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Automatic Full Text Analysis in Public Social Media – Adoption of a Software Prototype to Investigate Political Communication

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Abstract

The relevance of web 2.0 and social networks has increased rapidly in the last years. As people use different networks for different purposes, communication is a common goal. Activities in virtual social networks result in a massive amount of information. User-generated content is clustered respect to platform, way of communication as well as quality and richness of content. Often the subject of information exchange deals with personal issues concerning events and individuals. Until now this information is not considered by means of classic information retrieval. Identifying distinct subjects, gathering and analyzing information and putting them into relationship at once are open scientific challenges. This contribution describes an approach to partial aspects of this problem by providing a prototype for full text analysis in social networks. Furthermore, based on a test scenario of analyzing postings in the field of political communication, potentials and limitations of the prototype are discussed.

Keywords: Social network; monitoring; politics 2.0; web 2.0.

1. Introduction

Social networks show a rapid growth of user counts and have been object of scientific analysis in the last years (vom Brocke et al., 2009, McAfee 2005). Facebook, Twitter and MySpace already host several hundred million user profiles, and the growth of members is still accelerating. About 6 million Germans own profiles at Facebook (more than 500 million worldwide) and more than 16 millions are members of StudiVZ (similar to Facebook), which is one of the most popular social network sites (SNSs) used by German students. Young people, mostly students from high school and college, incorporate those SNSs into their daily life to communicate with friends, get information about events or to contact new people.

This development results in an increasing amount of information, which can hardly be filtered and analysed manually to find specific data. From the point of view of companies or political parties, personal opinions dealing with specific news and events that are published at SNSs, blogs or microblogging platforms (e.g. Twitter) cannot easily be found. One reason for this is that information of this kind is not considered by means of classic information retrieval, as done by common search engines. Identifying distinct subjects, gathering and analysing information and aggregate them is a scientific challenge, which has not been solved yet. It also lacks specific empirical studies.
Even if the identification of relevant data could be realized properly, a following question is how to systemize and display search results to provide an overview about specific fields of interest discussed in social networks. The complexity of information can hardly be visualized in a simple text list, as it is common for search engines. Especially dynamic changes of different topics can reveal additional and important information on subjects but can hardly be considered by traditional searches. The goal of this contribution is to present first explorative steps of data aggregation from different social networks. Therefore, in this contribution we present a prototype full text analysis in social media.

The paper proceeds as follows: The next section provides background information and a literature review in the field of social software and social software monitoring. Followed by this, a software prototype is presented. In chapter 4 the prototype interface is explained and its practical relevance is discussed in a test scenario in the field of political communication. The paper ends with a conclusion, which summarizes the results and gives an outlook for further studies.

2. Background

Within the last years innovative web-based collaboration technologies comprised as web 2.0 have emerged and changed the communication in the Internet (McAfee 2005). In this context, web 2.0 applications are often associated with social software, which is based on different services for establishing networks between people and supporting the distribution of information within the network. Blogs, SNSs, Internet forums, wikis, instant messaging, RSS, podcasts, and social bookmarking are tools of social software (Green and Pearson, 2005). As with any such term, the definition’s boundaries are fuzzy, and the topic lends itself both to technologically deterministic prognostication and hastily constructed rebuttal. Following Green and Pearson (2005), social software is any software that supports group communications.

Based on social software, virtual communities can evolve to share knowledge, experiences, opinions, and ideas among the participants. In the context of enterprises, community members may even be integrated into the value creation processes of a company, e.g. by identifying and interpreting comments published by customers in social networks (Boyd and Ellison 2007). This may also be adapted to the area of political communication. From this point of view, it is highly relevant to provide efficient tools that may help to analyze and monitor public social networks. The mechanisms of social networks and their impact on personal behavior and on changing communication habits have been subject to scientific research. Social network monitoring is becoming increasingly important and is covered by contributions such as marketing (Carrasco et al., 2003), recommender systems (Palau et al., 2004), and propagation of influence in social network (Goyal et al., 2008; Chen et al., 2009). Han & Kamber (2006) and Getoor & Diehl (2005) provide examples of social network monitoring applications. These analyzing tools treat social networks as a construct where a static graph is either derived from aggregation of data over all time or taken as a snapshot of data at a particular time (Lin et al., 2009). Existing studies range from well established social network analysis (Wasserman and Faust, 2004) to recent successful applications (such as Kleinberg, 1999). Also there already exist some commercial tools, which are available to analyze social networks (e.g. Greplin, Openbook, FouPas, and SocialMention). However, these tools can only be customized to a certain degree, usually do not support dynamic analysis, and most of the applied algorithms are not comprehensible from an academic point of view.

3. Architecture of a Prototype for Full Text Analysis in Social Networks

In order to analyze communication about individuals and events in social networks, a technical framework is developed and implemented as a software prototype. To analyze social network communication in an automated way, the prototype’s architecture is constructed as a modularized computer program that gathers, stores and analyses data from social networks continuously. Data is gathered and analyzed in respect to their temporal evolution. In the following the program parts are sketched with their interactions and the general data flow and possible analysis results are described.
3.1. Server Framework

To achieve a high flexibility, which is needed to react on changing APIs of social networks, the analysis server is highly modularized, with the core just offering a few general services. All non-generic functionality is separated into smallish modules, each of which is independently responsible for a single task. This allows easy integration of new modules (plug-ins) and keeps changes (e.g., due to changes in social network APIs or input formats) local. Extensions are easily possible and can be integrated into the running server.

The major core parts of the server and their interactions are shown in figure 1. The core includes (1) a virtual high-level file system stored in a relational database, which contains the configuration for the modules, (2) a schedule to execute module actions at specific times, and (3) a simple template system integrated into the file system for structured text output (XML, LaTeX). More specific output formats, in particular graphical ones, are to be implemented in further modules.

![Figure 1. System architecture](image_url)

Administration and configuration of the server is done via HTTP. Most work to be done in developing the server was a matter of high-level organization and integration of existing third-party libraries or APIs. The amount of code in reused libraries is vastly larger. Many social network services offer either a web-based API or even an existing Java wrapper around the API, which is also integrated here. Only in some cases, a module has to be pretending it is a web client/browser and resort to a low-level parse of the resulting HTML web pages to obtain higher-level information due to a lack of standardized interfaces and the fact that interoperability with applications outside of the provider’s website should not take place.

In general data, acquisition actions are schedule-based, i.e., they are executed periodically, either with a fixed interval or at fixed time. The update period is determined empirically, separately for each module, by the requirements imposed by the API/web service and the expected amount and speed of change of the data in question.

3.2. Data Formats, Modules, Dataflow, and Output Formats

Most data to be gathered are in text-form. Such data is stored, after some sanitization and canonicalization (e.g., merge different spellings of a term), in Lucene text index databases. The format used is semi-structured, with the actual textual content (e.g. short status message) analysed by a full text indexer. Some other structured formats are also offered by a module, e.g. to just count the number of results or store other metadata. For specialized requirements, a module can also obtain access to an SQL database. The prototype implementation creates a separate index per day to easily track developments over time, but this could be changed easily for finer or coarser-grained analysis. The usual update period is a few batches per day per data source.

In general, modules can be classified into three basic kinds:

a) Data gathering (e.g. Twitter status of users), and offer it to other module to store
b) Data storage, obtained from other modules, in some pre-processed form, usually in a Lucene index database.
c) Analysing data (usually one or multiple text indices).
The social networks with specific input modules of type a) and b) are Twitter, Facebook, and StudiVZ. Generic content-based textual analysis is also possible for general web pages and certain RSS/Atom feeds. The entry points for these modules are either a specific user or group or a specific term used in the search function. Initially, these are configured statically, but, as a starting point for a meta-analysis, we also determine search terms from the top terms of specific database indices.

There is no continuous dataflow between data acquisition and final analysis. To provide a better understanding, we show the following example of the dataflow (based on figure 2): Here, the TwitterSearch module performs a twitter search query (using the Twitter4J API). The search results are both taken directly by an index, which uses a separate service for post-processing the data, filtering common words and canonizing misspellings. But the results are also parsed by a separate module (URL extractor) for URLs (because of limitation of 140 characters, Twitter status often just consistent of a partial sentence and a link to an URL giving the whole story). The URL extractor, in turn, uses the web fetch service offered to obtain the contents of the URL. If of interest, the data is also sent to interested parties (modules) and ends up being stored in the textual index. Not only in this case, the dataflow between modules is not hardcoded, but dynamically configurable.

The following output formats of interest are implemented in modules: a) Spark lines showing the time-development of total data gathered from a specific source, b) presentation of the most frequent terms used in a specific index, and comparison or tracking of changes over time, and c) showing the correlation of terms between two indices.

4. Social Network Monitoring of Political Communication

4.1. Background: Social Networks and Politics

Regarding the field of politics, social software can be an enabler for participation and democracy. Creighton (2005) defines public participation as the process by which 'public concerns, needs and values are incorporated into governmental and corporate decision-making'. Therefore, e-participation is focusing on this process as well but concentrates on using the Internet as an additional or exclusive instrument to create a dialogue between the elected and the electorate. Related to this, Karpf (2009) describes the term of Politics 2.0, which can be understood as the harnessing of the Internet’s lowered transaction costs and condition of information abundance toward the goal of building more participatory, interactive political institutions. By this means social software helps to create, exchange, and link content without knowledge in programming or information technologies.

The growing relevance of the Internet regarding political issues has been analysed and documented by researchers since the 1990s (Davis 1998; Davis 1999; Kilinenberg and Perrin, 2000). The upcoming of web 2.0 technologies in 2005 has furthermore increased the relevance of the Internet for political communication. To use web 2.0 efficiently as communication channel, politicians face new problems.

From the point of view of politicians it needs a lot of resources (time, money) to keep updated about current discussions and their reputation in virtual communities. Furthermore topics can emerge that end up in a scandal or crisis for a specific politician. By social media monitoring of multiple social networks, politicians may receive an instrument to identify those developments in an early stage. Missing information could be gathered and summarized e.g. in a regular report, which is generated for a specific person, party or topic.
In order to learn more about the relevance of communication in public social networks an explorative analysis has been conducted for social network sites and microblogging (McAfee 2005).

4.2. Adoption of the Prototype for Analysis of Political Communication in Social Networks

As a first test scenario the prototype has been applied to the real-world environment of political communication in public social networks. Data were gathered by using APIs of Facebook, Twitter, and StudiVZ.

In order to test the potential of the prototype, the research was concentrated either on a person and the person’s impact on social networks as well as on recently discussed topics in the political media. To neglect some aspects and open problems that can be found also in traditional web search, such as word doublets, word stemming and mixed meanings of single words, the subject in the tests was a German politician with a very unique name, Mrs. Leutheusser-Schnarrenberger. In 2010, she holds the position as federal minister of justice and is a member of the German parliament as well. On the one hand it can be assumed that this name is only used to refer to this person and on the other hand, she is minister of justice and therefore regularly in the media and on various social networks (her name is often misspelled). In a time frame of three months data have been gathered automatically based on the name of the politician and the three of the five most influential German parties (CDU/CSU, SPD, Grüne, FDP, Linke) as keywords. The prototype gathers and processes the data and also automatically provides output in different formats. Some graphics outputs are shown in the following figures 3 and 4.

Figure 3. Tag cloud showing relevant terms relating to the person at a specific day

Figure 4. Spark lines indicating the changing relevance of topics in one week

Figure 5 shows the number of subscribers to the analysed person and parties in comparison to the average of their colleagues among their party and in comparison to all members of parliament in popular social networks (blue number). For members of the political parties “CDU/CSU” and “Linke” no data have been gathered in the considered period for this first step.

Figure 5. Dynamic social network monitoring automatically generated by the prototype (the right hand columns show the growth (+) or decrease (-) of followers/friends compared to the previous day)

As a result of this work even the early test case with only one test person shows the change of importance of topics in the social networks environment of Mrs. Leutheusser-Schnarrenberger. Significant changes can be taken as predictions for new rising topics that the politician might have to deal with in the next days.

5. Conclusion

The growing relevance of social networks results in the requirement of analysing large amounts of data, often on a short timescale. Therefore, information systems have to provide methods and instruments for such monitoring. In this article, we have made a contribution to this by describing the architecture for a software prototype. Our tools for
the analysis of various social networks contributes to automatically merge the information from various sources and to continuously summarize data of several virtual communities in a daily or weekly report, which is generated for a specific person or topic.

As a first implementation the prototype was applied to the sector of political communication. This field is characterized by a high degree of collaboration. Furthermore, as it was shown, political discussions exist in several different types of online communities. The tracing of these discussions need significant amount of resources, such as time and money. A multi social network analysis, which, is provided by software algorithms, can help to reduce these costs and to increase transparency.

The developed prototype has been used to collect data of news and discussions about a specific test person. Her activities and the activities of her friends and followers on Twitter, Facebook, StudiVZ are captured regularly and the snapshots of communication and relations can be analysed over a period of time and therefore provide dynamic insights. This leads to new cognition in the field of social network monitoring, which was not possible in before, without observing multiple networks over the time in respect to a single subject. However, it has still to be analysed how useful those collected data are for the addressee. Furthermore, the quality of data has to be ensured and further investigated. Interviews as well as quantitative data, based on a questionnaire, will be collected in further research.

Our testing shows that the developed multiple social network monitoring tool has the capability to give in depth analysis regarding specific questions on persons and events which cannot be retrieved with means of classic web search engines. In general, the provided prototype and its architecture can also be adapted to various fields, e.g. issue management of enterprises. In order to achieve a higher resolution in retrieval the usage should be extended to collect more data and to deal with questions in other fields of interest.

References