Intent Tag Clouds: An Intentional Approach To Visual Text Analysis

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Abstract. Getting a quick impression of the author's intention of a text is an task often performed. An author's intention plays a major role in successfully understanding a text. For supporting readers in this task, we present an intentional approach to visual text analysis, making use of tag clouds. The objective of tag clouds is presenting meta-information in a visually appealing way. However there is also much uncertainty associated with tag clouds, such as giving the wrong impression. It is not clear whether the author's intent can be grasped clearly while looking at a corresponding tag cloud. Therefore it is interesting to ask to what extent, with tag clouds, it is possible to support the user in understanding intentions expressed. In order to answer this question, we construct an intentional perspective on textual content. Based on an existing algorithm for extracting intent annotations from textual content we present a prototypical implementation to produce intent tag clouds, and describe a formative testing, illustrating how intent visualizations may support readers in understanding a text successfully. With the initial prototype, we conducted user studies of our intentional tag cloud visualization and a comparison with a traditional one that visualizes frequent terms. The evaluation's results indicate, that intent tag clouds have a positive effect on supporting users in grasping an author's intent.

Key words: Intent Tag Cloud, Usability Study, Visual Text Analysis

1 Introduction

Ongoing developments in the field of information visualization on the web support visual tasks in various ways. A technique called tag clouds has become a quite familiar technique to visualize textual data on many websites and many users know how to use it. Figure 1 shows two tag clouds. Tag clouds can be used in various ways to help users in getting a quick overview. Imagine that a user wants to visit a website to read an online article or essay but before would like to know what the text is about or moreover even know what the meaning and purpose of the text is. This means we need a simple methodology and application for supporting the task of both understanding a text as well as having an idea what the author(s) intended to communicate. The reader would like to sense what the authors meant or implicated when they created a specific text. This is a common problem that has no clear solution yet. According to [9], an

author's intentions are crucial for understanding the meaning of a (speech) text. Therefore our approach is not only to sum up a text but further trying to explain it. We assume, it is possible to visualize specific information in a way the readers are able to grasp both the meaning and purpose of the text. We therefore developed intent tag clouds as a research prototype for improving the process of successfully understanding a text.
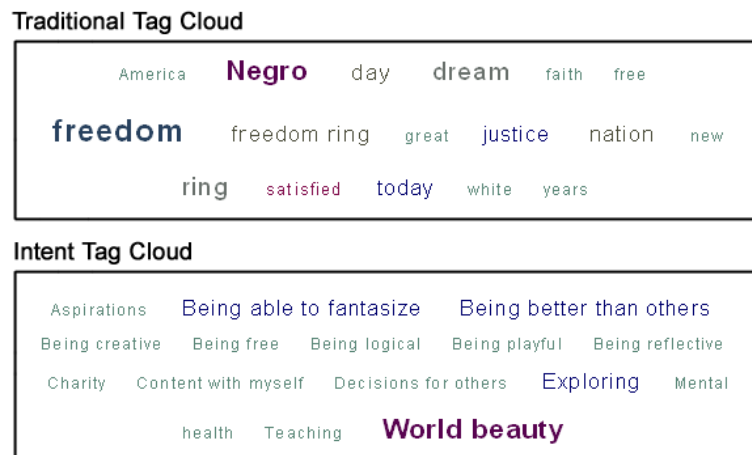
Fig. 1. Two Tag Cloud Versions of M. L. Kings famous speech in 1963

However, the use of traditional tag clouds is also a controversial topic due to the fact, that tag clouds may provide a wrong impression or just do not fullfill the task of giving a quick impression of an author's intentions of a text. Moreover, research within this field still lacks user evaluations. This paper addresses the question, how to support the user in understanding a text and its intentions and explores the usage of tag clouds to provide an intentional perspective on the textual content.

2 Related Work

A tag cloud is a non-hierarchical presentation of linked terms [10]. A tag cloud is also described as a visualization of word frequencies [16].
The author of [15] recapitulates the history of tag clouds insofar as he argues, that the basic look of a tag cloud, namely a combination of many different type sizes in a single view, goes back to the early 20th century. This visualization technique has first been introduced outside of academic circles, namely on the popular website called Flickr[1] as described in [10].
The authors of [1] state that the motivation for tagging also changed with the flickr online community. They show that users can be motivated to annotate

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[1] Flickr - Photo Sharing: `http://www.flickr.com`

content. Both the before mentioned aspects as well as the increasing incentives for tagging result in an increasing number of online annotations.

For now, there are many different kinds and variations of tag clouds that are currently available: Such as improvements over traditional tag clouds presented by [16], include the ability to measure the frequency of two word tags in a text and to dynamically filter the tag cloud by entering query strings. The work of [6] presents a different tag cloud layout to improve information retrieval based on clustering of similar tags. The paper [15] shortly presents some non-traditional tag clouds such as a time-based one.Yahoo Research created the geographic tag visualization Tagmaps, a world exploration tool as described in [18]. The same authors also created the so called Taglines[2] which is an online tool demonstrating some novel contributions for expressing timescales to generate the possibility to navigate through the interesting tags for a particular period of time [5]. Alternative ways, where intent annotations can play a major role in supporting a user's understanding, including results presented in [13] that show how capturing aspects of intent rather than content can support social software. The work of [11] explores the way how users express their intentions in digital photo search. Such works indicate that user intentions may also play a role in multimedia retrieval and context different from textual content as well.

2.1 Discussion Of Tag Cloud Visualizations

Research has shown, that tag clouds can have positive effects on basic visual tasks due to the layout's compactness, due to it's ability to show more dimensions (alphabetically, size and items) at once due to the fact, that within tag clouds, users are able to quickly identify the most frequent term etc [7]. Therefore tag clouds are scannable, offering good overview. Compared to [17] where it is shown that users read about 20% of the text on the average page, these positive effects of tag clouds appear useful. Moreover, the work by [12] shows that tag clouds can support many user tasks such as providing an overview and general impression of the underlying data set. [10] also shows that tag clouds are good for prototyping because of the easy implementation. Other visualization techniques are more complex. Last but not least research, such as [8] has shown that tag clouds are useful for social information such as showing human behavior and reflect human mental activities.

Next to the already stated positive effects of tag clouds there are also a few drawbacks. The authors of [7] and [8] show that longer words grab more attention than shorter ones. Moreover, there is also no meaning in visual proximity and therefore meaningful associations are lost. Last but not least visual comparisons are difficult, The work by [8] even suggests to compare also other research results such as proposals by E.Tufte.

As summarized before, there are points of criticism for tag cloud discussions. However, many of these can be addressed simply by visualization enhancements regarding tag positioning, tag sorting, tag normalization as well as aesthetic

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[2] TagLines: `http://research.yahoo.com/taglines/`

considerations. The author of [3] also states that tag clouds are only one specific kind of weighted lists. There are many kinds of mappings from visual features to underlying data that have not yet been exploited. Bumgardner [3] suggests trying out different mappings such as mapping font size to time or using older-fashioned fonts for older data. The authors of [4] describe a Yahoo project that makes use of the Flickr service. Their approach was that any user may append a tag to any photo in the system. There are also existing guidelines for tag cloud construction and comparisons between semantic arrangements, alphabetic and random tag layouts, such as described in [12]. Enhanced tag clouds then guarantee scannability and visual appeal. Some of these methods were also used while usability inspections on our intent tag cloud prototype revealed some needs for improvements.

2.2 Research Rationale & Setup

However, all these studies did not try to clarify whether the user clearly grasps the author's intent of a text, nor tried to support the user in understanding a text successfully. Furthermore no user-based evaluations of intent annotation approaches have been conducted yet. Therefore it is our aim to to answer the question, how to best support the user in successfully understanding a text respectively in determining the author's intentions corresponding to a given text. As knowledge of intentions is relevant for interpreting text, we try not only to sum up a text, but also visualize information in a way the readers are able to grasp the meaning and purpose the author intended to communicate with the given text.
We explore the usage of tag clouds to provide an intentional perspective on the textual content. The authors of [14] demonstrated how to automatically annotate textual resources with human intent. We try to make use of this novel idea of intent annotation and present an approach making use of tag clouds for presenting the author's intentions of a speech text. In other words, we propose visualizing such intent annotations instead of traditionally visualizing a tag cloud based on term frequency. Understanding these design enhancements may allow interface customization that could further improve the task of keeping the user informed.

3 Intent Tag Cloud Prototype

In figure 1 we show two versions of tag clouds. The top tag cloud shows a traditional tag cloud consisting of frequent terms. The bottom tag cloud is containing intent tags. These tag clouds are one part of the output of our prototypical implementation that can be seen in figure 2. The implementation and benefits of the intentional visualization approach are further described below:
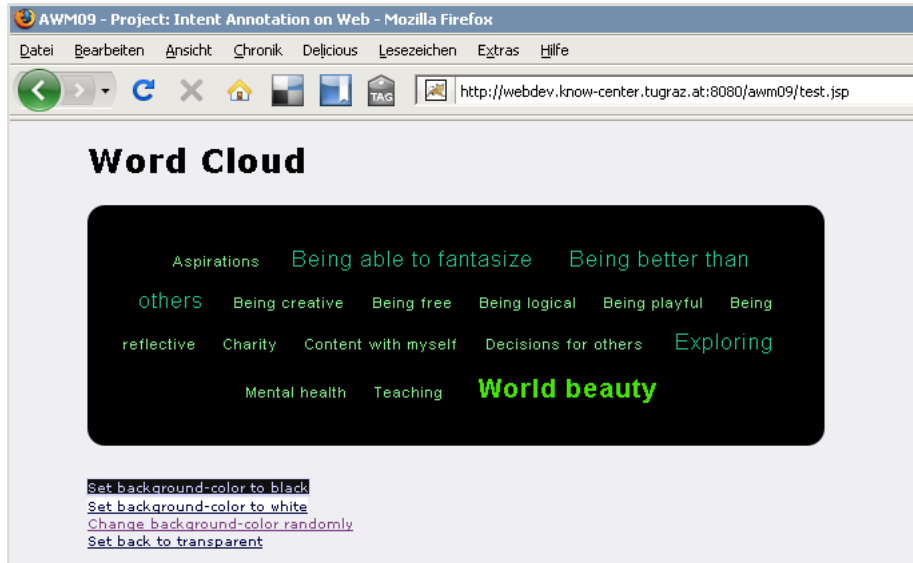
Fig. 2. Screenshot of the prototype used in the experiment

3.1 Intent Annotation

Existing tag suggestion approaches mainly focus on annotating a document according to its most predominant subject matter such as using frequency terms to show what a text is about (e.g. 'sport', 'politics'). In contrast, the authors of [14] describe the annotation of resources according to the intentions, such as showing what goals a resource is about (e.g. 'Achieve Happiness' or 'Maintain Good Health'). According to [14], intent annotations deal with future states of affairs that someone would like to achieve (in contrast to topic, sentiment or opinion tags). In [14], the authors explore the use of indicative actions as a proxy for inferring intentions from textual resources. Therefore intent annotation can be understood as the problem of identifying a set of adequate intent annotations for each and every action indicative of intent in a given textual resource. The basic concepts of intent annotation itself and the automatic extraction approach is summarized within [14].

The algorithm described there is only one possible way how intent annotations can be generated. Also the already mentioned work of [13] shows another possibility. However this paper focuses mainly on exploring the usage and benefits of visual interfaces for intent annotations; the generation of the intent tags is not the focus of our investigations here.

3.2 Implementation of the Intent Tag Cloud

The simplified prototype in Figure 2 has been used in the experiment. The original prototype also includes some other interaction possibilities such as not only

using sample speech texts but also using own text-input and changing the visualization in size and color. First of all the interface takes a speech text as input. After making use of the automatic extraction mechanism described in [14], a weighted list of intent annotations is created. The list's terms are organized insofar as the listed intent annotations are tag pairs, consisting of both the tag-name as String and a weight-level of type Double. This tag-list is then used for the creating the intent tag cloud visualization. For the later formative testing [2] a traditional tag cloud is also generated, making use of a web-based tool for generating a cloud of frequent terms from a given text.

The Design Process was an iterative one, including prototyping and usability evaluation. While usability inspections methods have been applied, several designs for the prototype have been created and the intent tag cloud has been upgraded consistently. At the very beginning, when the first prototype version went online, the visual interface has been inspected using web usability heuristics. In the first prototype versions, no user tests have been conducted due to the early stages. These inspections have led to enhancements of the tag cloud visualization itself, such as the font-family, letter-spacing, positioning and colouring, but also including interface enhancements, such as the web form's usability including the possibility of changing parts of the visualization dynamically as well as providing an example-text.

Last but not least, after further enhancing the tag cloud visualization, a usability test was planned and conducted. Test focus was the visualization's usability, its effectiveness and its benefits to answer the research question addressed. Selected participants did comparisons between a simple traditional tag cloud and an intentional version. After successfully executing the formative test, using a simple questionnaire, a final analysis and conclusion was produced.

3.3 Evaluation Setup

To test the the intent tag cloud prototype, a formative test has been conducted to evaluate the prototype's usability, its precision as well its as informative completeness. The formative test was planned and performed in the following manner:

First of all a testplan has been written and 4 test users have been chosen for participating in a questionnaire. Two tag clouds versions have been created, one version making use of the presented intent tags, the other version visualizing the common frequency tags. Figure 1 shows both of them.

The tag clouds have been created using Martin Luther King's famous speech 'I have a dream' (given on August 28, 1963). Both tag cloud versions are using the same mechanisms for visualization. The different tag levels were represented as XHTML, whereas the tag level was an integer value that ranges from 1 to 11. Depending on the tag's level a CSS selector has been assigned to the various tags. According to the CSS selector, the tag has been styled with a different font-size and -color value as well as given a varying letter-spacing value.

Tag cloud differences existed in particular with regard to term-length and level-variation. In more detail, the traditional tag cloud's tags have been shorter and

consisted only of one word, whereas some of the intent tags have been represented by two word combinations such as 'being playful'. The other difference occured for the tag levels insofar as word frequency calculated levels from 1 to 9 (namely 1,2,3,4,5,7,9) as output, whereas the intent tags varied only between 1, 3 and 7. As a result the traditional tag cloud looked more colourful and dynamic than the intent tag cloud.

After completing the test setup, participants have been chosen and invited to join the questionnaire sessions. All four participants were Austrian, therefore the questionnaire's language was German. The questionnaire included an introductory text, a statement of agreement and several task descriptions and questions. The participants were asked to speak aloud what they think. Some of the questions have been designed as close ones (yes/no) and (1-to-10-selections) as well as some open ones to get qualitative feedback. For detailed information on usability inspection and evaluation methods we used - in addition to our own experiences - primarily the between-groups description of [2].

4 Results

For answering the research questions that have been stated aerlier, i.e. how to support the user in understanding a text and its intentions expressed successfully and are the intentions always scannable for the reader within such a tag cloud, we make use of both initial findings from related work as well as qualitative studies. The results have been collected with an excel sheet and include both qualitative feedback such as a list of interesting participant quotations and suggestions as well as closed answers such as yes/no and numerical answers from one to ten. Figure 3 to 5 show charts that summarizes the collected answers and data.

Formative testing methods usually involve observing a small number of test users [2] using an interface in order to gain more qualitative feedback and insights why something does (not) work as planned. Four participants have been chosen to join the formative testing. Table 1 shows the participants' distribution. All participants are using Computers on daily basis, but all are working in different areas, ranging from medicine and chemistry over design up to administrative fields. participants have been asked to speak aloud and tell us what they are thinking while trying to solve the stated tasks or respectively answer the stated questions [2].

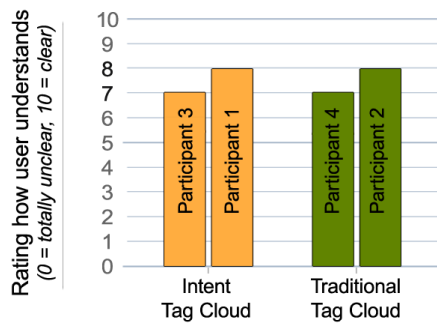| Participants:	1	2	3	4
Traditional Tag Cloud Version	x		x	
Intentional Tag Cloud Version		x		x
Age	27	26	29	27
Gender	female	male	male	female
Educational level	Academic	Student	Technical College	Academic

Table 1. Participant Distribution

Some questions were asked during the interview. For instance, the participants asked, when looking on the tag cloud terms: 'What is the striking point?' and 'Could that be a political speech because it is a quite spongy one?'. Table 2 shows a list of all questions.

Introductory Text	Question
Look at the tag cloud for 15 seconds.	Please tell us, after this short time, in one or two words, what do you think the author intended to communicate?
Study the tag cloud for at least one minute.	Do you think you understand what the purpose and meaning of the text is? - What is your impression? (unclear = 0, clear = 10)
Please answer in short the following more specific questions:	
	Do you perceive the tag cloud being of avail and helpful? (0 = no, not at all, 10 = yes, quite helpful)
	Would you wish to see such a visualization of meta informationen more often? (1 = yes, 0 = no)
	What do you perceive as positive within the tested tag cloud and what did you perceive as disturbing?

**Table 2.** Questionnaire Extract (Translated from German)

For example by asking the first question, we tried to understand what is the participants perceived value of the displayed meta information in general.

Do the participants think they have a clear impression of what the author intended to communicate, or are they rather unsure about it? We also tried to answer the question whether the participants thought, they understand the text's meaning and purpose by asking to name us those one or two terms, they think the speech text obviously describes. Figure 3 shows the recapitulated answers as a block chart. As can be seen in this figure the participants 1 and 2 had a quite clear impression of what the text is about, but participant 3 and 4 stated that they had a adequately clear impression. For this particular test case there are no noticeable differences between the tag clouds and their performances regarding the quality of information.

Fig. 3. Do the participants understand what the author intended to communicate?

To learn more about the general tag cloud's readability, another closed question was asked. We wanted to know more about the fact, whether the tag cloud and its tags are easy to read and therefore may support or rather interfere with getting a clear understanding of what the text is about. Figure 4 shows the answers as a horizontal chart.
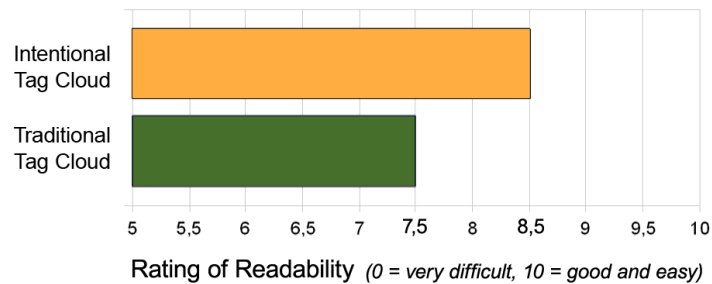

Fig. 4. What is the participants' impression of the readability?

This chart illustrates that the participants mainly agreed on the fact that tag clouds are both readable, while the intent tag cloud testers rated the readability a little bit higher. A participant testing the traditional tag cloud argued that some terms are clearer with a more specific meaning than others. That is why the participant felt not comfortable when deciding which term fits best for describing the meaning and purpose of the associated speech text.

This perception of imbalance when comparing the different terms while trying to choose an appropriate one shows one of the limitations of the term frequency method.

Furthermore the participants have been asked, whether they think that tag clouds were of avail and helpful. They were also asked to state reasons why (not) and how exactly the tag cloud is helpful in successfully understanding the text in their opinion. The participants showed a positive attitude regarding assistance. In the end, the participants were asked to summarize their positive and negative findings. We wanted to get an impression of what are the participant's overall thoughts and feelings about the particular tag cloud. We also used the opportunity to get feedback for future improvements. Figure 5 shows the tag cloud comparison illustrating the sum of Pros and Cons.
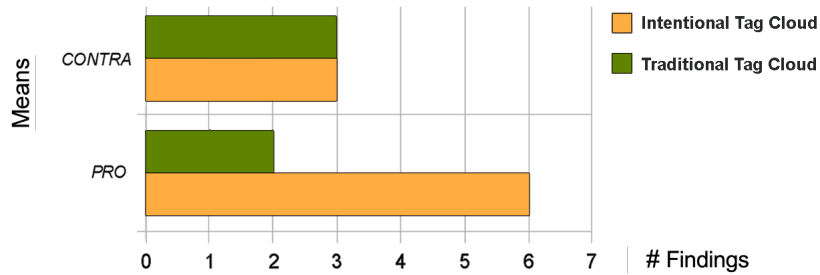
Fig. 5. Amount of Pros and Cons stated by the participants.

This figure illustrates quite concisely the variations in positive findings. Taking all the collected answers into account we assume that the intent tag cloud benefits from interpretation issues. The intent tag cloud terms seem to be clearer and more similar. Especially regarding these differences in semantic density, it can be assumed that a tag cloud of intent tags is a useful approach for describing textual content.

Regarding the experiences made with the formative test, especially the consistently positive answers to the question whether tag clouds were of avail and helpful or not, we can answer the main research question of how to support the user by understanding a text's meaning: Namely the approach of using (intentional) tag clouds appears to support the process of successfully understanding a text. To answer the subsequent question, namely whether the intentions are always scannable for the reader within such a tag cloud or not, we again refer to the formative test results: The answers indicate that intentions are scannable for the reader.

Additionally, the gathered statements during the test also give a good insight to answer the question 'Compared to a content tag cloud, is there a clear benefit in using an intent tag cloud?' and also the subsequent question of 'What are possibilities of further improving the intent annotation visualization?'. First of all due to the varying answers regarding the topic precision, we argue that the traditional tag cloud version, compared to the intent annotation version, is best used when giving a quick overview of what a text is about, whereas enhanced intent tag clouds grant the possibility of spotting and recognizing more precisely a speech text's intentions. The participants who have been using the intent tag cloud version answered in a more focused and specific way and the topic guesses were well chosen. Nevertheless, participants also argued that they are not sure whether the visualization may lack the most important term(s). On the other hand, the traditional tag loud users were quite satisfied with their mostly general impressions of what the speech text is about, because they perceived the tag cloud visualization itself as a kind of funny and motivating type of presenting meta information in a concise way. That may be why the intentional version performed well in precision whereas the traditional tag cloud version performed well in delivering a quick and motivating general glance about the text's topic.

4.1 Future Improvements

During the project's evaluation phase a number of ideas have been generated that will be a focus of future work. Among these ideas, answering the question of how to understand a topic change over time has become mostly prominent. Therefore we consider further enhancing our intent annotation visualization and develop a mechanism for visualizing changes over time. We will continue with studying approaches like the one shown in [5] and [15]. Due to the fact that we only investigated one possible way how intent annotations may support the user in understanding a textual content, the studies can be extended to other multimedia content as well.

5 Conclusions & Outlook

In this paper we explored the usability of intentional tag clouds by implementing a prototype and conducting a user study. Results from our user study suggest that intent tag clouds are accepted and support users in analyzing textual content visually. We described one possible way how intent annotations may be used in a supportive way. Though we used a particular automatic extraction technique, it is not essential how intent tags are produced. We hope that this paper is used as an inspiration, how intent annotations can help users in understanding. Referring to the user studies, intent tag clouds might be applied to other online- as well as offline applications. For instance online magazines might benefit by using the proposed tag cloud enhancements for summarizing articles; however, these text summaries may also work with all other kind of text as well as multimedia, such as articles and advertisement in print media and also digital image databases. The intent annotation visualization can also further be extended by integrating new features such as a mechanism for visualizing changes over time.

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