

WRIGHT STATE UNIVERSITY

CS 7900

FINAL REPORT

A Sentiment Analysis Application for Tweets

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1 Goal

Social media is a very ingrained component of our culture. In this day and age, there are social media users all over the world. In fact, social data is a very rich source of data in today's information age. For this project, we aim to leverage the power of social data from Twitter. As a micro-blogging outlet, users regularly churn out bite-sized chunks of information that can be analysed for information on just about any topic. By aggregating tweets about a certain topic from Twitter, one can get a general sentiment from the populous about that certain topic.

Since tweets can be retrieved in real time, the sentiment of current and trending topics, such as presidential debates and debate topics, can be evaluated to determine how the populous feels about each topic. Understanding and incorporating this user feedback, specifically by examining tweets with a negative sentiment, one can receive the feedback required to move towards a more popular opinion.

2 Objective

We created a web application that allows users to view the sentiment of topics on Twitter. Through the use of two APIs, we 1) retrieved tweets from Twitter and 2) performed sentiment analysis on these tweets and also aggregated the general sentiment about a topic.

3 Approach

This application can be split into two parts: a frontend for the user to select topics and view the sentiment, and a backend for the text retrieval and sentiment analysis to take place.

3.1 Frontend

The user interface was developed with HTML, CSS and Javascript, technologies that have been learned in class. Specifically we used nodejs as a server backend to host the site. We used the Express framework for routing and logic as well as Swig for the user interface templating language. Swig provided a flexible design that incorporated template inheritance and ease of use. In addition to Swig, Bootstrap was used for the CSS styling.

The user interface is comprised of two parts, the user input section, and the results display. A depiction is shown in Figure 1. The user input section consists of a start date, end date, topic search, and a selection to search by topic or by tweet id. The start and end dates define the time range that returned results will occur in. The topic search input can be a tweet topic, or can be a tweet id. If the tweet id check mark is selected, a specific tweet with the specified id will be searched and if found, its sentiment will be analysed. The tweet results section shows the tweet, the tweet sentiment and the person who tweeted it. The accumulated tweet sentiment is also displayed to the user.

Using these technologies we can create a dynamic layout that, given a search topic, can display several retrieved tweets with their individual sentiment, as well as the overall sentiment of a topic.

3.2 Backend

The backend was split into two parts: tweet retrieval and text sentiment.

Search Criteria Form

Start Date

04/18/2016

End Date

04/18/2016

✕ ▾ ▴

Tweet Input

gender neutral bathroom

☒ Topic
 ☐ Tweet ID

Submit

Note: Can't search by topic for tweets that are over a week old!

Relevant Tweets

Total Sentiment: 45

Transgender Bathroom hysteria is crazy smh, simple solution is to add a 3rd bathroom gender neutral!

Valence: negative

Polarity: -4

Link to Tweet

you know, I don't mind the concept of a "gender neutral" bathroom. Just make sure there are men's and women's beside it

Valence: neutral

Polarity: 0

Link to Tweet

RT @ : would you feel comfortable in a gender neutral bathroom? rt after voting, I'm trying to prove a point

Valence: positive

Polarity: 2

Link to Tweet

Figure 1: User Interface

3.2.1 Tweet Retrieval

The tweet retrieval was performed with the node module *twit*. This module allowed us to search twitter with query strings that encode the topic, start and end date. Using this API we can also search twitter with a specific tweet id to get the associated tweet. The twitter API does have its drawbacks however. The first drawback being that there is a usage rate limit for the search API of 180 calls per 15 minutes.

The second limitation is the page size when using the search API. The page size denotes the number of tweets retrieved per api call up to a maximum of 100 tweets. This allows us to retrieve 100 tweets with each 180 allowed API calls for a total of 18,000 tweets each 15 minutes. This might seem like a large number, however this number can be easily exhausted when querying a popular topic. For example, querying "Trump" will return 100 results within a time window of a few seconds. Querying another, less popular topic such as "Grand Canyon" will return 100 tweets within a time window of several hours (note that this is situational and the frequency of requests could change).

The third limitation is that the search API only indexes tweets within a 7 day window of when they were created. After roughly 7 days, the tweets are removed from the search index and are unable to be retrieved. This makes it impossible to retrieve tweets by topic that are further in the past.

To accommodate all of these limitations, our program only returns 100 tweets per search. However calculating the sentiment of only 100 tweets is not indicative of the overall sentiment of a topic. For popular topics that are constantly being discussed, this 100 tweet limit is a mere snapshot of a few seconds of conversation. The only way to overcome these limitations would be to use the Twitter streaming API to retrieve tweets as they occur, however there are no current plans to integrate this into our application.

3.2.2 Text Sentiment

The sentiment analysis was performed with the node module *retext-sentiment* which is a plugin for the *retext* module. The *retext-sentiment* module operates at the sentence level through the word level. Each word is assigned a polarity and negation is also supported. The word "bad" would have a negative connotation, but the phrase "not bad" would not have a negative connotation. There is also built in support for emoji as well. A smiley will have a positive connotation while a frown would have a negative connotation.

The overall sentiment of a tweet would be $sentiment = good\ words - bad\ words$. This gives us a sentiment polarity that represents how positive or negative the sentiment is and, consequently, a valence of negative, neutral or positive.

One limitation of this module is that it uses a mapping of sentiment to words, so if a word is misspelled, the sentiment cannot be computed. Since this module is used on unprocessed twitter data, there is the possibility that tweets exhibiting a negative sentiment, but are not spelled correctly, will not be labelled accurately.

4 Evaluation

To evaluate the sentiment analysis component of the application we used the following two sub-datasets from the Sentiment Strength Twitter Dataset (SS-Tweet) [4]: 1) Youtube comments and 2) twitter tweets (see Table 1). Using data from two domains allowed us to better evaluate the robustness of our sentiment analysis tool.

To keep the evaluation simple, we performed binary evaluation for this multiclass problem. The testing datasets were labeled with a mean positive and mean negative value for each sample. To calculate the sentiment, we define $sentiment = good - bad$ and then threshold it into a class *negative*, *neutral*, *positive* based on it's value. To compute precision and recall for a multiclass problem, we transformed the problem into several one-vs-many problems, calculated the precision and recall for those, and then took the average values for the multiclass problem.

Dataset	Samples	Positive	Neutral	Negative
Twitter	4,242	1,340	1,953	949
Youtube	3,307	1,665	875	767

Table 1: Dataset class breakdown

The results of the sentiment analysis evaluation can be seen in Table 2 and Figure 2. We can see that the Twitter and Youtube datasets have similar precision and recall values, and this implies that this sentiment module is robust across different text domains. Now while the precision and recall values do not seem that high, it's important to realize that not even humans can accurately determine the sentiment of a text 100% of the time. In fact humans can only determine the correct sentiment 70-80% [1][2][3] of the time! This is because humans do not universally agree with each other on any subjective matter.

Examining the confusion matrices in Figure 2 we can see that the algorithm mostly has trouble with the neutral class. With sentiment being such a subjective issue, it intuitively makes sense that there would be more trouble evaluating whether a text is *positive vs neutral* or *negative vs neutral*. The lines can be more gray here rather than the stark contrast that a *positive vs negative* tweet would have.

Dataset	Precision	Recall
Twitter	.55	.58
Youtube	.53	.55

Table 2: Sentiment Metrics

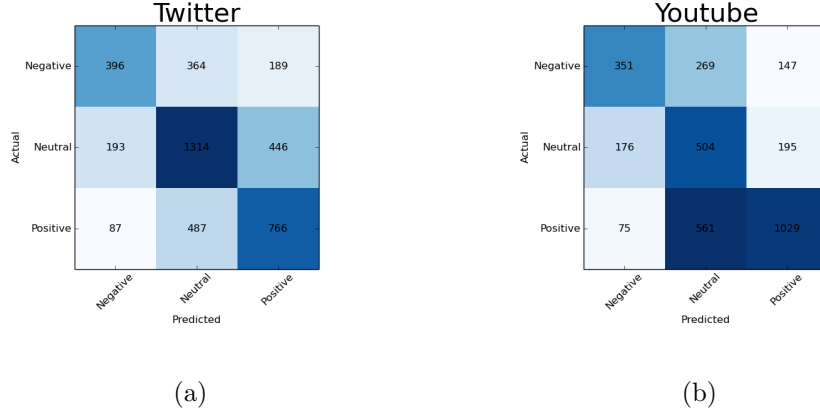


Figure 2: Sentiment Confusion Matrices

Since the algorithms performs much better than just guessing the class (which would be a 33.3% precision), we conclude that the performance of this algorithm is adequate for the task at hand.

5 Results

One usage of this application was for "gender neutral bathrooms". As a current controversial topic in the U.S., this provides a good platform to determine the sentiment of the populous. While the total accumulated sentiment fluctuates rapidly (since we are only viewing 100 tweets), we can see some examples of positive and negative tweets in Figure 3. We don't display the neutral results since the more polar opinions will depict negative and positive feelings about the topic.

Positive	Negative
would you feel comfortable in a gender neutral bathroom? rt after voting, I'm trying to prove a point	isn't the bathroom in the house a gender neutral one? Ppl don't seem to have problems with those
This new gender neutral bathroom at Lincoln probably gonna be clean af so I'm in that thing, Idc I'll be transgender for a min to use it.	Transgender Bathroom hysteria is crazy smh, simple solution is to add a 3rd bathroom gender neutral!
god bless the gender neutral bathroom	That awks moment when you realize you've been using the guys bathroom by accident. Gender neutral, I guess??????

Table 3: Gender neutral bathroom results

By examining this data, we can determine the more positive and negative aspects of a specific topic. For example, in Fig 3, the first positive tweets mentions how people may or may not be comfortable in a shared bathroom while the first negative comment points out that household

bathrooms are gender neutral. Similarly, the second negative comment offers one solution of adding an additional third gender neutral bathroom.

Utilizing this application can provide a good start for garnering a populations' feeling on a subject.

6 Conclusion & Future Work

This application provides a user interface to view tweets about a topic and view the overall sentiment about that topic. This application can provide a baseline approach for citizen sensing about particular topics. By examining the polar opinions on topics, the pros and cons of a topic can be established and considered when evaluating the merits certain topics like proposed legislation. This allows for more informed decisions to be made while also considering the opinions of the populous as a whole.

This project could be further enhanced to support geolocation and user history models. Defining a geolocation filter would allow for a topic search at a finer level. The sentiment of topics could be compared across different localities such as cities and more information can be gleaned. Moreover, by incorporating user models, we can establish how reliable a user's sentiment on a topic is by modelling their past behavior. For example, a user that mostly posts negative comments and also posted negatively about the search topic might carry less weight than a person who has a more neutral posting history who also posted negatively. Using this enhanced functionality would provide a more accurate depiction of the sentiment on a specific topic.

References

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