Paper ID: 233

Social media sentiment analysis for customer purchasing behavior – A systematic literature review

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Abstract: Social Media Sentiment Analysis is a field of study with a vast number of applications. One important application is analysing customer behaviours using the results of social media sentiment analysis which is a great tool that decision-makers can utilize. There are several studies conducted about this field. This paper presents the results of a systematic literature review conducted on the existing studies which would be beneficial for developers and researchers interested in this field. This is a preliminary SLR in which, research papers published in journals and conferences until 2020 were collected from 7 electrical databases. Initially, 86 studies were found and 5 most relevant studies derived through specific inclusion and exclusion criteria were investigated to analyse the current status of research, approaches and methods used, results, limitations, existing gaps and future recommendations by researchers. The results of this study suggest that hybrid models that combine lexicons and machine learning classification models produce more accurate results in sentiments analysis. Researchers have attempted to conduct sentiment analysis considering various components of social media text data: punctuation, emoji and emoticons, negations, acronyms and slangs etc. Most studies focus on various applications of social media sentiment analysis beneficial for understanding and interacting with customers. Such as identifying how cultural and economical differences, occurrence of various events impact consumer purchasing behaviours, dealing with negative sentiment shifts, segmenting consumers into groups and even predicting sales performance etc. This study makes a significant contribution by providing a comprehensive and up-to-date review of the previous attempts made in the selected domain.

Key Words: systematic literature review, sentiment analysis, social media, purchasing behaviour

Introduction

3.484 billion of people around the world use Social Media by the end of 2019 and this number will be increased by 9% each year. Social media users freely express and share their ideas on social media creating zeta bytes of data. These data led way to Social Media Sentiment Analysis which generates valuable insights about data creators that would otherwise stay hidden. Businesses around the world have been increasingly using social media data to understand their customers and to generate business intelligence.

A. Sentiment Analysis

Sentiment analysis is also known as opinion mining and is a sub-domain of Natural Language Processing. It aims to derive the writers' opinion, emotions or attitudes from a text including the degree of positivity or negativity of the sentiment (Liu 2012).

According to (Wolny 2016), (Pang & Lee 2008) it can also be used to identify if a text is subjective or objective. Sentiment analysis results are applied for a variety of purposes. Analysing movie reviews, product reviews, blogs and news etc.

B. Social Media Sentiment Analysis

At present social media platforms are spread everywhere within the globe. The digital age that we are currently living in has nourished the fast growth of social media. Approximately 2.82 billion people are actively using social media in 2018 worldwide. This number will be increased to 2.93 billion in 2020. Users freely express their ideas, attitudes, emotions and opinions about anything and everything in these social media platforms. This creates a massive amount of user-generated content which fall under the category of big data. When the sentiments contained in this huge amount of text data are analyzed properly the results produce valuable insights that can be applied in many fields. Product recommendations, stock prices prediction, sales prediction, election results prediction, public health planning, economic forecasting, political analysis, disaster predictions are few of them.

However, social media sentiment analysis includes its' own benefits and limitations. For example, gathering data is relatively easier and is of low cost. There is content freely available about any topic. In the negative side, in some geographical areas, especially under developing countries social media does not represent the opinion of the general public as the majority of the population using social media tend to be younger and socio-economically privileged (Gayo-Avello, Metaxas & Mustafaraj 2011). In addition, language changes are harder to analyse. Social media data is also unstructured, high volume and noisy thus traditional methods are powerless in analysing them (Ibrahim & Wang 2019). Thus, machine learning approaches are frequently used by researchers.

C. Social Media Sentiment Analysis for Customer Behaviour

Social media sentiment analysis provides valuable insights related to customer behaviours. Social media is so integrated with human lives, serves as a main method of communication and affects all the kinds of human activities (Lassen, Madsen & Vatrapu 2014). As mentioned in (Arora, Li & Neville 2015) most users express their opinions about different brands, products and services on social media platforms. Users freely and frequently create and share content on what they purchase, what features they like or dislike, how disappointed or pleased they are with a specific brand etc. When analysed properly, these users generated content which is in the form of comments, posts, likes, tweets or retweets uncovers hidden knowledge that decision-makers can utilize for the success of their businesses.

Emotions are what drives human in everything they do, including making purchasing decisions. The emotion, opinion or sentiment they have about a specific product or service determines whether they make a purchase or not. Their emotions are affected by the opinion of both leading figures and the general public thus their decision-making process is also affected by both (Feldman 2013). Thus closely monitoring social media data which represents the opinion of the customer base is critical for a successful business firm. Firms can become aware of shifts in customer sentiment and react accordingly to reduce harmful effects. They can also utilize it as a performance evaluator: to identify what products and services need to be improved the degree to which customers' needs are met and the successfulness of their market strategies. Social media sentiment analysis is utilized as a market research tool

by analysing customers' sentiment about competitors. Hidden patterns and knowledge from social media sentiment analysis results provide firms with a competitive advantage. Conducting a systematic literature review which identifies the current status of existing literature in this domain including limitations, barriers and gaps in the existing researches will provide a solid foundation for prospective researches. Mainly, this study identifies approaches and technologies used, applications of social media sentiment analysis related to customer insights, limitations and barriers faced by researchers. This is an up-to-date and comprehensive record of existing research attempts made related to this domain that provides a significant contribution to existing knowledge.

Table 1: Search strings used to fetch studies

Area	Search Term
Customer Purchasing Behavior	"customer purchasing behaviour", "customer buying pattern"
Social Media Sentiment Analysis	"social media sentiment analysis" "social media opinion mining" "microblogging sentiment analysis" "microblogging opinion mining"
Full search string	("customer purchasing behaviour" OR "customer buying pattern") AND ("social media sentiment analysis" OR "social media opinion mining" OR "microblogging sentiment analysis" OR "microblogging opinion mining")

Methodology and Experimental Design

This study was conducted following the methodology given in (Kitchenham 2004) to conduct a Systematic Literature Review. The following are the steps followed.

A. The strategy of Literature Search

As mentioned earlier, plenty of studies are already conducted under this field. Application of a smart searching strategy allows retrieving many of them as possible.

B. Sources

The following sources were queried to fetch existing studies

i. Emerald Insight (http://emeraldinsight.com)
ii. Science Direct (https://www.sciencedirect.com)
iii. Research Gate (https://www.researchgate.net)
iv. IEEE Xplore (http://ieeexplore.ieee.org)
v. Springer Link (https://link.springer.com)
vi. ACM Digital Library (https://dl.acm.org)
vii. GoogleScholar (https://www.scholar.google.com)

At the end of the search process, a total of 86 number of papers were found. The statistics are as following: IEEEXplore-23, Research Gate-9, Springer Link-5, Science Direct-19, Emerald Insight-6, ACM Digital Library-5, Google Scholar-19.

C. Inclusion and Exclusion Criteria

Studies to be included and excluded for this review were determined under the following criteria.

Inclusion Criteria

IC1 - Publications from above mentioned digital libraries related to identifying customer purchasing behaviours using social media sentiment analysis were included.

IC2 - Publications published from 2007 to 2020 were included

Exclusion Criteria

EC1- The study does not have an abstract.

EC2- study is not written in English.

EC3- The study is an older version of another study already considered.

EC4- The study is not primary.

EC5- Removing multiple versions of the same article from different libraries.

D. Data exaction and synthesis method

Following steps were followed to exact and synthesize data from research papers.

i. Articles were fetched as in IC1 using the search strings mentioned in section C.
ii. Articles complying to IC2 were shortlisted.
iii. EC1, EC2, EC3, EC4 and EC5 were applied to shortlist the best suitable articles.
iv. Each selected article was analyzed under the research questions mentioned in section E, with the aid of a form.
v. All the results were arranged and sorted.

E. Research Questions

In this review, the following research questions are addressed.

RQ1: What are the aspects that had been covered in the existing researches regarding social media sentiment analysis for customer purchasing behaviour?

RQ2: What are the issues/limitations the previous researchers had to face in this field of study?

RQ3: What are the applications of knowledge generated in previous research?

RQ4: What are the technologies/methods /approaches used to conduct this type of research?

RQ5: What are the main conclusions drawn from existing studies?

Results

This section presents the findings of this study based on the answers for each research question and summary of selected literature.

RQ1: What are the aspects that had been covered in the existing researches regarding social media sentiment analysis?

Table 2: Outcomes of selection stages

Stage	Criteria	Analyzed Content	Initial no of studies	Final no of studies
1st	IC1, IC2,EC1, EC2	Title, Abstract, Keywords	86	64
2nd	IC1,IC2 EC3, EC5	Title, Abstract, Keywords	64	19
3rd	IC1, IC2 Snowballing, EC4	Full text, Title, Abstract, Keywords	19	4
4th	Research group, IC1, IC2, EC4	Full text	4 (added by Snow balling)	1 (added by Snowballing)
5th	IC1,IC2, EC1, EC3, EC4	Full text	3 (added by Research group)	0 (added by Research group)
Final			86+4+3 = 93	4+1+0 = 5

Former studies were conducted on identifying the best method between different methods that can be used (Zul, Yulia & Nurmalasari 2018), creating more efficient and accurate frameworks and approaches (Chang et al. 2019), (Eder, Guigas & Debeye 2019), (Tan, Hong & Tan 2012), different tools that can be used to conduct sentiment analysis (Peacock & Khan 2019), different applications of analysis results: generating competitive intelligence (Part 2010), predicting consumer confidence (Shayaa et al. 2018), analysing the characteristics of consumers of different cultures (Zhong et al. 2019), evaluating social media brand presence(Pletikosa Cvijikj, Dubach Spiegler & Michahelles 2013), using emojis and emoticons for emotion mining (Zhang et al. 2013), (Alita, Priyanta & Rokhman 2019), (Solakidis, Vavliakis & Mitkas 2014).

RQ2: What are the issues/limitations the previous researchers had to face in this field of study?

If the research was conducted using a lexicon-based approach for sentiment analysis then the final result heavily depends on the words of the lexicon. A framework built on lexicon approach would fail to classify any word that is not in the lexicon. A language is a complex intellectual that is constantly changing. The meanings of words depend on the context it is being used in. Sarcasm detection, handling multilingualism (80% of researches done are for English language, sentiment analysis using other languages is very less), identifying spellings mistakes, handling negations, handling acronyms and slang language (social media content is mostly written informal language with terms like “Lol”, “Ha ha”,”Bff” with sentiments in them but traditional lexicons are not capable of understanding them), handing lexical variations (same word written in multiple ways eg: gdn8, good night, gdnt) are difficulties faced by researchers (Yadav & Pandya 2017). Researchers in this field of study must address all these issues in natural language processing. On the other hand in some countries social media are not used by the entire population, mostly younger and socio-economically benefited people tend to be active social media users (Gayo-Avello, Metaxas & Mustafaraj 2011). Hens, making conclusions about the entire customer base is questionable.

The English language had been the focus of a comparatively very large number of studies. This causes the English language to have more attenuated datasets than other languages. So, because of this, using automated systems to analyse sentiments in other languages will result in low accuracy. (Mohammad 2016)

RQ3: What are the applications of knowledge generated from previous research?

Results of analysing social media sentiment for customer purchasing behaviour are applied in every place where awareness of the sentiment or the opinion of the customers is critical. For example (Zhong et al. 2019) analyses differences in customer sentiment in different cultures for the same product- this result is useful to marketers and decision-makers. Another study (Ibrahimand Wang, 2019) analyses customer sentiments in a timely manner to discover the effect of events that occur to the customers' opinion. Exploring trends in customer sentiment is also very useful (Ibrahim & Wang 2019). Measuring consumer confidence via customer sentiment is another application (Shayaa et al. 2018). Sales and marketing performance can be analysed using customer sentiment (Part 2010). Another very useful application is predicting customer purchasing behaviours using customer sentiment analysis results.

RQ4: What are the technologies/methods /approaches used to conduct researches related to this field?

Various researchers have followed different approaches

for sentiment classification: machine learning-based methods (Naïve-Bayes, Support Vector Machine, K-mean, K-nearest neighbour, Logistic Regression, Decision trees), lexicon-based methods and Hybrid methods that combine both lexicons and machine learning models. Machine learning gives computers the ability to learn by themselves without being explicitly programmed algorithms require a large amount of training data set.

The other approach, Lexicon means a vocabulary. This type of approaches use lexicons for calculating polarity of individual words and aggregate their scores to determine the overall polarity of text. Lexicon based approaches are further classified as corpus-based and dictionary-based lexicon approaches (Wang et al. 2014).

Table 3: Bibliographic References

Paper Id	Bibliographic Reference
#1	Zhong, Q. *et al.* (2019) 'Using online reviews to explore consumer purchasing behaviour in different cultural settings', *Kybernetes*, 48(6), pp. 1242–1263. doi: 10.1108/K-03-2018-0117
#2	Ibrahim, N. F. and Wang, X. (2019) 'Decoding the sentiment dynamics of online retailing customers: Time series analysis of social media', *Computers in Human Behavior*. Elsevier, 96(October 2018), pp. 32–45. doi: 10.1016/j.chb.2019.02.004.
#3	Elkhunni, M. (2015) 'Visualizing in Twitter Sentiment To Measure Consumer Insight Visualizing in Twitter Sentiment to Measure Consumer Insight Mustafa Bashir B El-Khunni Department of Computer Science', (September 2013), pp. 0–108. doi: 10.13140/RG.2.1.1809.1044.
#4	Shayaa, S. *et al.* (2018) 'Linking consumer confidence index and social media sentiment analysis', *Cogent Business and Management*. Cogent, 5(1), pp. 1–12. doi: 10.1080/23311975.2018.1509424.
#5	Setiya, K., Ubacht, J., Cunningham, S. and Oruç, S., 2016. Business Intelligence from User Generated Content: Online Opinion Formation in Purchasing Decisions in High-Tech Markets. *Social Media: The Good, the Bad, and the Ugly*, pp.505-521.

Table 4: Summary of selected studies

Paper Id	Method/Tools	Application/Results	Context	Limitations
#1	Lexicon	Proves that customers from different cultures have different levels of emotions and pay different level of attention to the same product.	Online reviews	Better feature lexicons should be made with network surveys and expert advice. Need a way to analyze real-time data
#2	Combination of time series analysis, sentiment analysis (using lexicon) and topic modelling	Explore trends in Tweets volume and sentiments to provide an understanding of online retailing customer behaviour	Twitter	Only focus on Twitter users, need to involve other user groups using surveys and interviews
#3	Lexicon (WordNik) and machine learning models (Naïve Bayes, Support Vector Machine)	Classifier to measure consumer insight.	Twitter	Lexicon phrases and vocabulary sets in the database are not fully included due to time limitations
#4	Supervised Machine Learning based classifier	Proves there's a significant correlation between the official Consumer Confidence Index and social media big data (via sentiment analysis) on consumer purchasing behaviour	Twitter	The method used to obtain Consumer Confidence Index data is time-consuming and costly and is not generalizable enough
#5	Poisson Regression and sentiment analysis(using natural language processing techniques)	A conceptual model for deriving business intelligence from tweets, to understand the influence of online opinion formation on customer purchasing decisions	Twitter	Need data from various social media sources to cover wider demographics and need data from other products to generalize the modal

In the lexicon-based approach, no prior information or training data is needed. It is proved that hybrid approaches provide the best accuracy for prediction.

Sentiment analysis using data other than the words in the content is another technique. Social media users tend to add emoticons and emoji to express emotions in their tweets and posts. Emoticons are emotions presented using standard ASCII character set, only basic emotions can be presented with them. Emoji are small icons that can be anything: faces, trees, sun etc. (Peacock & Khan 2019). Analysing these has been used as a great way to discover the emotion in a text (Solakidis, Vavliakis & Mitkas 2014), (Hogenboom et al. 2013) .

Programming languages R and Python are adopted by many researches as they have inbuilt packages suitable for sentiment analysis. SentiStrength, NodeXL Pro, MALLET LDA and Vadar are used by many researchers as tools for conducting SMSA.

RQ5: What are the main conclusions drawn from existing studies?

Even though this field of study has been discussed for a long period, the highest accuracy of the sentiments generated vary between 80% to 96%. Despite the number of researches being conducted in this field, still, there is room for novelty and aspects that need improvement. Most studies only utilize words for generating sentiment, only a limited number of studies attempt to utilize all words, emoticons, negations and punctuations that appear in almost all user generate content on social media. This is a significant gap since emoticons, negations and punctuations have a great impact on sentiment analysis as proven by (Zhang et al. 2013), (Liu & Zhang 2012). People post their views, opinions and emotions on social networking sites such as Facebook (Akaichi 2013) and Twitter with a wide use of emojis (Hogenboom et al. 2013) thus including them in sentiment analysis would be highly beneficial.

Regarding the type of approaches being used, machine learning approaches are more accurate than lexicon-based approaches and hybrid approaches produce the highest accuracy. Using extended lexicons is another way to increase accuracy.

Discussion and Conclusion

Social media sentiment analysis is a very broadly discussed topic by researchers, studies have been conducted continuously utilizing various methods and techniques. In this SLR 86 number of studies from libraries: ResearchGate, Emerald Insight, ScienceDirect, IEEE Xplore, Google Scholar, ACM Digital Library and SpringerLink were initially taken into consideration and 5 were shortlisted for complete analysis under the research questions mentioned in section E. Even though a large number of researches have been conducted related to social media sentiment analysis, few seem to concern about customer purchasing behaviours.

Existing researches are conducted on using words, punctuations, emoji and emoticons to increase the accuracy of sentiment analysis, detecting and removing sarcasm and fake content to increase accuracy, identifying the reasons behind sentiments, predicting sentiments, how to fix issues arising in customer purchasing behaviours as an impact of sentiment shifts, using sentiment analysis to identify characteristics of various consumer groups.

Most of the researches only focus on classifying sentiment as negative, positive or neutral. Lesser number of researches try to declare the intensity of negativity or positivity. Majority of the researches were conducted using the English language. Analysis of social media text data that are in other languages was comparably low.

The issues that arise in natural language processing techniques are all in sentiment analysis. For a successful implementation, researchers have to overcome these barriers. Also, they have to deal with picture icons, slang and acronyms that appear in social media data.

Studies that used hybrid models that combine both lexicons and machine learning models and extended lexicons achieved the highest accuracy. Naïve Bayes, Logistic Regression, Support Vector Machine, K Nearest Neighbours are among the most popular machine learning classifiers. Other than base classifiers, ensembling techniques are also used to increase performance. SentiStrength, NodeXL Pro, MALLET LDA and Vadar are the commonly used tools for sentiment analysis.

It is believed that the findings of this mapping study would contribute to improving existing applications of social media sentiment analysis for customer purchasing behaviours and enable the research community to better address the existing limitations and challenges.

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