can use different languages to post tweets on Twitter. The Twitter dataset has been very noisy, so to remove the unwanted noise from the tweets, pre-processing data is carried out in this research by using the NLP library and lambda function in Python to clean the tweets.

To pre-process the dataset following steps are carried out:
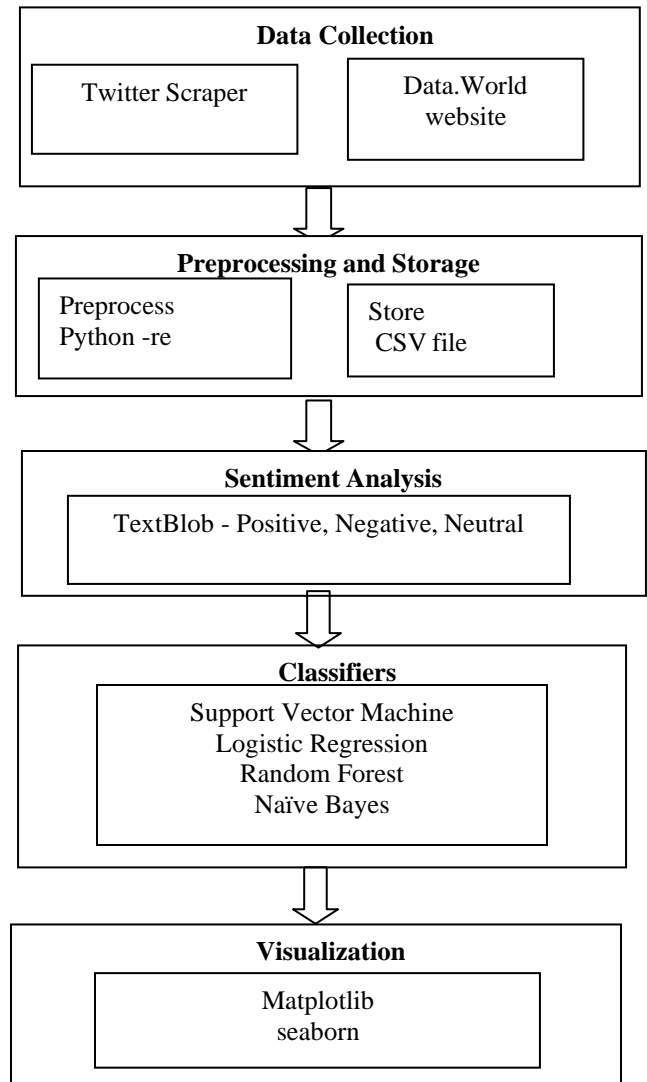
Fig. 2 Proposed Sentimental Analysis Model

- a) Each tweet converts upper case into lower case.
- b) A, an, the and likewise Stopwords remove from tweets.

c) Words that are not started with the alphabet remove those and remove extra spaces from the tweets.
d) Remove repeated characters such as" metooooo", converted into" metoo".
e) Remove usernames starting with" @" like @chandan_samant.
f) Remove URLs from the tweets like" https://twitter.com".
g) Remove #hashtags from tweets like #metoo, #women. only removed" #" at hashtags from tweets because hashtags are provided useful information
h) Punctuation marks to be removed from tweets.

3.2 Feature Extraction

Here, Using TextBlob in Python identifies the sentiment of each tweet. To enhance the performance of the model by using count vectorizer and Tfidvectorizer, for enhancing the accuracy of classifiers following features are used:

b) With the help of Text Blob labeled each tweet as Positive, Negative, and Neutral based on the polarity of each tweet. NLTK library is used for extracting the features and enhancing the efficiency and accuracy of classifiers.
c) To analyze the sentiments of the #MeToo dataset collected using a Twitter scraper in python and download the dataset from the data world website. In this research work, diverse hashtags are selected related to Women's issues and combined all year's tweets in one CSV file.

3.3 Classification of Models

Twitter Scraper library tool is used to collect tweets related to women's issues from #MeToo hashtag from the internet for sentiment analysis. To build the model different classifiers are applied based on Logistic Regression (LR), Naive Bayes (NB), Support Vector Machine (SVM), and Random Forest Classifier (RF). Firstly, split the dataset into training and testing. To train the dataset different classifiers are used to increase the efficiency of different classifiers steps are followed:

The classifiers perform operations through the following steps:

1. Twitter Scraper and the data world website is used for collecting the dataset of sentiment and tweets based on the topic of sexual harassment of women Python Programming Language in Jupyter notebook is used then saved the tweet dataset into a database as a CSV file. Using Twitter Scraper, tweets have been downloaded from Twitter related to"#MeToo.
2. Once tweets are collected, tweets are pre-processed to remove unnecessary noise.
3. Once pre-processing is done, extract the subjective features based on tweets, Bigram, and unigram, by using the NLTK library for enhanced performance.

4. After that training, the model goes through different classifiers as a Support Vector Machine classifier, Naïve Bayes, Random Forest Classifiers, and Logistic Regression, then compare the performance with other models.
5. Graphs are plotted by using the most popular and easy-to-use library which is the Matplotlib module and tweets are classified as positive, negative, and neutral.

4. EXPERIMENTAL RESULTS

4.1 Experiments

This work contains in total of 1,15,575 tweets from #MeToo hashtag, and after preprocessing 1,08,234 tweets are remaining for further processing. Tweets labeling is done using the TextBlob library in Python in which 43052 tweets are labeled as positive, 14136 tweets are labeled as negative, and 51046 tweets are labeled as neutral tweets. The details of labeled tweets are shown below in Table 1.

Table. 2 No. of tweets as Neutral, Positive, and Negative

Class label	No. of tweets (%)
Negative	14136 (13.6%)
Neutral	51046 (47.16%)
Positive	43052 (39.77%)

In Table 1. A training set of 108234 tweets are collected through Twitter Scraper. The labeled tweets as subjective or objective for training using Text blob and then trained by using different classifiers such as Naïve Bayes, Support Vector Machine, Logistic Regression, and Random Forest Classifier. Also, three types of features extracted containing Unigram, Bigram, n-gram for training, and experiments to enhance the performance of classifiers in this paper. The dataset is split into training and testing to apply the model and predict the label.

4.2 Results

In This research work we evaluated the accuracy of diverse classifiers on the tweet dataset and compared them based on their performances. Below the given tables are the details of the accuracy of each model with the name of the classifier and the accuracy of the model.

Table. 3 Accuracy of different classifiers on 1,08,234 tweets

Classifiers	Accuracy (%)

Support Vector Machine	96.65
Logistic Regression	94.87
Random Forest Classifier	95.55
Naive Bayes	87.48

The results shown in Table 2 labels the accuracy of different classifiers on a dataset of 1,08,234 tweets. The accuracy of the Support Vector Machine is 96.65%, the Logistic Regression is 94.87%, the Random Forest classifier is 95.55% and the Naive Bayes is 87.48%
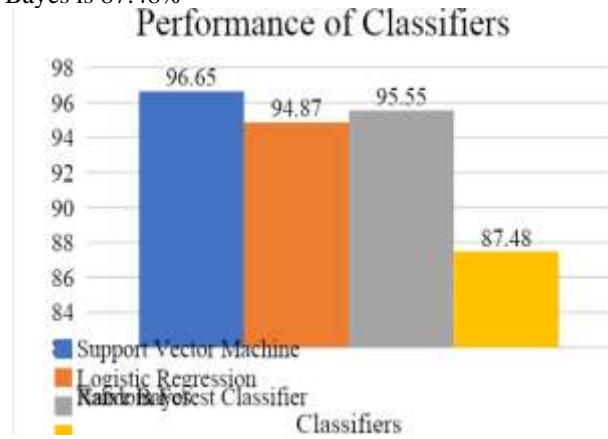

Fig. 3 Performance of Classifiers

In Fig. 3 classifiers' accuracy is displayed in the percentage. The accuracy of the support vector machine is higher than other classifiers.

The detail of Precision, Recall, and F1 score of classifiers on the dataset using different models, express in Table 3,4,5,6:

Table 4. Performance Evaluation of Naïve Bayes subjective classifier

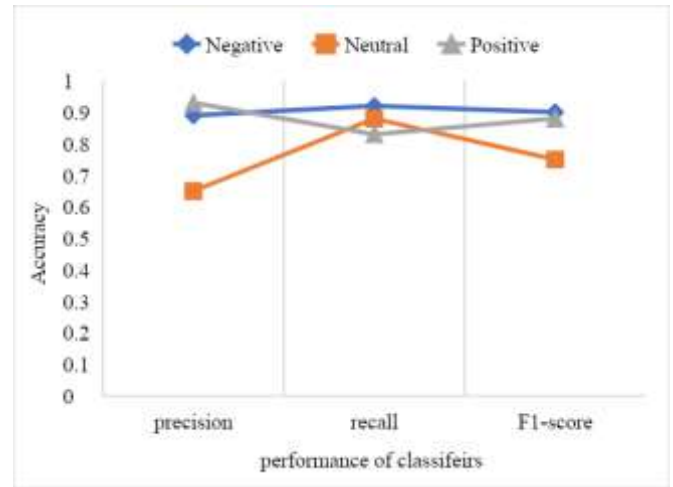| Classes	Precision	Recall	F1-score
Negative	0.89	0.92	0.90
Neutral	0.65	0.88	0.75
Positive	0.93	0.83	0.88
Naïve Bayes Accuracy	87.4809442416963		

Fig. 4 Measurement Performance as Precision, Recall, and F1 score of Naïve Bays Classifiers

Table. 5 Performance Evaluation of Support Vector Machine Subjective Classifier

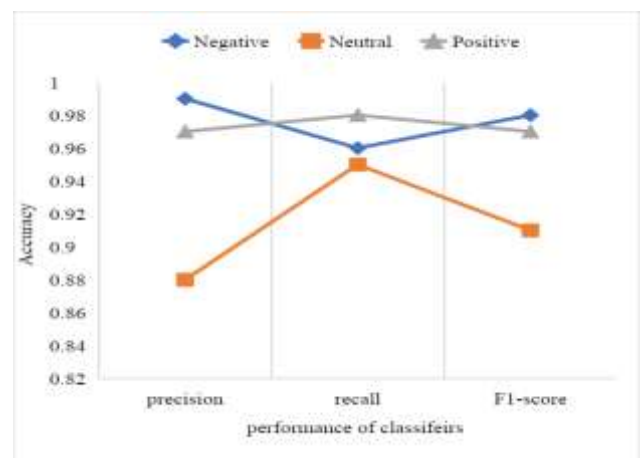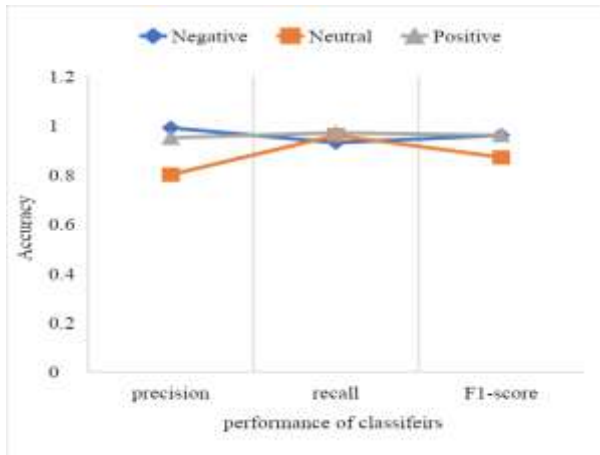| Classes	Precision	Recall	F1-score
Negative	0.99	0.96	0.98
Neutral	0.88	0.95	0.91
Positive	0.97	0.98	0.97
Support Vector Machine Accuracy	96.65542569409156		

Fig. 5 Measurement Performance as Precision, Recall, and F1 score of Support Vector Machine Classifiers

**Table. 6** Performance Evaluation of Logistic Regression Sentiment Classifier

Classes	Precision	Recall	F1-score
Negative	0.99	0.93	0.96
Neutral	0.80	0.96	0.87
Positive	0.95	0.97	0.96
Logistic Regression Classifier Accuracy	94.87226867464314		

Fig. 6 Measurement Performance as Precision, Recall, and F1 score of Logistic Regression Sentiment Classifier

Table. 7 Performance Evaluation of Random Forest Classifier

Classes	Precision	Recall	F1-score
Negative	0.99	0.94	0.97
Neutral	0.84	0.95	0.89
Positive	0.95	0.97	0.96
Random Forest Classifier Accuracy	95.55134660692013		
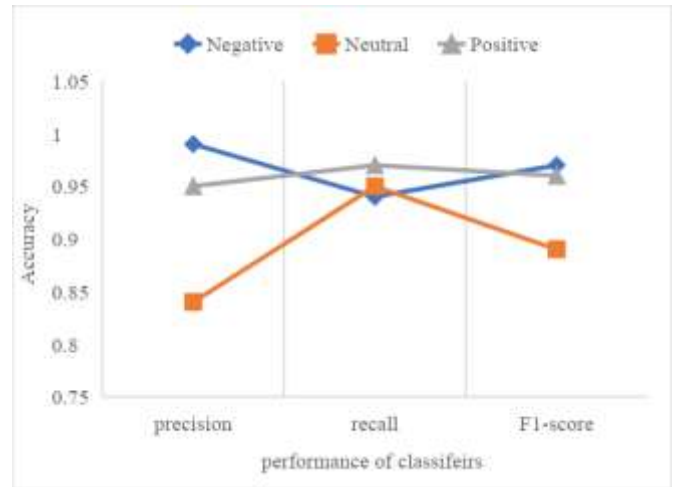
Fig. 7 Measurement Performance as Precision, Recall, and F1 score of Random Forest Classifier

The results show that the accuracy of the Support Vector Machine is 94.16% which is higher than other models. results provide better performance because it extracted significant features for sentiment analysis using machine learning. These features help to enhance the accuracy of each classifier. Also, in Fig. 3 visualization results of tweets as positive, negative, and neutral tweets in a graph that creates for expressing analysis.
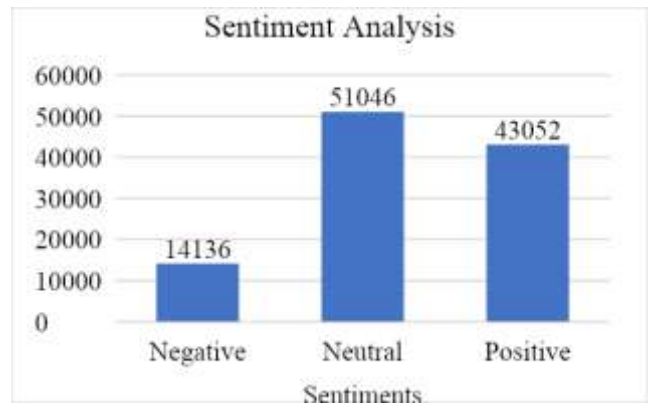
Fig. 8 Sentiment analysis as positive, negative, and neutral.

Figure 8 analyzes the sentiments as positive, negative, and neutral, it shows 13.6% of tweets are negative 47.16% of tweets are neutral, and 39.77% of tweets are positive. It shows that the rate of negative sentiments is lower than neutral and positive sentiments.

5. CONCLUSION

To conclude this research work, The Analysis of women's sentiments against sexual harassment is a critical concern of the globe. In this paper, 13.6% of tweets are negative 47.16% of tweets are neutral, and 39.77% of tweets are positive. The Results shown in the paper indicate that the rate of negative sentiments is lower than neutral and positive sentiments. To build an efficient model and

enhance the accuracy of the model Support Vector Machine, Logistic Regression, Random Forest Classifier, and Naïve Bayes classifiers are applied. The accuracy of the Naïve Bayes classifier is 87.48%, the logistic regression is 94.87%, the Random Forest classifier is 95.55% and the accuracy of the Support Vector Machine is 96.65% which is higher compared to other classifiers. Also measure the precision, recall, and F1-score of each classifier. This research analysis shows that women are aware of their rights and self-security but still need more awareness to be secure and safe to live with freedom and dignity in society.

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