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Sentiment Analysis in Social Media and Its Application: Systematic Literature Review

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Abstract

This paper is a report of a review on sentiment analysis in social media that explored the methods, social media platform used and its application. Social media contain a large amount of raw data that has been uploaded by users in the form of text, videos, photos and audio. The data can be converted into valuable information by using sentiment analysis. A systematic review of studies published between 2014 to 2019 was undertaken using the following trusted and credible database including ACM, Emerald Insight, IEEE Xplore, Science Direct and Scopus. After the initial and in-depth screening of paper, 24 out of 77 articles have been chosen from the review process. The articles have been reviewed based on the aim of the study. The result shows most of the articles applied opinion-lexicon method to analyses text sentiment in social media, extracted data on microblogging site mainly Twitter and sentiment analysis application can be seen in world events, healthcare, politics and business.

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1. Introduction

The emergence of web 2.0 is changing the world of social media. Not only online social media used to connect, share information and their personal opinion to others, but even business can also communicate, understand and improve their product and services through connecting in social media. The number of social media users increases every day and it is estimated in 2019 there will be up to 2.77 billion social media users worldwide [1]. There is various

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type of information uploaded and shared on social media in the form of text, videos, photos and audio [2]. Social media is rich with raw and unprocessed data and the improvement in technology, especially in machine learning and artificial intelligence, allow the data to be processed and converted it into a useful data that they can benefit most business organization [3].

This paper focuses to provide a better understanding of the application of sentiment analysis in social media platform by examining related literature published between 2014 to 2019. Sentiment analysis is an approach that uses Natural Language Processing (NLP) to extract, convert and interpret opinion from a text and classify them into positive, negative or natural sentiment [4]. Most of the previous study applied sentiment analysis into a product or movie review to better understand their customer and make the necessary decision to improve their product or services [5].

Scholars have been conducting a study on sentiment analysis since the last decade which most papers started to appear and rapidly growing after the year 2004 [6]. Sentiment analysis is divided into three different levels which are sentence level, document level and feature level. The purpose is to classify the opinion either from sentence, document or features into positive and negative sentiment [7].

There are 2 main methods of sentiment analysis have been identified which is a machine learning approach and lexicon-based approach. Machine learning approach utilized algorithms to extract and detect sentiment from a data while lexicon-based approach works by counting the positive and negative words that related to the data. Scholars have been developing a new effective and accurate model in sentiment analysis. But there is a challenge arise in developing a model where most of it is design for the English language. But a recent study shows that there is sentiment analysis model design in other languages such as Korean [8], Thailand [9], Arabic [10], Malay [11], Portuguese [12] and Chinese [13]. As for the application of sentiment analysis, it is reported that it has been done in business and marketing, politics and public action context. Example of the application is E-commerce, voting application and world events [14]. Most of the data extracted for the study was extracted from social media. The social media contain a vast amount of data from online users and we can get any information on a product, services, place or events which makes it fit for sentiment analysis study.

2. The review

2.1. Design

A systematic review was undertaken using 6 steps guidelines for conducting a systematic literature review in management [15]. First, we start by defining the research question. Then determine the required characteristic for the study. Continue by retrieving potentially relevant literature and selecting pertinent literature. We then synthesize relevant information from the literature and the final step is reporting the result of the review.

2.2. *To provide an overview of the review, the following research question was addressed:*

- RQ1: What is the method used in sentiment analysis of social media?
- RQ2: What is the type of social media platform used to applied sentiment analysis?
- RQ3: What is the application context of sentiment analysis in social media?

2.3. Retrieving and selecting pertinent literature

The review utilizing five reputable and credible online databases that published literature covering information and computer science area. Search strings keywords used for all five online databases is “Sentiment analysis, social media, Facebook, Twitter”. The total articles identified from the database search is 407 articles. 34 articles identified from Emerald Insight, 244 results identified from science direct, 24 results from Association for computing machinery (ACM), 54 articles from Scopus and 51 articles identified from IEEE.

Then the screening of papers is conducted based on the inclusion and exclusion criteria and the screening resulted in 77 articles. Consequently, the screening involved reading the full texts and analyzing each article and we obtain 24 finalized articles.

2.4. Synthesizing the literature

The studies were published between 2014 to February 2019. There is a total of 24 articles selected that suits the purpose of this review. The data from the paper is extracted and the primary study findings are analyzed and integrated into a Table 1.

Table 1. Summary of reviewed literature.

Author	Title	Method / Tools	Application / Result	Context
Yuliyanti, Djatna & Sukoco. (2017)	Sentiment Mining of Community Development Program Evaluation Based on Social Media	Lexicon-based and machine learning	Success level of the community development program	Twitter
Martin-Domingo, Martin, & Mandsberg. (2019)	Social media as a resource for sentiment analysis of Airport Service Quality	Machine learning	Analyse airport service quality	Twitter account
Mansour. (2018)	Social Media Analysis of User's Responses to terrorism using sentiment analysis and text mining	Lexicon-based	Most user view ISIS as a threat and fear	Twitter
Saragih & Girsang. (2017)	Sentiment Analysis of Customer Engagement on Social Media in Transport Online	Lexicon-based	Evaluate the business performance of online transport.	Facebook and Twitter comments
Hassan, Hussain, Husain, Sadiq, Lee. (2017)	Sentiment Analysis of Social Networking Sites (SNS) Data using Machine Learning Approach for the Measurement of Depression	Machine learning	Find the depression level of a person	Twitter and newsgroup
Joyce & Deng. (2017)	Sentiment Analysis of Tweets for the 2016 US Presidential Election	Lexicon-based and machine learning	Calculate sentiment expressed and compare with polling data to see the correlation	Twitter
Ikoro, Harmina, Malik, & Batista-Navarro. (2018)	Analyzing Sentiments Expressed on Twitter by UK Energy Company Consumers	Lexicon-based	Analyze energy provider company and the sentiment that users show	Twitter
Hao & Dai. (2016)	Social media content and sentiment analysis on consumer security breaches	Lexicon-based	Security breaches can be detected in the early stages and prevent further destruction	Twitter
Shayaa, Wai, Chung, Sulaiman, Jaafar & Zakaria. (2017)	Social Media Sentiment Analysis on Employment in Malaysia	Lexicon-based	Negative sentiment score on employment	Multiple channel social media
Isah, Trundle & Neagu. (2014)	Social Media Analysis for Product Safety using Text Mining and Sentiment Analysis	Lexicon-based and machine learning	Monitor brand in order to act in even of a sudden rise in negative sentiment.	Facebook comment and Twitter
Ali, Dong, Bouguettaya, Erradi & Hadjidj. (2017)	Sentiment Analysis as a Service: A social media-based sentiment analysis framework	Machine Learning	Identify the location of disease outbreaks	Twitter, Reddit, Instagram, news forum.

Author	Title	Method / Tools	Application / Result	Context
Akter, Aziz & Tareq (2016)	Sentiment analysis on facebook group using the lexicon-based approach	Machine learning	Determine recent trends and characteristics of people food habit.	Facebook Group – Foodbank
Mahtab, Islam & Rahaman (2018)	Sentiment Analysis on Bangladesh Cricket with Support Vector Machine	Lexicon-based and machine learning	Analyze people sentiment expressed towards cricket	Facebook Group – Bangladesh Cricket
Chedia Cynthia & Tan (2017)	Social media sentiment analysis: lexicon versus machine learning	Lexicon-based and Machine learning	Sentiment analysis on consumer generated content	Facebook brand pages
ElRahman, AlOtaibi & AlShehri (2019)	Sentiment Analysis of Twitter Data	Machine learning	Popularity between two restaurant – KFC and Mcdonalds	Twitter
Abd El-Jawad, Hodhod & Omar (2018)	Sentiment Analysis of Social Media Networks Using Machine Learning	Machine Learning	System to provide insight on how people perception	Twitter
Fatyanosa & Bachtiar (2017)	Classification method comparison on Indonesian social media sentiment analysis	Lexicon-based and Machine learning	Sentiment on Jakarta governor election	Twitter
Karamollaoğlu, Doğru, Dörterler, Utku & Yıldız (2018)	Sentiment Analysis of Turkish Social Media Shares through Lexicon Based Approach	Lexicon-based	Measure the perception or influences of the phenomena	Twitter
Poeceze, Ebster, Strauss & Christine (2018)	Social media metrics and sentiment analysis to evaluate the effectiveness of social media posts	Machine learning	Optimize brand communication and understanding consumer feedback	Facebook page of YouTube Gamers
Ragini, Anand & Bhaskar (2018)	Big data analytics for disaster response and recovery through sentiment analysis	Lexicon-based and machine learning	sentiment towards the needs of affected people during disaster	Twitter
Ramanathan & Meyyappan (2019)	Twitter Text Mining for Sentiment Analysis on People's Feedback about Oman Tourism	Lexicon-based	Feedback on Oman tourism	Twitter
Shahare (2017)	Sentiment analysis for the new data based on social media	Machine learning	Process and identify emotion level from news data	News from blogs
Vishal & Uma (2018)	An Extensive study of Sentiment Analysis tools and Binary Classification of tweets using Rapid Miner	Machine learning	Identify an efficient tool which can help an enterprise	Twitter
Suman, Gupta & Sharma (2017)	Analysis of Stock Price Flow Based on Social Media Sentiments	Machine learning	Relate the flow of stock price	Stock Twists

3. Reporting the result

3.1. *The sentiment analysis method used in social media*

Based on the papers reviewed, all of the paper demonstrated the usage of either Lexicon based method, Machine learning method or a mix of both method when implementing sentiment analysis. The results show in conducting sentiment analysis, 7 of the reviewed paper uses the lexicon-based method, 10 papers use machine learning and 7 papers show the combination of both methods.

Lexicon based method is known as an unsupervised learning method. Lexicon method does not require any training data and only depends on the dictionary. Most of the study adapted Sentiwordnet and TF-IDF method when conducting sentiment analysis. This approach is calculated based on the occurrences of the terms in the text data with other positive or negative words in the predeveloped polarity lexicons like Sentiwordnet [4]. As for TF-IDF method, it works by converting the words into a number and it is calculated using the term frequency-inverse document frequency method [16].

The techniques rely on lexical resources and the effectiveness of the whole approach strongly depends on the quality of the lexical resources. It is based on the polarity of a piece of text can be obtained on the ground of polarity of the words which compose it. Due to the complexity of natural languages, this approach is not designed to cover all aspect of language especially when it comes to slang, sarcasm and negation [17]. Using sentiment words are not sufficient. Some of the problems exist such as some words have different meaning based on the application, some sentence containing sentiment words may not express any sentiment and many sentences without sentiment words can also imply opinion [18]. However, the lexicon-based method does have its own advantage such as it provides simple counting positive and negative words, flexible to fit with different language and speed to complete analysis.

Machine learning method falls under supervise learning and the method requires training data in order to be processed. The most used method in machine learning method is the SVM and Naïve Bayes model. Different machine learning model but these are the most common used. Naïve Bayes is successful when applied on well-formed text corpus [19] while support vector machine it gives a good performance for low shape dataset. Nevertheless, machine learning method performs poorly on Facebook with people post in random length and lots of spelling mistake and it requires a huge amount of training sample in order to adapt the method as the amount of dataset will influence the size and quality the output [18, 20]. Furthermore, analyzing with machine learning is time consuming where it takes hours in the complex machine learning model especially if training is required [11]. The process is faster with a smaller size of training dataset but it leads to poorer classification accuracy [21].

Interestingly, researchers argue that both types of analysis method perform very similar in terms of accuracy [21]. There are options to combine two approaches mainly lexicon-based sentiment classification that contain sentiment scoring function and Naïve Bayes multinomial event models from a machine learning approach to predict the direction of sentiment. Instead of relying on one method, studies have proven that combining both methods it has better efficiency [19]. Thus, in order to improve the outcome, it is recommended to combine both methods as it will complement each other, and the result is improved compared to using one approach only. Combine approach is valuable to identify a phenomenon [21]. It also can improve the handling of unstructured data [22].

3.2. *Type of social media platform use to extract data for sentiment analysis*

Social information services or social media can be categorized into four types based on their application usage: Content communities (Youtube, Instagram), Social networking (Facebook, LinkedIn), Blogs (Reddit, Quora) and Micro-blogs (Twitter, Tumblr) [23].

Based on the reviewed paper, among the four types of social media services, micro-blogging sites specifically twitter is the top social media platform used to collect information on user opinion. 85% of the reviewed paper uses twitter to collect information for sentiment analysis. Twitter is one of the ten most visited websites and enables users to post and interact with short messages. Twitter also use to express their opinion and provide very valuable information to scholars, business organization and even the government.

Twitter as a famous microblogging tool social media platform for people to express their emotion towards a particular person, event or product. What makes Twitter popular is the content or data that is readily available for

public use. With the usage of API, people can access and copy the data on any desired topic based on the keywords or hashtag. Twitter to conduct real-time analysis and closely public sentiment as Twitter has about 500 million tweets per day and it allows public access to its data through API [24]. Twitter is used to search and collect tweet from 8 different countries from the western and eastern country. There is Twitter user all around the world thus making it rich with opinion and views by people from a different country, different language and different perception [25].

For example, Twitter is used collected users tweet on particular president candidate during election [26] and collected tweets that had been written on a community development program activity [27].

Moreover, Twitter also used to collect message from the customer to energy company in the UK [28] and analyze tweets downloaded from London Heathrow airport official twitter account to be analyzed further using sentiment analysis [29].

Facebook has the largest social media users in the world. But it is not very popular for sentiment analysis as the data is messy, it is not structured well, and people often use short forms and a lot of spelling error. This makes the data harder to be analyzed. An example is using Facebook and Twitter to fetch pages, status updates and comments suggesting user experiences [30]. A study conducted gathered data from various source of social media includes forum, blogs, Expedia, blog spot, mainstream media, WordPress, YouTube, Twitter, aggregator, Facebook. And the result shows that 88% of the data comes from Twitter [31]. The other source of social media is not preferable because of the number of data or opinions that can be extracted is limited such as in Blogspot, YouTube and WordPress.

3.3. Application context of sentiment analysis

The application of sentiment analysis ranges from business and marketing, politic, health to public action. Sentiment analysis is not limited to one application, but it provides a vast application in different areas to assist in decision making.

Sentiment analysis can be applied on world events such as an event, activity, sports or disaster that is occurring in the world [20, 32]. Some of the examples are a study conducted to compare how people from western countries and eastern countries view ISIS. The result shows how two sides of the world view ISIS the same way which is a terrorist [25]. Sentiment analysis also allows raising awareness of data security and the danger of security breaches. It also acts as a guideline for companies to respond to security breaches in shaping public perception [24]. Furthermore, sentiment analysis also conducted on the unemployment rate and employment sentiment score in social media [31].

We can see the application of sentiment analysis in healthcare and where the study uses Sentiment analysis as a service framework is proposed and utilize spatio-temporal properties to identify locations of disease outbreaks [23]. In addition, sentiment analysis can identify sentiment needs of people during a disaster and prepare an appropriate response to rescue [33]. Moreover, Sentiment analysis allows finding the level of depression of a person by overserving and analyzing emotions from text [19].

Sentiment analysis can be used to predict political election where it shows the data analyzed from twitter is more reliable as a platform where 94% of correlation has been found to polling data and have the potential to become a platform that is able to rival sophisticated polling techniques [26].

Lastly, feedback of customer plays an utmost important role in the application of sentiment analysis where it can assist business and organization to take appropriate action to improve their product or services and business strategy. This is shown in a study where it concludes views and experiences of drug and cosmetic product among social media users [30]. Sentiment analysis also allows detecting area that needs to be improved in airport service quality and apply proper corrective measures such as pay attention to passenger feedback in social media [29]. Then, sentiment analysis able to analyze trends and characteristics of people food habit which is useful for the business organization when planning their product and marketing strategy [18].

Sentiment analysis creates advantages for business owners to identify their popularity among customer and how customer think about their product or service [22] and assessing the effectiveness and capability of business brand communication and social media [34] and evaluate their business flow of stock price through social media [35].

The feedback given by consumer is important so that we recognize our own weakness. It is displayed by a study that compares sentiment data on consumer tweets on Big Six (Britain's largest and oldest gas and electricity supplier and new entrant energy consumer) [28]. The result indicates that the sentiment from the Big six is more negative than a new entrant energy consumer. In addition, sentiment analysis on social media allows the organization to evaluate

the success level of a program as shown in a study where a high positive sentiment is obtained from a tweet on community development program activity. The result can help to improve the overall living standard of the community [27].

4. Conclusion

The conducted systematic literature review provides information on studies on sentiment analysis in social media. The paper makes the following three contributions. First, we show what is the method used in analyzing sentiment in social media. There is various method introduced by researches, still, the most common method uses in Lexicon based method is SentiWordnet and TF-IDF while for machine learning is Naïve Bayes and SVM. Choosing the appropriate method of sentiment analysis is depending on the data itself. Both methods demonstrated a similar accuracy. The things that need to take into consideration is the structure of the text, time and amount of data. If the data structure is messy, a small amount of data and limited time available to analyses, it is recommended to go for lexicon-based method. Bigger data is suitable for machine learning based method as it requires more time and data to train. In order to improve the quality and accuracy of the result, it is suggested to combine both lexicon and machine learning method.

Second, we identify what is the most common type of social media site to extract information for sentiment analysis. The most popular social media site to extract information is Twitter. Most of the reviewed paper use twitter as their social media context. This is due to the availability, accessibility and richness of Twitter content. There are millions of tweets every day on almost any topic. This indicates that social media is becoming a precious source of information. However, less attention is given to other social media sources such as blogs, WordPress, YouTube and others. The content of each social media might be different, and it is worth exploring other sources might open to new knowledge and findings.

Third, we demonstrate the application of sentiment analysis in social media. Sentiment analysis has a broad application and can be utilized in different areas such as improving quality and strategy in business, political forecasting an election result, monitor disease outbreak, create awareness on the importance of data security, perception towards a particular sport, and improve locate and response to the disaster. This shows that sentiment analysis plays a huge role to understand people perception and helps in decision making. For future recommendation, further investigation is needed to develop a universal model of sentiment analysis that can be applied to a different type of data, explores other potential social networking sites to obtain users opinion and expanding the context of sentiment analysis application.

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