

Using Information Visualization Techniques to Improve the Perception of the Organizations' Image on Social Networks

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Abstract. Nowadays it is notorious the growth and the popularity of social networks such as Facebook, LinkedIn and Twitter, especially with the facilities provided by the use of mobile devices. Considering these social networks, Twitter has a different approach: a friendship connection doesn't need to exist and a person can follow another person or organization just to receive its tweets. So, this social network is often used as a way to get general or specific news and to express (dis)satisfaction about products, politics, organizations, etc. Considering this, the need for organizations to monitor what people are “saying” about them has arisen. Thus, the main goal of this work is to understand how information visualization techniques can support and improve the analysis of the perceived image of organizations on social networks. For this, we developed an application prototype to support sentiment analyses on Twitter and we conducted a study on how this prototype, called MentionStats, can contribute to the company's image analysis on Twitter. This study consisted on interviews with professionals about their perceptions of the MentionStats and its visualizations. Our main contribution are the presented possibilities of using information visualization techniques in order to help users to deepen the analysis of their organizations image on social networks, and also users' impressions about this.

Keywords: Data visualization · Social networks · Sentiment analysis

1 Introduction

The advent of Web 2.0 has changed the way people use the Internet. Nowadays it is notorious the growth and the popularity of social networks such as Facebook, LinkedIn and Twitter, especially with the facilities provided by the use of mobile devices. Social networks became one of the most important communication tools among people over the Internet. It allow users to find other users with similar interests, share with friends personal and professional information, data and

applications, publish photos, engage on conversations, etc. [1]. Considering these social networks, Twitter has a different approach: a friendship connection doesn't need to exist. A person can follow another person or organization just to receive its tweets¹. Thus, this social network is often used as a way to get general or specific news. It is also used to express (dis)satisfaction about products, politics, organizations, etc. Considering this, the need for organizations to monitor what people are "saying" about them has arisen [2].

According to Fan et al. [3], issues as "how to track social media return on investment", "how to identify and engage with the most influential social media users" and "what tactics to use to create an effective social media strategy" can be analyzed through social media analytical tools. In addition, at the same time that help to answer these questions, data analysis shall consider that social media transform the very nature of business. The large volume of data generated and stored by companies defies social media analytics about how companies can monitor and analyze social media conversations about them, their services or their products.

According to Zeng et al. [4], social media analytics aims derive information from social media in context-rich application, support decision-making process and provide architectural designs and solution frameworks for applications that can benefit from the "wisdom of crowds" through the Web. In other words, it involves developing and evaluating tools and frameworks to collect, monitor, analyze, summarize, and visualize social media data to facilitate conversations and interactions to extract intelligence [4].

In this context, the main goal of this work is to understand how information visualization techniques can support and improve the analysis of the perceived image of organizations on social networks (here organization's image is used with the same meaning as organization's reputation or company reputation). We choose to explore features as visualization of feelings and statistics about mentions in Twitter, whose data is public [5]. We defined the following guiding research questions: "Does the use of interaction techniques with information visualization help to deepen the social network data analysis?", "It is possible to have a dynamic analysis of a data set using information visualization techniques?", "Could the understanding of customer's perception assist the company in making decisions?".

Trying to answer these questions we developed an application prototype that allows us to visualize the mentions² about one specific user at Twitter. This application is aimed specifically at professionals working in the area of relationships and their needs, exploring features as visualization of feelings and statistics about mentions. Through interviews, we collected the users' opinions about the prototype and about how existing visualizations can aid the decision-making process in the company. Thus, as our main contribution, we presented

¹ Tweet is every message posted by a Twitter user. It can have a maximum of 140 characters and it can also be called "post".

² Mention is a way to talk to or reference someone on Twitter. For this, the tweet must contain the @username referenced in the message body.

possibilities of using interactive visualization techniques in order to help users to deepen the analysis of their organization's image on social networks, and also users impressions about this.

The remaining of this paper is organized as follows: next section presents the background of our work and it is followed by a section dedicated to related works. Section 4 presents the methodology adopted for this research. The MentionStats application prototype and its features are described in Section 5. Section 6 is dedicated to data analysis, where the preliminary user impressions are presented. Last section concludes the paper with final considerations and the future works.

2 Background

Mobile devices, social networks and spaces devoted to companies and products on Internet that make it easier to share information instantly, create a social media landscape that is quickly becoming part of the fabric of everyday business operations. With the growing number of users on social media sites, arises the need for businesses to monitor and use them to their advantage [3]. This has opened space for development of tools to support the analysis of social-media. In this section we present some fundamental concepts used in this research field.

2.1 Organizations and Social Networks

According to Fan et al. [3], social media has changed our conversations about products and services but not about the business activities behind them. Social media is more relevant to the design development and utilization stages in the product (or service) life cycle. In addition, the analysis of social media helps businesses to gather competitive intelligence and understand more completely their business environments, suppliers, and competitors. Trend analysis and other social media analytic tools help in the identification of any changes in behavior and sentiment affecting product design and development.

Customers' reactions can also help to change a marketing campaign or a product. Companies hope that social network interactions (retweets, reblogs, and social tagging) are positive, though it does not always mean they are. "Customers' on-line complaints about products and services are common, and real-time sentiment analysis, topic modeling, and other tools allow businesses to know how their customers feel about their products and services and respond quickly, before customer complaints become an on-line torrent" [3].

In spite of the growing interest of companies in this area, there is little understanding of the potential business applications of mining social networks. According to Bonchi et al. [6], while there is a large body of research on different problems and methods for mining social network, the potential business impact of these techniques is still largely unexplored.

2.2 Data Visualization

Data visualization is a growing research area that seeks to improve the presentation of data and its goal is to support users in the process of sensemaking, in which information is collected, organized, and analyzed to form new knowledge and inform further action [7]. In other words, it assists users to understand the data, store them and in the decision-making process [8,9].

According to Heer et al. [9], the goal of visualization is to aid the understanding of data by leveraging the human visual system ability to recognize patterns, spot trends, and identify outliers. If visual representations are well-designed, they “can replace intuitive cognitive calculations with simple perceptual inferences and improve comprehension, memory, and decision-making process”. The challenge in visualization involves issues such as for any given data set, the number of visual encodings is extremely large. To improve this process, computer scientists, psychologists, and statisticians have studied how well different encodings facilitate the comprehension of data types such as numbers, categories, and networks [9]. Thus, we can consider the data visualization techniques a kind of big-dataset translator for a more easily understood language, using charts, tables, colors and other visual aids.

Another point to be considered is the fact that the human ability to perceive patterns and draw conclusions is a key factor [3], since it can vary from person to person. Because of this, visualization techniques shall also exploits an individual’s visual perception to facilitate cognition [7–9].

2.3 Sentiment Analysis on Twitter

According to Fan et al. [3], opinion mining, or sentiment analysis, is the core technique behind many social media monitoring systems and trend-analysis applications. It leverages computational linguistics, natural language processing, and other methods of text analytics to automatically extract user sentiment or opinions from text sources at any level of granularity (words or phrases, up to entire documents). Such subjective information extracted about people, products, and services supports predicting the movement of stock markets, identifying market trends, analyzing product defects, and managing crises.

In this work we adopt the view of Pang et al. [10], to conceptualize the terms “opinion mining” and “sentiment analysis”. The authors pointed that both terms denote the same field of study (which itself can be considered a sub-area of subjectivity analysis). The terms have multiple definitions that cover the subjective textual analysis of social media source.

As the audience of microblogging platforms - as Twitter - and services grows everyday, according to Pak et al. [11] data from these sources can be used in opinion mining and sentiment analysis tasks. For example, companies may be interested in questions such as: “What do people think about our product (service, company etc.)?”, “How positive (or negative) are people about our product?” or “What would people prefer our product to be like?”.

3 Related Works

Studies have been carried out aiming to analyze sentiments for popular topics on the Internet and social networks using visualization techniques. One of them [12] presents a framework with modules to collect, parse, analyze, estimate and visualize the estimated public sentiment from a Twitter corpus. A dictionary-based approach and a machine learning approach were implemented within the framework and compared using one case study: the royal birth of 2013. They found there is good correlation between the results produced by the popular dictionary-based approach and the machine learning approach when large volumes of tweets are analysed. However, to allow rapid analysis, faster methods need to be developed using big data techniques and parallel methods.

A similar work, SentiView [13], allows us to visualize the sentiment evolution of Web users along a timeline. It is an interactive visualization system that analyzes public sentiments for popular topics on the Internet. SentiView search and correlates frequent words in text data, mining and modelling the changes of the sentiment on public topics. The relationships of interest among different participants are presented in a relationship map. SentiView is adaptable for different social networking platforms, such as Twitter, blog and forum, and, through this work, the authors demonstrated the effectiveness of it in analyzing and visualizing sentiments.

Dong et al. [14] developed a prototype that automates the process of collecting and analyzing data from Twitter and offers a variety of simple visualizations to understand the public sentiment. According to the authors, during disasters, extracting useful information from pool of social media data can be useful in understanding the sentiment of the public, especially to improve decision-making process. They developed a prototype that automates the process of collecting and analyzing social media data from Twitter and then explore a variety of visualizations that can be generated by the tool in order to understand the public sentiment. The Hurricane Sandy disaster in 2012 was explored to generate a variety of visualizations. They performed a statistical analysis to explore the causality correlation between an approaching hurricane and the sentiment of the public.

In DeepTwitter [15], standard visualization techniques allow the understanding of how they can help in the analysis of users behavior in social networks. These techniques are used to see users connections and the frequency of tweets sent by one or a group of users, as well as ways to classify these tweets considering its content. Other tools available are tag cloud and the most popular users. Studies with users about the set of visualization techniques implemented in the DeepTwitter show different profiles of users are interested in different features (and in different visualization ways). Moreover we identified the trend of users to simultaneously use several small applications to monitor the use of social networks. Through the results of DeepTwitter users analysis arises the idea of focusing on specific market niches [2]. And, in this work, we focus on organizations needs.

On studies about the organization's image in social media, Fan et al. [3] presents the power of social media analytics. They present examples of companies that use social media and they discuss ways of "how to use, and influence, consumer social communications to improve business performance, reputation, and profit". Social media has opened several ways to assist in business visibility as well as provide real-time customer feedback. Data visualization tools (an social media analytics) have allowed companies to quantify, understand, and answer to customers questions about their corporate reputation and brands within social networks.

4 Methodology

To answer our guiding research questions, we divided our research work in three stages, as shown in Fig. 1 and following described:

- First stage: development of the MentionStats application prototype.
- Second stage: user study:
 - application of a pre-test questionnaire with seven questions about company profile and how it uses social networks.
 - presentation of the prototype for potential users of the tool for testing it.
 - realization of a semi-structured interview about this use, with ten open questions about users' perceptions from application use, its features and the implemented interactive visualizations.
- Third stage: qualitative analysis of the data collected during the process.

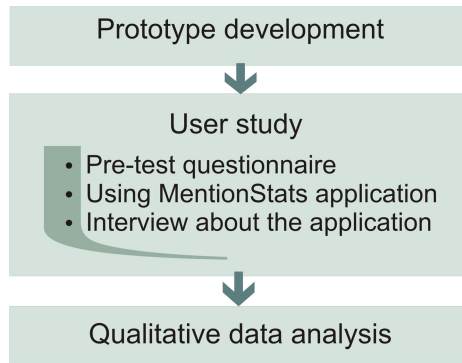


Fig. 1. Research steps.

5 MentionStats

MentionStats is an application prototype in which the user can monitor the mentions about a company, or individual, to get an overview of the perception that Twitter users have about it. The application was built for the operating

system iOS, and works exclusively on the iPad platform (Apple). Its interface was planned and designed with custom items, based on iOS Human Interface Guidelines³. The user just need to login to start the visualization and have a perception of his (or the organization) image on social networks, according with the account used to login. The focus of the application is the visualization of polarity mentions on Twitter with the possibility to store the mentions for future query and analysis. It presents a navigation bar that appears on every screen, making easy the navigation between features (Timeline, Statistics, Dictionary, Filter) by the user.

MentionStats automatically analyzes each mention of the logged user and classifies them into three categories: Good, Neutral and Bad, based on predefined words that determine the message content. Also, it does a query of mentions according to day and time that the messages were sent and shows the mentions to the user through interactive graphics and a percentage meter in the statistics section. The list of mentions also offers a graphic marker in which each mention receives a small badge with a color that determines the message content, as shown in Fig. 2⁴. When the user profile is configured (by automatic integration between the MentionStats and the iOS), the application searches by keywords in all mentions that refer to any emotional charge, being positive, negative or neutral, assigning to each one its respective color.

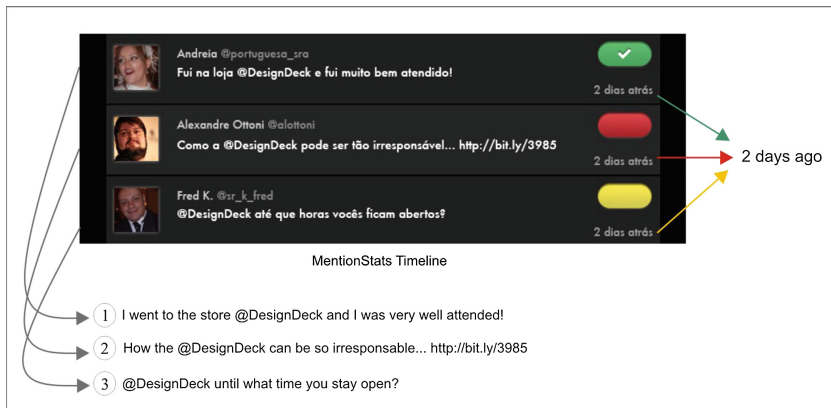


Fig. 2. Classification of the mentions (Color figure online).

When the application is searching by keywords, if an expression that refers to something positive is found, the system classifies such mention as positive. Besides the green check mark that appears next to the mention (Fig. 2), this information is included into the statistics (Fig. 3). The process is done in an

³ <http://goo.gl/WtDJx4>.

⁴ MentionStats application is in Portuguese Language. In the images used in this paper, translations will be presented when necessary.

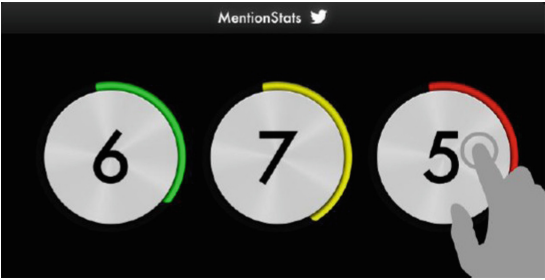


Fig. 3. Statistics of the total mentions (Color figure online).

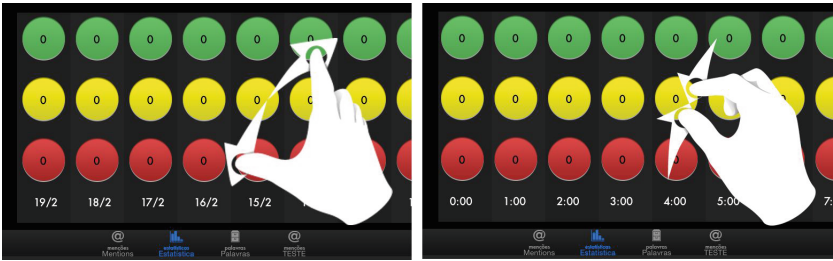


Fig. 4. Mentions presented per day or per hour (Color figure online).

analogous manner to negative words, but then the mentions are presented with a red mark. When the mention is not registered in the database as positive or negative, it is classified as neutral (yellow).

The statistics are shown in a panel divided into two parts: one static and other interactive. The first part allows the visualization of the percentages of mentions classified and the total number of positive, negative or neutral mentions (Fig. 3). The second part shows the total mentions per day or hour according to its classification. In this case, the visualization presents a circle for each polarity color (green, red and yellow), which contains the number of mentions (Fig. 4). The last thirty days are displayed and the user can change the granularity of the displayed timeline through pinch-out and pinch-in movement on the selected item, in this case, one day. Then, it is possible to see the mentions of one selected day classified per hour. The 24 hours of the selected day are presented.

The words used to classify the mentions are stored in a library that can be customized. So, the user can view, add and remove words in each category (positive, neutral or negative) for further classification of the mentions. It is also possible to use a lexicon of feelings such as Opinion Lexicon [16] for inclusion in this library to get better results of polarity classification. After making any changes in the library, user must update the list to save the changes and review their terms as the new indications.

6 Preliminary User Impressions

In this research, we have done a qualitative analysis of MentionStats through interviews with three professionals who are responsible for company's accounts in social networks (which is possibly our target audience). The three individuals were male with the mean age of 36 (34 to 40). The interviews were conducted in a private room in the University, lasting about 1 hour each one.

During the interviews, first, the participants answered a questionnaire about the company profile. After, a brief description of the application prototype were done and the participants were asked about their understanding of the tool and the purpose of MentionStats. In general, they replied that the application helps to monitor Twitter to detect opinion good or bad about their user profile. Finally, they used the application.

The interviewees reported that the companies have accounts on Twitter and Facebook to disseminate information about the company, its products and services, and do not have accounts on other social networks (or are little used). The use of Facebook is more intense than Twitter, and the company is interested to have a closer relationship with its customers and monitor conversations about their products and services in social networks. In general, companies maintains a professional dedicated in monitoring the mentions of their account on social networks. These companies access and use social networks every day and do not have a strategy or the company's disclosure plan on social networks. The relationship between companies and customers on social networks is more characterized by the dissemination of information and news, and little interaction. One interviewee reported that the company uses other means of communication with customers (telephone and on-line discussion lists), which more interaction than social networks.

Regarding to MentionStats, they said that the implemented techniques help to improve (and accelerate) not only the analysis of the organization image (*"with this [statistics] it is possible to get a general overview about positive, negative and neutral mentions (...) rapidly respond to the client in cases of negative mentions and give feedback to employees of the company, in case of positive mentions"*), but also in the decision-making process (*"you can quickly get a feedback from tweets posted by the organization (...) contributing in an agile decision-making process"*). The possibilities of personalization with the insertion of words related to the organization domain was also highlighted. According to one participant, *"viewing the timeline helps in finding relevant information about your organization's image. Not only in the organization's image but also in relation to the feedback from its own tweets. You can perform a quickly reading at the "image" of the company on social networks, each tweet that mentions the company is shown with its classification (good, neutral or bad)"*.

Other positive points mentioned: the visuals and colors are pleasant, the presentation of the list of tweets with photos of users (important to recognize people) and statistics are interesting. On the other hand they said that *"the library was considered nice but it could have a more "intelligent" way to associate words with their radical or verb tense"*.

The interaction with the application was considered non intuitive to one of the participants (Android mobile device user). In his opinion, to toggle between the visualization the number of mentions per hour and per day, user needs to know the fingers movements proper, and it was not easy to deduce.

As improvements, a participant pointed that the timeline update is not automatic - he could not drag the finger on the screen to update automatically (common feature in mobile applications) and he thinks this is an important functionality. In statistics, he would like to be able to separate also weekly or monthly. It would also be nice if an user could select a word in the timeline and set it as good or bad from that to be automatically incorporated into the words library. Another important point is to allow a synchronization with Twitter to enable answer users tweets directly from MentionStats.

Although the participants have suggested improvements, they were interested in employing these interactive visualization techniques.

7 Conclusion and Future Works

In this work it was possible to verify how interactive visualization techniques can facilitate and improve the analysis of the perceived image of organizations on social networks. We implemented MentionStats, an application prototype that provides interactive visualization techniques to support mentions analysis on Twitter. Through this prototype we conducted a user study in order to analyse the user impressions about it.

The presented related works contains some examples of the use of visualization techniques with social media data. They illustrate how the research in this area is evolving and the importance to combine several computational techniques to reach effective results. Some of them compare approaches for better data gathering and processing, such as machine learning and natural language processing, with little exploration of data visualization. Our work is similar to them in the aspect of sentiment analysis in social networks. On the other hand, our focus are in the design of interactive visualization techniques and not in the data gathering and processing, in order to help sentiment analysis on Twitter. We implemented an application prototype for mobile platforms and focused on the perception of the organizations image on social networks.

From the analysis carried out, we can see that companies are interested to know customers' opinion about their image, services or products, and also to give them a quickly feedback. As mentioned by the interviewees, these information could help in the decision-making process, which answers positively two of our guiding research question: "It is possible to have a dynamic analysis of a data set using information visualization techniques?" and "Could the understanding of customer's perception assist the company in making decisions?".

Although the participants suggested some improvements to be implemented, they made a good evaluation of the MentionStats, saying that they would adopt it and recommend it for monitoring mentions on social networks, because it support the analysis of opinion on Twitter and can be applied to the company's

image monitoring. This demonstrates that we have a positive answer for our other guiding research question: “Does the use of interaction techniques with information visualization help to deepen the social network data analysis?”.

Now we are improving the application prototype considering the users suggestions. As future work, we will deepen the user studies and we will continue to study and develop tools to support the sentiment analysis on large volumes of data, including data processing and visual mining. At now, we are using a database of tweets gathered during the World Cup 2014 and the Brazil presidential elections in 2014.

Acknowledgments. This work was partially supported by PUCRS (Edital 07/2012 - Programa de Apoio a Integração Entre Áreas/ PRAIAS).

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