

# Visual Exploration of Topic Controversy in Online Conversations

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**Abstract.** Online conversations are often quite long with a lot of comments. Readers of these conversations may be interested in understanding how controversial the discussion is and how the differences of opinions arise for different topics. In this work, we are combining natural language processing with information visualization to support readers in exploring disagreements in online conversations. We present an initial prototype and discuss the possible directions for future work.

**Keywords:** Visual analytics, social media, online conversations, natural language processing

## 1 Introduction

With the proliferation of social media, there has been an exponential growth of asynchronous online conversations. An online conversation in forums such as Reddit, Slashdot and Digg may start with a news article link, question or opinion and later generate a long thread with hundreds of comments [7]. Readers may become interested in understanding how disagreements arise in such conversations and how differences of opinions arise and evolve for different controversial topics [2].

In this ongoing work, we focus on supporting the exploration of topic controversy in a casual online conversation between users. To this end, we combine natural language processing (NLP) with information visualization techniques. On the side of NLP, we first apply a topic modeling technique that automatically clusters the sentences within a conversation into multiple topic segments and then assigns a keyphrase to describe what a given topic is about [10]. We then perform sentiment analysis and disagreement detection to discover how different comments react to a given topic [2].

We have been designing interactive visualization techniques with an aim to support users in exploring the results of these NLP methods to better understand the topic controversy in an online conversation. The goal is to help the user in getting a quick overview of the controversial topics and then drilling down to the detailed comments that trigger controversy. In this paper, we present visualization techniques for exploring controversial topics and then discuss the possible directions for future work.

## 2 Related Work

Recently, visual analysis of topics and opinions in social media conversations has received a lot of attention [11,12,14,17]. Some early works aimed to identify and visualize the primary themes or topical clusters within conversations [4, 15]. TIARA system applies an enhanced Latent Dirichlet Allocation (LDA)-based topic modeling technique, which automatically derives a set of topics to summarize a collection of documents and their content evolution over time [16]. Each layer in the graphical representation represents a topic, where the keywords of each topic are distributed along time. From the height of each topic and its content distributed over time, the user can see the topic evolution.

To support users explore sentiment in a large collection of tweets, Twit-Info [14] displays proportion of positive and negative tweets using pie charts in real-time. OpinionFlow [18] combines Sankey graph with tailored density maps to provide visualizations to analyze opinion diffusion for different topics in social media. Visualizations for opinion analysis is also examined in blogs, forums and multi-party conversations [3,5,7]. For example, ConVis [7,8] facilitated multi-faceted exploration of a blog conversation based on topics, authors, and sentiment using stacked bar charts. MultiConVis further extended this interface for exploring topics for a set of conversations [9]. ConToVi [5] visualizes speakers dynamics with regard to different topics in conversations like political debates using animations using radial visualization. It also displayed speaker's behavior using categories like sentiment, politeness, and eloquence.

While there have been some significant work on exploring topics and opinions in online conversations, visualizing the disagreements between participants for controversial topics have rarely been examined. Yee et al. [19] organize a discussion by creating a tree layout, where the parent comment is placed on top as a text block, while the space below the parent node is divided between supporting and opposing statements. ConsiderIt [13] builds a pro-con list from participants and shows a bar chart to augment personal deliberation to help users identify common ground from diverse opinions. Opinion Space [6] is a tool for browsing online opinions which combines ideas from deliberative polling, dimensionality reduction and collaborative filtering using a scatter plot visualization. Pol.is is another tool focusing on organizing the comments by the percentage of agreements based on a combination of machine learning and information visualization methods [1]. However, none of these works focus on automatically extracting topics and visualizing topic controversy.

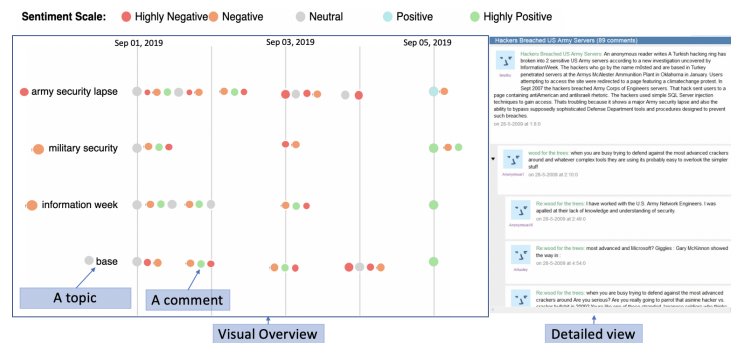
## 3 Visual Exploration of Topic Controversy

In order to design our visual interface, we analyze the possible tasks that the user wants to perform while exploring topic controversy. For example, the user may be interested in knowing how controversial was the conversation. Were there substantial differences in opinion? Why are people supporting/opposing an opinion? To help the user in answering these questions, the visual interface

should show the topics as well as their controversy scores. The interface should also encode the sentiment score for each comment so that the reader knows how disagreements happen between participants for a topic.

In order to extract the important information from conversations, we first apply a topic modeling technique [10] that clusters the sentences from a conversation into thematically coherent clusters. It then extracts keyphrases from each cluster that describe that topic cluster. We then apply a classification method that determines how controversial each topic is [2]. After applying the NLP techniques for extracting information, we have designed an initial visualization prototype (shown in Figure 1). The visualization follows an overview + detail approach, where the overview shows all the topics in a conversation and the amount of disagreements among participants for each topic. The detail view shows all the comments of a conversation in a scrollable list view. In the overview, the topics are arranged vertically, where each row shows a topic along with its controversy score. It also arranges the comments for each topic as circles along the x-axis where x-axis represents time, so that the reader get a sense of how the sentiment evolve over time in the discussion.

We have designed a set of interactions for filtering and sorting topics as well as drilling down to individual comments in a conversation. For example, the user can select a topic from the visual overview and then drill down to a specific subset of comments interests in the detailed view. The user can also sort topics based on controversy score or the number of comments belonging to each topic. Together, these interactions are designed to help users to quickly browse through topics and to understand disagreements that arise between participants.



**Fig. 1.** An initial prototype for exploring topic controversy. The Visual Overview in the left shows the topics and how controversial they are along with positive/negative comments while the Detail view shows the list of comments.

## 4 Conclusions and Future Work

In this ongoing work, we are designing visual interfaces for exploring controversial topics in online conversations. Our immediate plan is to iteratively refine the prototype and carry out user studies to evaluate the potential efficacy of our visualization approach. We would also like to apply more advanced NLP methods such as stance detection and emotion analysis [20]. Finally, we would like to improve the visual encodings and interaction techniques to address scalability issues. In particular, we would like to explore different layouts where more comments can be arranged without occlusion as well as interactive techniques to gradually zoom into the timeline.

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