

Sentiment Analysis Applications during COVID-19 Pandemics: An Exploratory Review



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Abstract: *Coronavirus pandemic has created complex challenges and adverse conditions. Sentiment analysis is a process of studying the user application. Because of using the internet in daily activities, many domains and organizations concentrate on analysis or getting user feedback to take the right decision. This paper is review the existing applications that used a sentiments analysis to identify major sentiment trends associated with the push to reopen the analyzing sentiment in social media like Twitter, etc. Data time aligned to the COVID-19 reopening debate. In addition, discover the most popular techniques and approaches. This study focus the research articles in high impact journals that published during the epidemics from 2019 to 2021. The research question that this study answer it are. This study can be beneficial to many domains such as sentiment analysis, text mining, research in related areas, and postgraduate students. This research could present valuable time sensitive opportunities for governments, and the nation into a successful new normal future. Several applications have employed in several domains, including tourism, education, business and health. Health information can be disseminated by social media and misinformation can be addressed via this platform.*

Keywords: *Sentiment; Data mining; Machine learning; Covid-19; Corona; Pandemic; NLP*

I. INTRODUCTION

Recently, the internet play a vital role in our life, particularly in business domains. Many people over the world wide using the social media platform such as Mobile applications, Facebook, Tweeter and YouTube, etc. [1-3]. The number of users increase tremendously in using social media network, the statistics shows that approximately 5.19 billion [4]. These platforms allow users to commenting of their post and advertisement. Such data can be utilize in order to improve the current product or decision for many companies. For example, if there is a product with specific brand is not prefer by customers, obtain the customers feedback through the comments. This comment is consider as an unstructured data. Area of analysis the user opinions is called sentiment analysis [5-6]. Sentiment analysis has been given attention in literature. There are many methods has been used such natural language processing [7-12], machine learning [13-18] and deep learning [19-20].

Manuscript received on February 28, 2022.
Revised Manuscript received on March 04, 2022.
Manuscript published on March 30, 2022.

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Retrieval Number: 100.1/ijrte.F68550310622
DOI: 10.35940/ijrte.F6855.0310622
Journal Website: www.ijrte.org

Therefore, the purpose of this paper is review the existing techniques of sentiment analysis for Covid-19. This study focus the research articles written in English language, more focus has been given to research paper in high impact journals which published during the pandemics from 2019 to 2021. The research question that this study answer it are. This study classified the research papers based the domain namely: social media, education, business intelligence, medical and entertainment:

- Sentiment Analysis on social media
 - Tweeter
 - Facebook
 - YouTube
- Sentiment Analysis on Education
- Sentiment Analysis on Business Intelligence
- Sentiment Analysis on Medical
- Sentiment Analysis Entertainment
 - Sports
 - Music
 - Movies

The research contribution is survey the existing techniques and application for sentiment analysis for Covid-19 during pandemic. Also, classified the research papers based domain namely: social media, education, business intelligence, medical and entertainment. This paper is orderly as follows. Section 2 presents the background for sentiment and sentiment terms, where section 3 presents the Sentiment Analysis Factors during Corona Pandemic. Section 4 describes the Sentiment Analysis Based Machine Learning Methods. Section 5 discusses the Taxonomy of Applications that used a sentiments analysis during COVID-19. Finally, section 6 concludes the paper.

II. SENTIMENT, SENTIMENT TERMS

The sentiment is a general feeling, attitude, or opinion about something [1], also people's opinions about a state, the likely future direction of a financial market, the economy, etc. Different terms with the same meaning for the term sentiment as a synonym are shown in Table 1 [2]. In a recent statistic, the number of user's increases tremendously in using social media networks. It has launched platforms to simplify communications between human publics and help them to share ideas, information, and other data. These platforms allow users to comment on their posts and advertisement. Therefore, sentiment analysis is a process of studying the user application. These applications have been employed in several domains, including tourism, education, business and health [3]–[5].

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TABLE I. SYNONYMS OF SENTIMENT TERM

Sentiment Term			
attitude	Bias	Feeling	Idea
Opinion	Passion	Position	Tendency
Thought	View	Affect	Conception
Conviction	Disposition	Emotionalism	Eye
Inclination	Inclining	Judgment	Leaning
Mind	Partiality	Penchant	Persuasion
Posture	Predilection	Propensity	Romanticism
Sensibility	Sentimentality	Slant	Softheartedness
Tenderness	Affectivity	Hearts and flowers	over emotionalism
Tender feeling	Way of thinking		

III. SENTIMENT ANALYSIS FACTORS DURING CORONA PANDEMIC

On the other hand, several of the tweets expressed are positive, neutral and negative sentiments; it is respectively 51.97%, 34.05% and 13.96%, [3]. Different study articles have shown that several outbreaks and pandemics could have promptly controlled if experts considered social media data. Therefore, sentiment analyses in studying pandemics, such as Coronavirus, are important based on recent events. The purpose of this paper is to review the existing applications that used a sentiments analysis during COVID-19 pandemics. Therefore, during the Corona pandemic, several studies of sentiments analysis were published based on social media platforms such as Twitter, Facebook etc., where strategies of technologies such as artificial intelligence (AI) were used in the medical field to discover the analysis of opinions about the pandemic such as lockdown, social distancing, and other strategies. Moreover, on social media platforms, opinions are expressed and generalizing emotions words about any event in the world, such as the covid-19 pandemic. These emotions (fear, sadness, crisis, recession, Optimistic, Pessimistic) are presented in several kinds of research such as [6]–[7], [8], [9]–[10]. Presents a word embedding method implemented based on machine learning methods and a large social media platform dataset. In this review, different language researchers presented the terms used in social media during an epidemic. The sample of terms or (#hashtag) of sentiment analysis used during epidemic shows in Table 2.

TABLE II. SAMPLE OF SENTIMENT TERMS DURING A PANDEMIC

Term (# hashtag)	Language
#lockdown	English
#COVID-19	English
#CoronaVirus	English
# Coronavirus Outbreak	English
# الحجر المنزلي (Home stone)	Arabic
# اغلاق المولات (Shopping malls closed)	Arabic
#اغلاق المساجد (mosques closed)	Arabic
#كورونا (corona)	Arabic

IV. METHODOLOGY

This section presents the research methodology, which are in the sentiment analysis for coronavirus during pandemic. The methodology discusses based on two methods, the first is sentiment analysis based machine learning methods, and the second is sentiment analysis based statistical methods, more details as in the following section .Figure 1. Shows the methodology used in this review.

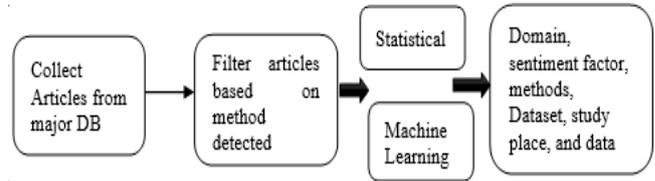


Fig. 1. Methodoloty for the Review Process.

A. Sentiment Analysis Based Machine Learning Methods

The current machine learning results are probable, as there is no pre-compiled dataset here and quick changes can be up-to-date here. Machine learning of data characteristics is fundamental to address advancing social issues in huge information. There are different amounts of renewed datasets. In this section, the researches of sentiment analysis by using machine-learning applications presented. The comparison of studies was during coronavirus pandemics, the studies that used machine-learning algorithms to detect emotions [7], [11], [12], [9], [13] and [10]. They introduce sentiments analysis applications based on supervised and unsupervised learning; they use deep learning classifiers [7]. The authors determine that though persons have tweeted mostly positively regarding COVID-19, the proposed model uses deep learning classifiers with up to 81% accuracy. K-means [12], the research proved the belief that it will permanently stay in the post-COVID time. naïve Bayes [9] [10] [12] [13] [21], the analysis of sentiment trends over a long period and their relation to announced news, and the comparison of the human behavior in two different geographical locations affected by this pandemic. SVM and Linear SVM [9] provide a practical accuracy of 74% with shorter Tweets, and both methods showed relatively weaker performance for longer Tweets.

B. Sentiment Analysis Based Statistical Methods

Sentiment analysis of social media datasets using statistical methods presented within several articles during the covid-19 pandemic. [14] [15], [8], [16], [17] Introduce sentiments analysis application, based on the unsupervised learning, the method uses co-occurrence statistical between terms and documents. In [14], the authors used time series statistical methods to show the health emergency and ensuing lockdown came with an unseen shift in households' economic sentiment. The research in [8] used Sina Weibo, Chinese social media and the unsupervised BERT model to classify sentiment categories (positive, neutral, and negative). The TF-IDF model used to summarize the topics of posts.



Weibo posts provide constructive instructions on public health responses that transparent information sharing and scientific guidance might help alleviate public concerns. On the other hand, in paper [16], the research analyses sentiment using Twitter-Data, time-aligned to the COVID-19 reviving discussion, also improves sentiment polarity based public sentiment scenarios (PSS) framework, that tweets data from American Twitter users show more positive sentiment support, than negative, for reopening the US economy. In research [17], the results showed that social media has a significant impact on spreading panic about COVID-19 among school students, with a potential negative impact on their mental health and psychological well-being.

V. RESULTS

Sentiment analysis on the social-media presented state of the people emotional during Covid-19 pandemic. This section presents and discussion the articles for sentiment analysis during Covid-19. The following section presents the taxonomy in details, which compare between the sentiment analyses applications used in Covid-19 pandemic.

A. Taxonomy of Applications used sentiment analysis during COVID-19 pandemic

Reviewing and analyses articles about the occurrence of different types of infectious diseases, such as pandemics, viruses or outbreaks, Understanding the application of sentiment analysis and obtaining the most important literature findings. Articles on related topics were systematically searched in five major databases, namely, ScienceDirect, PubMed, Web of Science, IEEE Xplore and Scopus, from 2019 to 2021. Table 3.1 and Table 3.2 shows the taxonomy in this review depending on the research domain, sentiment factors, methods, dataset, study place, and data language. Details for the factors are defined in the following section. The domain is the field studied in the research such as economic, education, etc. The Sentiment factor means the factors used by the researcher such as optimistic, pessimistic, positive, negative, etc. The method is the algorithms applied in the research. The dataset, which the data was used for the research in methodology, indicates the data's period. The study place depicts the location of the data on which the study was applied. The last factor is the data language (DL), which displays the language of the data for search such as English, Arabic, chains, Franc, etc.

TABLE III. COMPARISON BETWEEN SENTIMENT ANALYSIS APPLICATIONS DURING COVID-19

Ref.	Domain	Sentiment Factor	Methods	Data Set	Study Place	DL
[6]	Economic, Investor sentiment and medical	Optimistic, Pessimistic	Regression analysis	Coronavirus Related News (CRNs) From 12-2019 To 2-2020	China, HongKong, US, apan,Korea	English
[14]	Economic	crisis, recession, unemployment, social benefits	Time-series, statistics methods	internet search intensity data from Google Trends, January through April 2020	EU	English
[15]	Social distancing	implementation, purpose, social disruption, adaptation, positive emotions, and negative emotions	statistics	259,529 unique tweets, January 23- March 24, 2020 using the Twitter API	US	English
[7]	Emotion during covid-19	neutral , positive or negative sentiments	deep learning classifiers	226,668 tweets. December 2019 and May 2020		English
[18]	economic	Search Index	forecast root mean squared error (RMSE)	newspaper-based sentiment indicator for Spain	Spain	Spain
[11]	Social Media	Rumors ideas and emotional	LDA Model ,bag-of-words method and ML	Qingbo Big Data Agency, from January 24, 2020 to February 25, 2020.	Beijing, Shanghai, Guangdong	China
[12]	Social Media Users' Opinions on Remote Work		K-means, (Naïve Bayes)	500thousand tweets between 1st of February 2020 and 10th of August 2020	In general on tweeter	English
[8]	Social Media in China	neutral , positive or negative	TF-IDF, and BERT	Weibo posts from 1 January 2020 to 18 February 2020	Weibo -Chaina	China
[19]	correlations between crude oil and agricultural futures	Analysis of impact COVID-19	DCCA coefficie	from 3 April, 2017 to 3, April, 2020	3 April, 2017 to 3, April, 2020, of Brent Crude Oil consists of 776observa-tions	English



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[14]	Economic	internet search from google	Business cycle	data from Google Trends	EU	English
[16]	emotional consequences	extreme fear, confusion and volatile sentiments,	Statistical, N-Gram	American Twitter users from May 2020 to gauge sentiment associated with reopening. 293,597tweets	USA	English
[17]	Education	online questionnaire Yes, Nature, No	T-test, ANOVA, and chi-square	1067 school students	Gaza Strip-Palestine	English
[9]	applying the keyword "Corona"	Positive, Negative	SVM, Naïve Bayes,	nine hundred thousand tweets from February to March of 2020	US	English
[20]	nature, lockdown, health, education, market, and politics	Anger, Anticipation, Disgust, Fear, Joy, Sadness, Surprise, and Trust	NRC emotion lexicon, basic NLP operations for tweet cleaning	'25-03-2020' to '09-06-2020'	India tweets	English
[13]	Emotions (joy, fear, sadness and anger)	positive, negative, neutral	Naive Bayes, Logistic Regression, Linear SVM, Random Forest	3,332,565 tweets in English and 3,155,277 tweets in Portuguese	Brazil, and the USA	English, Portuguese
[10]	Grand Mosque closure	positive, negative,	Naïve Bayes machine learning	53,127 tweets were	Saudi Arabia	Arabic

VI. CONCLUSION

This study is survey the existing techniques and applications of sentiment analysis for Covid-19 during pandemic. This study focuses the research articles written in the English language. The focus has given to research paper published during the coronavirus pandemic from 2019 to 2021. Social media and COVID-19 studies reviewed based on various themes, topics, and methodological approaches. In this review the taxonomy is created depends on the research domain, sentiment factors, methods, dataset, study place, and data language. More factors used are positive, negative. On the other hand, the factors used in the some studies are yes or no. Therefore, sentiment analysis is a process of studying the user application. These applications have employed in several domains, including tourism, education, business and health. Understand the application of sentiment analysis and obtain the most important literature findings . This research could present valuable time sensitive opportunities for governments, and the nation into a successful new normal future .

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