PAPER • OPEN ACCESS

Artificial intelligence tools for analyzing emotionally colored information from customer reviews in the service sector

To cite this article: N I Yusupova *et al* 2021 *IOP Conf. Ser.: Mater. Sci. Eng.* **1069** 012013

View the article online for updates and enhancements.

Artificial intelligence tools for analyzing emotionally colored information from customer reviews in the service sector

N I Yusupova[1], D R Bogdanova[1], N P Komendantova[2]

[1]Ufa State Aviation Technical University, Ufa, Karl Marx str., 12, 450008, Russia

[2] International Institute for Applied Systems Analysis, Laxenburg, Schlossplatz, 1, A-2361, Austria

E-mail dianochka.bogdanova@gmail.com

Abstract. On the Internet, you can find millions of service reviews. This information can be useful to support decision-making for both potential customers and for managing a service business It is especially important to consider the emotional tone of such reviews, because emotions can attract or repel potential customers. The article discusses the actual task of the automatic processing of customer reviews and identifying emotionally colored information in it. In this paper we provide the definition of emotions and describe the results of the analysis of their classification. Further on, we identify six main emotions from the customer reviews. As our methodological basis we use a well-known approach for accounting emotionally colored information in customer reviews. This approach made it possible to set the task of automatic analysis of customer reviews, which we applied in this paper.

Keywords: Artificial intelligence tools; emotionally colored information; customer reviews; sentiment analysis

1. Introduction

Nowadays several specialized platforms and websites exist that contain reviews on a variety of products and services. This information contains the feelings and emotions that a person has experienced as a result of using these products or services. Modern artificial intelligence and affective computing tools make it possible to extract useful data from this emotionally colored information that decision makers can use when promoting these products and services.

Emotions – is an integral part of human thinking. They accompany any thought, any activity, any action. Emotions are a key element for human intelligence emulating. Humanity is on the verge of merging the real and virtual worlds. We can tell this by observing the fact that people spend more and more of their time in virtual reality such as social media, professional communities, where they exchange opinions about certain events, goods, services, etc.

Intelligence is a multifaceted concept, and emotional intelligence is its important component. Today, the development of information technology makes it possible to develop systems that account the user's emotions and are able to emulate them. And automatic analysis of emotionally colored information from user reviews is its important aspect. The solution of this problem is impossible without the use of the artificial intelligence tools.

The modern scientific community is faced with the task of developing models and methods for recognizing and accounting emotionally colored information in intelligent decision support systems. The first part of this article discusses the definition of emotions and approaches to their classification. The second part contains the formulation of the problem of recognizing and accounting emotions and opinions from customer reviews on the Internet in natural language. The third part analyzes the existing approaches to emotionally colored information accounting on the Internet. And the last part offers solutions and tools for analyzing emotionally colored information in the decision-making process.

2. Emotion classification in service sector customer reviews

According to Wikipedia, emotion is a medium-term mental process that reflects a subjective evaluative attitude towards existing or possible situations and the objective world. Emotions are studied and classified by many scientists in psychology and affective computing fields. There are several approaches to their classification, and we describe some of them below.

One of these approaches is based on the idea of a discreteness of emotions. In Tomkins' theory of discrete emotions [1], eight emotions are considered, such as: surprise, interest, joy, anger, fear, disgust, shame and suffering. These emotions are considered - culturally recognizable, basic, illogically determined emotional responses, in which both expression and recognition are the same for all people, regardless of their ethnic and cultural backgrounds [2].

In his cross-cultural study Paul Ekman identified six main emotions (anger, disgust, fear, happiness, sadness, and surprise), which are expressed to varying degrees through certain characteristics [3].

Another approach to the emotion classification is based on the assumption of the existence of a multidimensional space of emotions. Usually, there are one or more parameters, such as arousal, valence, and intensity, that are usually considered as measurements of emotional space. Within this approach, there is the Watson and Tellegen PANA model [4]. Russell's Circumplex model can also be attributed here [5]. The Pleasure-Arousal-Dominance (PAD) emotional state model also uses a three-dimensional approach to measure emotions [6]. Plutchik's model is the most famous three-dimensional hybrid of both basic and complex categories, in which emotions of different intensities can be combined into emotional dyadic. He presented a wheel of eight emotions: joy, trust, fear, surprise, sadness, disgust, anger, and anticipation in twenty-four primary, secondary and tertiary dyadic [7].

In the service sector, the role of emotions is increasing. The fact that emotion is a mental process of medium duration becomes important here. It means that we experience emotion exactly at the moment of service consumption. That is why it is important to be able to correctly assess emotions and take them into account in the process of providing services.

The brighter emotions are experienced by person, the more this person is motivated to share emotionally colored information about a particular service provided to him. This information can now be found in customer reviews on social media and specialized platforms. This information is extremely important and useful for decision makers in the management and promotion of certain goods and services.

3. Statement of the task

To improve the effectiveness of decision making in complex systems, it is necessary to take into account emotionally colored information from customer reviews. The task is to extract and account the emotions of the authors from the reviews of the services rendered using the example of a tourist complex.

To solve this problem, this study will consider six basic emotions - joy, surprise, sadness, fear, anger and disgust, as shown in Figure 1.

As a source of emotionally colored information processed, we will consider the texts of reviews about services from specialized Internet portals. The analysis uses text mining techniques and the benefits of natural language processing (NLP).

Figure 1. Considered emotions

4. Existing approaches

Many scientists are engaged in the recognition of emotionally colored information from user activities. The existing approaches can be roughly divided into several groups. We can select reviews analysis of sentiment, analysis of the sentiment polarity, analysis of the context. The approaches also can be grouped according to the type of source of information being processed - unimodal and multimodal.

The automatic fixation of public sentiments on social issues, political movements, marketing campaigns and preferences for goods and services has generated growing interest in the scientific and business communities. This led to the emergence of new areas of affective computing and text mining. And it led to the development of methods of information searching, multimodal signal processing, extraction of people's sentiment from the ever-growing volume of social data on the Internet [8].

Text sentiment analysis consists of extracting information about opinions, feelings and emotions transmitted by authors in relation to topics they interested in. It is often applied to opinion mining and emotion mining. Natural language processing and machine learning are used to determine the author's attitude to the subject described in the text, followed by opinion mining. Similar technologies are used to make an intelligence analysis authors' emotion and classify them in relation to events or topics. Methods of the text analysis of emotions are used in a variety of tasks, such as obtaining information about customer satisfaction, helping to select educational materials in online education, recommending products and services based on customer emotions, and even predicting mental disorders. In earlier works of mood analysis, emotions were not given enough attention [9].

Modern information technologies allow everyone to create and share their opinions and ideas in the generated Internet content with millions of people around the world. Most of the content posted and consumed on the Internet is multimodal. Today there are many devices that allow to create such content, and the amount of generated information is growing very fast. It is becoming increasingly difficult for researchers to evaluate and process this multimodal content stream, and even harder to organize or comprehend it. Receiving information from photos and videos is a critical need for mood analysis because product and service reviews are gradually shifting from unimodal too multimodal. Some researchers have proposed the usage of deep convolutional neural networks to extract features from visual and textual modalities. This provides a significant improvement in multimodal emotion recognition and mood analysis on various data sets [10].

Social media today are platforms that give people a possibility to share their opinions on various issues and topics with their friends, family, relatives and other members of the community. To do this, people use texts, images, audio and video messages and posts. But despite the presence of other forms of communication, text is still one of the most common methods of communication on social networks. The use of sentiment analysis methods for analyzing messages on the Internet allows to determine moods and emotions by posts and their comments and give user impact assessments based on various user parameters. It is also possible to create generalized and personalized recommendations for users, based on their activity in the posts of social networks [11].

The analysis of feelings and emotions are related tasks, and, therefore, are more effectively solved together. Multimodal input signals convey diverse and differing information and usually have different contributions to decision making. There is an intermodal method that works at the context level for

simultaneously predicting moods and expressed emotions in statements. This approach works well on the CMU-MOSEI dataset for multimodal analysis of moods and emotions and shows a better result in comparison with the solution of only one of the considering problems [12].

The task of determining how different cultures respond to a crisis is another interesting challenge that uses the analysis of opinions and emotions. What feelings prevail in societies and political agenda in dealing with the crisis situation. The decisions made in this case are conditioned by events, social pressure and may not reflect the wishes of the population of a particular country. And while some are happy with this, others may show resentment. Social media is a mirror for public sentiment. Despite geographic proximity, many neighboring countries respond differently to the same threat. For example, in 2020, the leaderships of Denmark and Sweden made different decisions regarding the new threat. In 2020, the actions of the leadership of Denmark and Sweden to counter the danger did not coincide, and both countries populations supported these decisions mostly unanimously. The purpose of the research is to analyze the reaction of people of different cultures to the crisis, as well as the attitude of people to subsequent actions taken in different countries. To solve this problem, deep long-term short-term memory (LSTM) models are used on data extracted from social media posts and trained on the sentiment140 dataset. A distinctive feature of this study was the inclusion of smileys when analyzing the tone and emotion of messages. [13].

The application of sentiment analysis and emotionally colored information has a variety of applications, also including in the financial services sector. Online peer-to-peer (P2P) lending platforms are gaining popularity for providing finance and loans to small and micro-entrepreneurs. By applying an assessment of emotionally charged information, borrowers in a P2P financial platform can increase the probability that their microloan applications will be funded. The text of the application is analyzed, and the set of characteristics of the description of the microcredit is assessed. The influence of this description on the success of financing is also revealed. Sentiment mining methods are used to analyze and extract emotion from an unstructured P2P credit dataset. Borrowers can increase the chances of financing success by improving the quality of credit descriptions. They can make them more attractive to potential lenders by investing in them certain emotions [14].

5. Proposed solutions and tools for analyzing emotionally colored information in the decision-making process

To solve the problem of the emotionally colored information accounting in decision-making in the service sector, it must be understood that different customer emotions have different importance for a decision-maker. Negative customer emotions are critical for the stable operation of the enterprise. This can cause the rejection of the service by current customers and reduce the number of customers in the future.

In this paper we propose to analyze customer reviews in several stages. The stages of customer reviews analysis is presented in more detail in the Figure 2. A functional model for solving the problem of analyzing emotionally colored information from customer reviews in the decision-making process was developed in the SADT methodology.

At the first stage - collecting reviews from Internet resources. At the second stage - cleaning, preprocessing, and analyzing the collected reviews. It includes reviews markup, lemmatization and coding the reviews in vector form. At the third stage, the sentiment analysis is carried out using with machine learning tools and data from open-source corpus from sentiment-marked words. At the fourth stage, the analysis of emotions shown by customers is carried out in the allocated classes of positive, negative, and neutral reviews by using pattern recognition methods and a fuzzy search tool. It is important for the decision maker to know which aspect of the service provided is caused by the emotions that the customer have experienced. Therefore, at the fifth stage, an aspect analysis of classified reviews is carried out, and the emotional sentiments of individual statements about aspects are determined using the formation of dictionaries of provided services aspects. Qualitative research of customer reviews is carried out using the construction of models based on decision trees, where the emotional tone of the response is a variable dependent on the presence or absence of emotionally colored information on

certain aspects of services. It allows you to identify patterns that affect customer satisfaction and form the rules for decision-making.
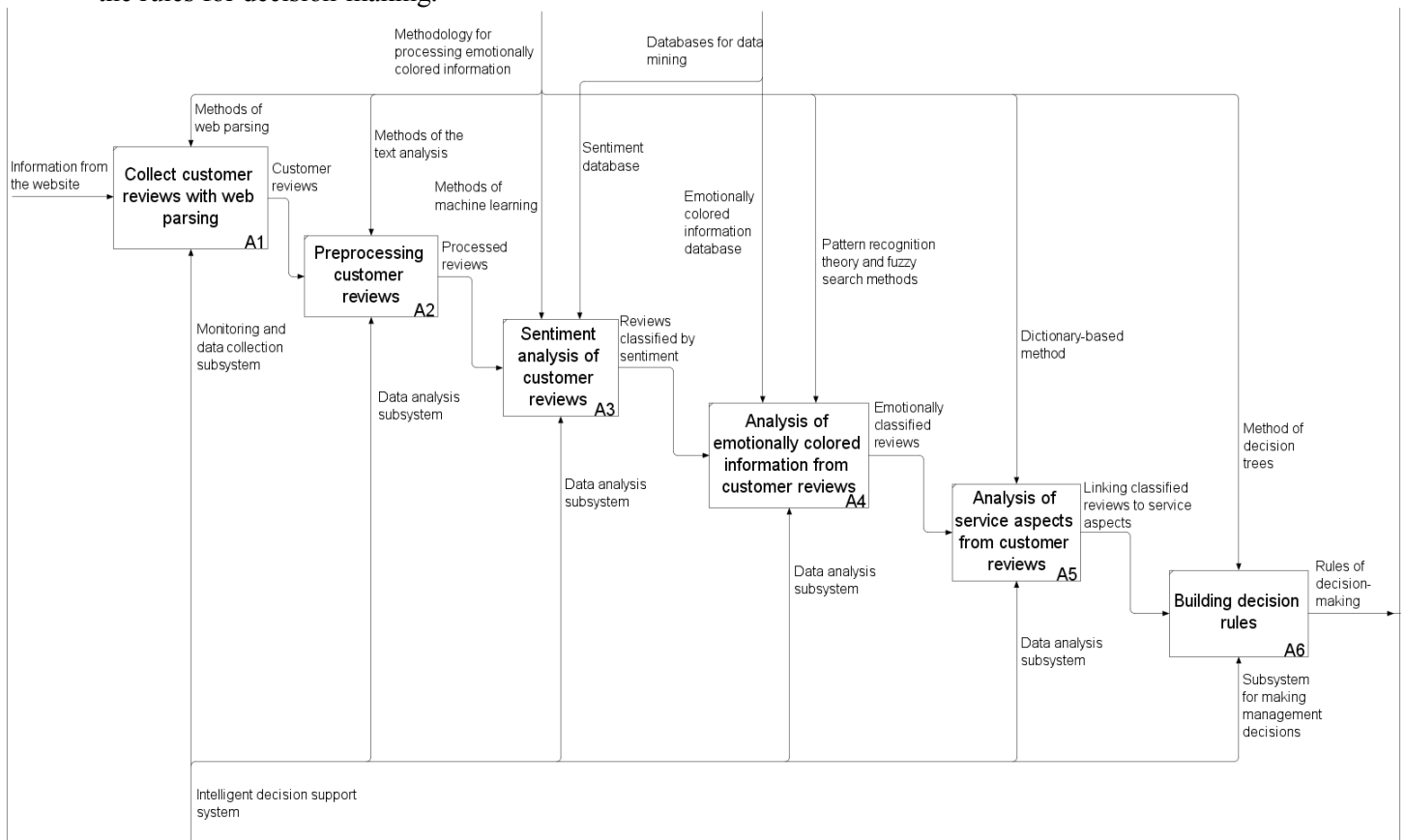

Figure 2. Functional model for analyzing emotionally colored information from customer reviews in the decision-making process

Today, one cannot do analysis without artificial intelligence tools at different stages of solving the problem of analyzing emotionally colored information from customer reviews in the decision-making process. The applied methods are shown in Figure 3.
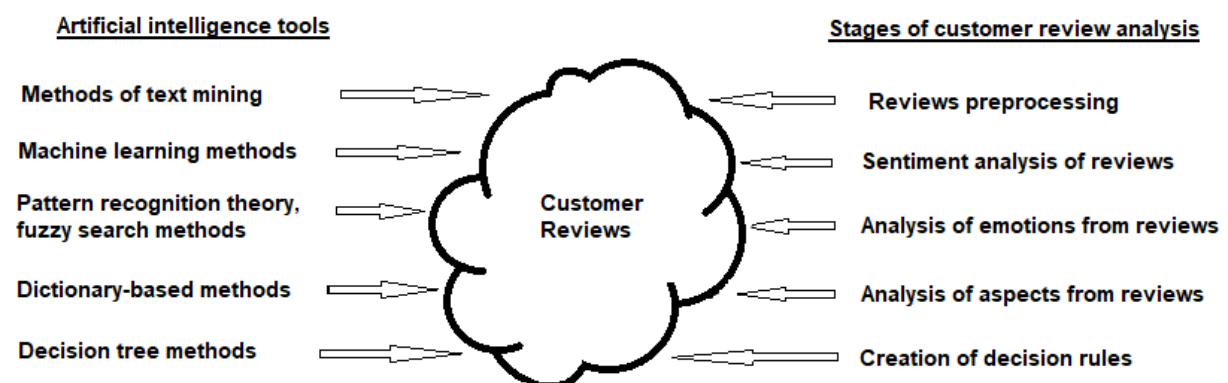

Figure 3. Artificial intelligence tools used to analyze emotionally colored information from customer reviews in the decision-making process

The developed model for analyzing emotionally colored information from customer reviews of the service sector allows us to define requirements for the applied methods of customer reviews analysis.

To date, the stage of determining the sentiment of customer reviews based on the machine learning tools and the Naive Bayesian classifier has been implemented. This stage is presented in more detail in this article [15].

6. Conclusion

On the Internet, you can find millions of service reviews. This information can be useful to support decision-making for both potential customers and for managing a service business. It is especially important to consider the emotional tone of such reviews because emotions can attract or repel potential customers. In this article the actual task of the automatic processing of customer reviews and identifying emotionally colored information in it was discussed.

Reviews on the Internet contain a lot of information, which makes it impossible to process them without use of the artificial intelligence tools. Current studies should show which of these tools are effective for processing customer reviews in natural language texts.

The article considers the actual problem of automatic customer reviews processing and the identification of emotionally colored information in them using artificial intelligence tools.

The definition of emotions was given, and an analysis of their classification is carried out, six main emotions are selected in customer reviews. The well-known approaches to accounting emotionally colored information in customer reviews, which made it possible to set the task of automatic analysis of customer reviews, had been analyzed.

A model analyzing emotionally colored information from customer reviews of the service sector was developed. This made it possible to define requirements for the methods used to analyze customer reviews. The application of artificial intelligence tools at different stages of the proposed approach to the analysis of customer reviews was considered. Further research will focus on the implementation of the presented stages of customer review analysis. To date, the stage of determining the sentiment of customer reviews based on the machine learning tools and the Naive Bayesian classifier has been implemented. In the future, it is planned to implement the stage of analyzing emotionally colored information using the theory of pattern recognition and methods of fuzzy search in dictionaries.

7. Acknowledgment

References

[1]   Tomkins S S 1962 Affect Imagery Consciousness: The Positive Affects *vol. 1* (New York, NY, USA: Springer)

[2]   Colombetti G 2009 From affect programs to dynamical discrete emotions *Phil. Psychol (vol 22 no 4)* pp 407–425

[3]   Ekman P 1992 An argument for basic emotions *Cognition Emotion (vol 6 nos 3–4*) pp 169–200

[4]   Watson D and Tellegen A 1985 Toward a consensual structure of mood *Psychol. Bull* (vol 98 no 2) p 219

[5]   Russell J A 1980 A circumplex model of affect *J. Personality Social Psychol* (vol. 39 no 6) p 1161

[6]   Mehrabian A 1995 Framework for a comprehensive description and measurement of emotional states *Genetic, Social, and General Psychology Monographs* (121(3)) pp 339–361

[7]   Plutchik R 1980 A general psychoevolutionary theory of emotion *Theories Emotion* (Amsterdam, The Netherlands: Elsevier) pp 3–33

[8]   Cambria E 2016 Affective Computing and Sentiment Analysis *IEEE Intelligent Systems* (vol 31 no 2) pp. 102-107

[9]   Yadollahi A and Ameneh Gholipour Shahraki and. Zaiane O R 2017 Current State of Text Sentiment Analysis from Opinion to Emotion Mining *ACM Computing Surveys* (Vol 50 No 2)

[10]   Poria S and Chaturvedi I and Cambria E and Hussain A Convolutional 2016 MKL Based Multimodal Emotion Recognition and Sentiment Analysis *IEEE 16th International Conference on Data Mining (ICDM)* (Barcelona) pp. 439-448

[11]   Sailunaz K and Alhajj R 2019 Emotion and sentiment analysis from Twitter text *Journal of Computational Science* (Volume 36)

[12]   Akhtar M S and Chauhan D S and Ghosal D and Poria S and Ekbal A and Bhattacharyya P 2019 Multi-task Learning for Multi-modal Emotion Recognition and Sentiment Analysis *Computation and Language*

[13]   S. Imran, S. M. Daudpota, Z. Kastrati and R. Batra, "Cross-Cultural Polarity and Emotion Detection Using Sentiment Analysis and Deep Learning on COVID-19 Related Tweets," in IEEE Access, vol. 8, pp. 181074-181090, 2020, doi: 10.1109/ACCESS.2020.3027350

[14]   Pengnate S and Riggins F J 2020 The role of emotion in P2P microfinance funding: A sentiment analysis approach *International Journal of Information Management* (Volume 54)

[15]   Kovács G and Bogdanov D and Yussupova N and Boyko M 2015 Informatics Tools, AI Models and Methods Used for Automatic Analysis of Customer Satisfaction *Studies in Informatics and Control*.