Game of Thrones Series Visualization

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CS 7450 Project Proposal

October 17, 2016

Abstract

We propose an interactive visualization to summarize the visual and textual aspects of the hit HBO original series Game of Thrones.

Overview

After watching a TV series, the curious viewer often wants to go back and examine details of the series that were especially interesting or unusual. Unfortunately, high-level summaries of an audiovisual experience, like a TV series, are often limited to text summaries or summary statistics that cannot support a user's exploration of the actual experience. We currently lack standardized methods to expose the inner structure of an animated feature, apart from whatever screen-captured images are generated manually by fans after the screening. A visualization that sheds light on the textual and visual qualities of a TV episode can lend insight into the episode's narrative qualities, such as the arc of a storyline or the development of a character, or the cinematographic elements used in story-telling. Even better is a system that allows the viewer to compare multiple parts of a series, which reveals key similarities and differences across episodes in a series. Fundamentally, our project treats TV series visualization as a multi-layered time series analysis problem to expose the viewer to high-level attributes of the series. We choose to analyze the HBO series Game of Thrones for its wide cultural appeal, acclaim, and interesting use of both cinematography and dialogue.

We begin with example questions that our visualization would help the user explore, continue by describing the data to be visualized, and end with a discussion of past and future design ideas for the final visualization system.

Example queries

We motivate our project with several questions that film analysts, loyal fans or potential viewers would want to explore:

1. How does the distribution of colors change across the series?

   Answering this question would serve multiple purposes. For a fan of the show, this would be a useful summary of the entire show at different levels of granularity, such as an entire season or episode characterized by the white-blues of winter scenes. For a potential new viewer, this would be a visual way to assess the mood of the show before even watching any episodes. For example, excessive dark colors may indicate indoor scenes or dark themed story lines which may not be appealing to newer viewers deciding on whether to watch the show. For a critic, this would help in visualizing the continuity and consistency of the colors used to depict the different story lines, adding another dimension to the overall analysis.

2. How does the dialogue on the show reflect different emotions, and what is the trend of all these emotions?

   As we describe in the data section, it is possible to estimate several emotion variables from text. Thus, it is possible for us to answer this question by looking at the subtitles for each episode of the show. Again, answering this question visually would not just serve as effective summarization but can also be informative to different needs based on the audience roles. For instance, dialogue containing swearing and anger might discourage newer viewers deciding whether to watch the show,

whereas some might prefer it. For script writers, it would help to know the high level trends across different emotional categories, so that they can find an effective balance in character development while matching their audience's interests.

3. Do changes in textual qualities correspond to changes in the color palette? For instance, if most of the images are dark grays but one scene is in full color, we may see a corresponding spike in positive textual sentiment. We expect that the biggest color changes will result from scene changes, such as the transition from white snow to green jungle.

4. Which season of the show was the most surprising in terms of its visual and textual trajectory? Pinpointing unexpected combinations of color and sentiment could help fans understand what made a particular season especially exciting or controversial. It would also provide a tool to help directors generate future storylines that will surprise rather than bore viewers.

Data & Analysis

We provide a summary of the raw data, as well as the analysis that we use to process it and render it usable in an interactive visualization.

Color

As described above, we want to extract the dominate colors from the Game of Thrones series to see how color changes over the length of an episode, a season, and the entire series. A typical Game of Thrones episodes runs on average 60 minutes. So for the 6 seasons each containing 10 episodes, our original video dataset contains 60 high-definition videos totaling approximately 75GB. We use the visual content of the show by representing the video for each episode as a sampling of still frames at a uniform sampling rate. We choose a rate of 1 frame per second. At this natural sampling rate for the average episode, we then capture approximately 3600 frames from each episode, totaling 216,000 frames for the entire series. Note that the original video data is in an HD format (720p: 1280px x 720px), but we resize the still images to a slightly smaller size (720px x 405px) in order to speed up further processing. We have now reduced our original video dataset of size 75GB to a still image dataset of size 6GB.

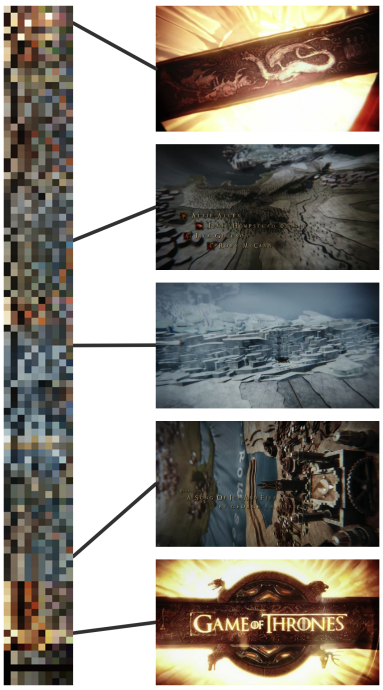


Figure 1: The colors of the iconic Game of Thrones theme song over time. Time moves from top to bottom, where each row is a frame extracted from the video containing the top 10 most distinctive colors. Notice the distinctiveness of each frame even during a relatively smooth camera transition between scenes.

Color quantization is a process that reduces the number of distinct colors used in an image, usually with the intention that the new image should be as visually similar as possible to the original image. We use the well-studied median cut quantization clustering algorithm [2] from computer graphics on our dataset of still image in order to extract the top ten most dominant colors in each image. For each image, we now have a list of the RGB values for the ten desired colors, which we save to disk in per-episode batches. We store them all in JSON files. This leaves us with 60 corresponding color files that make up our raw color data, totalling just 34MB.

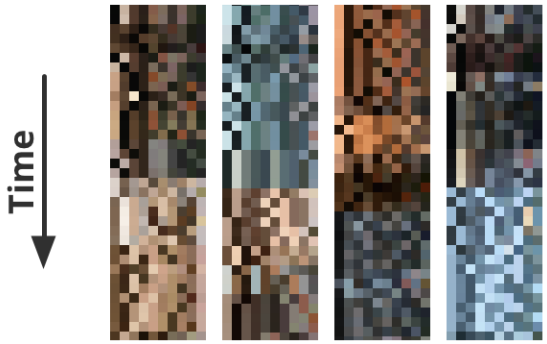


Figure 2: Four example scene transitions that become apparent when looking at the color palette.

Explicitly, we have 60 JSON files, each corresponding to one episode, that contains a list of approximately 3600 entries, where each entry is one color palette of ten colors in RGB corresponding to one frame of the episode. We use JSON to keep our data format agnostic, just in case we need to do further analysis in python, but we can also directly import our JSON files in Javascript and D3 when we build the visualization.

Text

For every episode, we also have the subtitles to provide the text of the conversations between the characters, synchronized to the time that they appear on screen. Each episode has an average of about 700 dialogue segments, often consisting of a few sentences from a character.

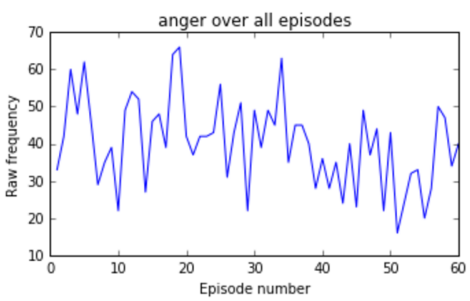
Anger	hating, threat	Negative	dumb, worse
Death	fatal, kill	Positive	better, nice
Family	relatives, son	Religion	holy, soul
Home	door, kitchen	Swear	damn, hell
Humans	kid, person	Sexual	lover, pregnant

Table 1: Textual attributes (via LIWC) and example words.

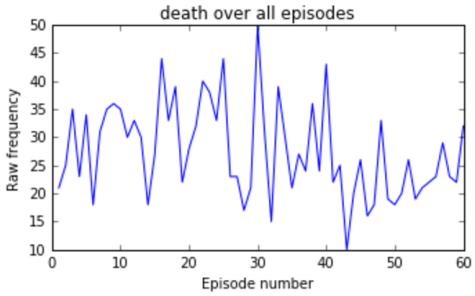
We have also extracted text category counts from the text data and visualize it alongside the color by aligning the timestamped dialogue with the screenshots. This allows us to provide the user with a high-level, interpretable summary of each episode's dialogue. By correlating the categories with colors, we can get an insight into what kinds of visual qualities co-occur with a certain textual quality.

Drawing on LIWC corpora [1], we can characterize our text with psychological and topical categories, such as anger and swearing. We have selected 10 textual attributes relevant to Game of Thrones as a means of providing interesting insight to system users, and we summarize these attributes in Table 1. We show in Figure 3 the trend of two such categories. In addition to individual text categories, we also include the total word count over time as a feature that allows users to see which sections of the series involved more or less dialogue.

[1]LIWC stands for Linguistic Inquiry and Word Count is a dictionary based approach for determining estimates of different emotion categories in psychological research [1].



(a) Trajectory of Anger words found in the dialogue over the entire series



(b) Trajectory of Death-related words found in the dialogue over the entire series

Figure 3: The figure shows how two of the text categories change as the series progresses. Our final visualization would include such time-series line plots.

Target Audience

Our visualization would serve any fan or critic of a series who wants to uncover how a particular part of the show fit into the overarching plot. This is especially applicable since we will make the system interactive, such that fans can zoom in and out of regions of interest (e.g. within a season or across multiple seasons) to make "deep dives" in addition to the "big picture" view. The visualization will provide evidence to a fan who wants to make a particular argument about the TV series, such as how a certain season is disliked by fans because of its consistently dull colors. In addition to current fans, the visualization could help future fans decide whether or not to watch the series based on the representative colors or text attributes.

Conversely, the visualization could also help the TV show's directors and artists to better understand the big picture behind their day-to-day plans. A new set designer on Season 7 of Game of Thrones, for instance, could use the visualization to get a better understanding of the color scheme of the previous season.

Design Ideas

Our visualization ideas revolve around exploratory analysis that allows the user to highlight certain temporal aspects of the data (e.g. repeated color patterns) by analyzing color alongside textual categories. We present below our four main ideas that we demonstrated during the poster session.

Single View Designs

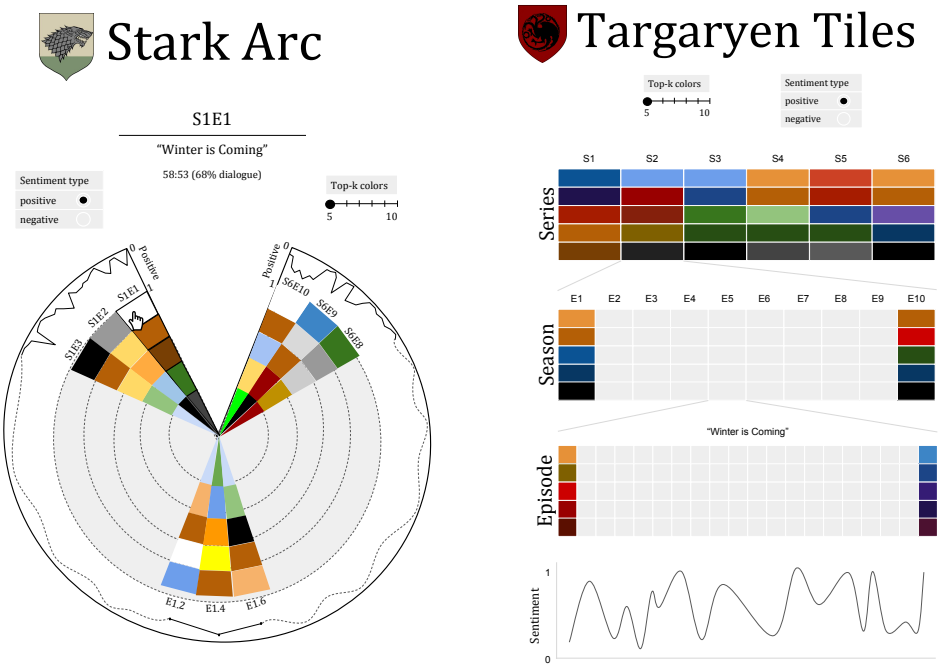
We show our single-view designs in Figure 4, demonstrating the basic idea of how to show color and text sentiment changing over time on the same axis.

Figure 4a represents the entire series as a circular object, where each episode is fills up one slice. The top colors are contained with each slice, and the plotted text sentiment time series runs along the out rim of the visualization. Upon clicking a pie piece, we replace the entire GOT series data with that specific episode's data, allowing the user to drill down into the series deeper.

Figure 4b is fundamentally the same visualization as Figure 4a, but now we have a more standard linear representation of time that runs along the x-axis. A user is first presented with the top rectangle view of the data. Upon clicking a season, that block expands below to show a more detailed visualization of that specific data. Once again, a user can select one of the now displayed episode blocks to expand into a third visualization, where we are now looking at a specific episode's data. Note that the text time series is always appended to the bottom-most color visualization, and its axis is the same length as the color axis, allowing for easy vertical comparison between color and text.

Multi-View Designs

We display our multi-coordinated design ideas in Figure 5, investigating more correlative techniques to pick up potential connections between color and text categories.



(a) Cyclic view displaying the top-k colors for the entire series and its text sentiment, as well as an example zoomed-in view of a single episode (bottom).

(b) Tile view displaying top-k colors in a particular episode and its text sentiment, as well as the colors from the corresponding season and the overall series.

Figure 4: Single-view design ideas, using the natural data hierarchy to do "drill down" exploration.

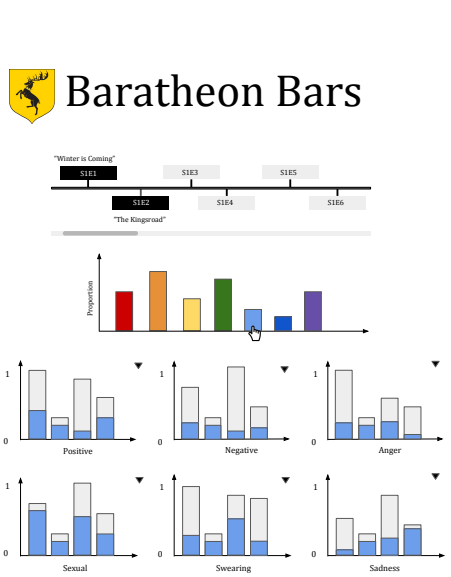
In 5a we proposed to show the correlations between text categories and color, presuming that the user is interested in the connection between the two representations. In this view, the user could first select the episodes from a timeline that would bring up the color distribution of the selected episodes. At the same time, the user would also be shown the different quartiles of scores for each category. Additionally, the user could click to select a color from the distribution, and the quartile bars would fill up based on the extent to which that color corresponded to the quartile. In this way, the user could find the correlation between multiple categories and color at the same time.

In 5b, we proposed an alternative way of doing correlation analysis. Here, we assume that the user would want to find correlations across time. The user would first select a set of episodes (contiguous or non-contiguous) from the episode grid. We would then show the color time series as stacked line plots and the emotion categories as line plots. The plots would be linked together with a slider that the user could move in any direction. If the user clicked on any color, we would brush the text category time plots with the the same color at the times where that color was dominant to highlight notable trends.

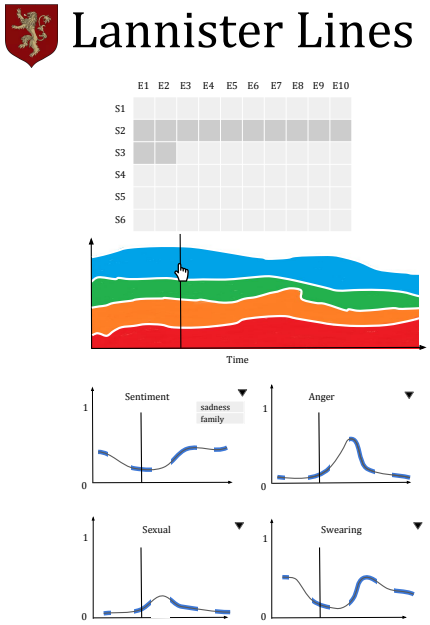
Poster Feedback and Final Design

During the poster session, our designs we met with overall favor, with comments such as "Do it all!" However, one particular repeated item of feedback was the idea of moving toward a query-based system in addition to pure visualization. For instance, what if a user wants to see all scenes with a white and blue color palette (i.e. snowy scenes)? We can incorporate this idea with a query function that brings up all color slices that are similar to a user's query. Given the complexity and depth of data querying, we want this feature to lend itself to the bigger narrative we want to tell with our visualization. Since Game of Thrones is inherently one big story, our unique datasets are packed with potential for storytelling. Therefore, for our final design, we want to build a visualization about our rich Game of Thrones datasets giving each user the ability to query the data in order to uncover and tell interesting stories, paralleling the stories within the series itself.

Given our comments from the poster session, for our final design we want to include the best elements



(a) Multiple histogram view to display the cooccurrence between color and different text categories, through linking and brushing of all histograms.



(b) Multiple time series view to display the cooccurrence between color and different text categories, through linking and brushing of all line plots.

Figure 5: Multi-coordinated design views to investigate the correlation between color and text categories.

of each design in order to build our final visualization. Given the nice visual appeal of Figure 4a, we want that to be our crown-jewel of the visualization. However, this view does not allow for easy color and textual comparison, which is the primary focus of our data fusion proposal. So we want to borrow from design in 4b and use the individual episode color and text comparison (the bottom-most rectangular grid and time series plot). We want to link these two together using the selection and querying idea presented in the top of 5b where a user can select what episodes to view from a grid. This grid selection method allow us to query the data with non-contiguous blocks, so that in addition to just season or episode comparison, a user is able to look at all data from the 9th episodes (typical Game of thrones has particularly shocking penultimate episodes), etc. Since we have multiple textual category time series data, we want to normalize the data and overlay multiple line plots on top of one another, corresponding to each category, allowing a user to see where certain categories spike, others may fall.

In our proposed design, we only show the trends for textual categories, without revealing the text at all. But this might be limiting if the user wants to go one step deep to understand what words caused a certain spike or a dip in the trend. To correct this, we plan to show a histogram of word frequencies that correspond to any point in the trend if the user clicks on that point. Although the finer details about the interactivity, positioning and the styling of this feature aren't yet fixed, we believe this would lead to a much richer analysis. In our design, we hope to lay the groundwork for future visualizations of other TV series that exhibit the same level of diversity of color and dialogue as Game of Thrones.

References

[1] Pennebaker, James W., Martha E. Francis, and Roger J. Booth. *Linguistic inquiry and word count: LIWC 2001.*. Mahway: Lawrence Erlbaum Associates 71 (2001): 2001.

[2] Heckbert, Paul. *Color image quantization for frame buffer display.* ACM, 16 (3): 1982.