Capturing Emotion and Mood: An Analysis of Cinematic Color and Light

Leah Bracken, Silas Keeter, Eliza Tuta

Introduction

As movie enthusiasts and computer science majors, we seek to find a way to converge these two interests. This project offers the opportunity to analyze movies in a new light. We hope to conceptualize and quantize the mood of cinema through color evaluation. Through this lense, we hope to shine a light on common cinematographic elements between film genres, cultures, and target age groups. To do this analysis, we intend to aggregate each individual frame of the movie into a single image that we can then perform multiple functions on to see if it has any commonalities with films in its genre or other peer group. Some of the elements that may be tested, as will be better explained later in this paper, are image symmetry, locationality of colors, brightness, and general color preference. This will allow a more in depth analysis by what makes a movie cater to a particular group or evoke a certain feeling.

Methods

We collected multiple movie trailers from youtube.com using OnlineVideoConverter.com. Movies were selected by the author's familiarity with a film and their belief of its representation of a genre. While not perfectly random, we believe that this method allowed us to select more representative films than a random selection would do and eliminate edge cases. Some edge cases were films such as "Monster House" & "Coraline", where they are children's animated movies, but also horror movies. This was done to limit data crossover, where the films would have elements of both genres, corrupting the final data of either genre. Black and white films were also excluded, as were trailers of movies already selected, (i.e. we would not pick 2 trailers for "Halloween 2"). This was done to allow for better color variation. Most film trailers were roughly 2 minutes in length after cropping with small amounts of variation. We decided that this variation in length was acceptable as the film trailers would be forming a single image to

represent the movie in overall tone and thus small differences in length would be a non-issue and standardizing the length could result in loss of overall trailer tone.

We then processed the movies, cropping out the opening title sequence and the ending title sequence. This was done so as to reduce the amount of screen transitions, where the fades and cuts to perfectly black for a few seconds after it displays a logo. We found including these sections significantly darkend an image and damaged the quality of the data we were trying to gather.

After the videos were properly cropped, they were run through our image aggregator. This aggregator took every individual frame of a movie, added them together, and then divide by the sum of the number of frames. This could be represented by the equation:

$$B = \frac{1}{n} \sum_{i}^{n-1} A_i$$

where A_i is a unique frame, n is the number of frames, and B is the total image. Thus, each frame was overlaid on top of each other and averaged to create a single image representing the entire film trailer. An example of this can be seen in Figure 1, where the trailer for the film "The Nun" was run through the aggregator.

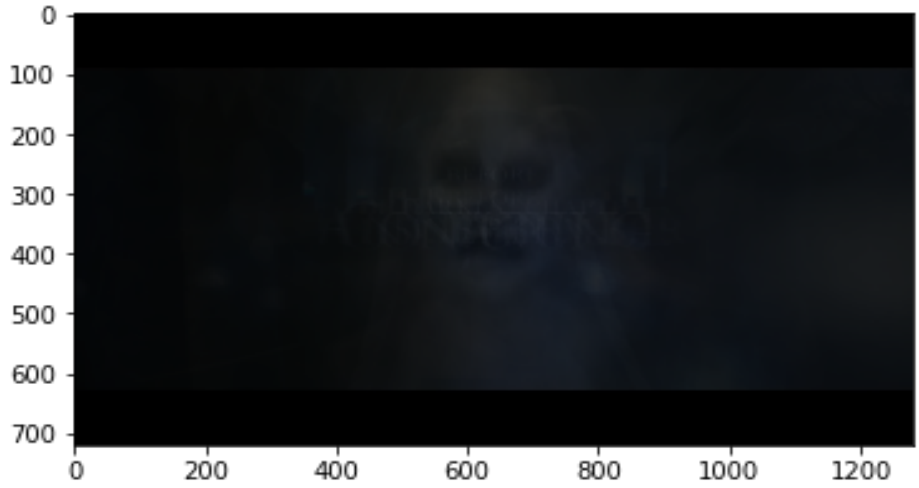


Figure 1. Video agregate of the trailer for “The Nun”. Pulled from the youtube.com video “THE NUN - Official Teaser Trailer [HD]”

After aggregation, movies were then sorted into their genres and the final accumulated products for each genre were combined into a single image. The genre aggregate was then qualitatively analyzed for color and brightness. A histogram was then taken to provide further insight and allow for image enhancement. Image enhancement was then done by taking the histogram, sorting it, and then finding the top and bottom 33rd of the image. We then performed a histogram flattening function using the equation:

$$m = (255 - 0)/(p - q) \; where \; p = img[imgsize/33] \; \& \; q = img[-imgsize/33]$$

$$Flat\ Image = img * m$$

The top and bottom 33rd were selected as they consistently did not eliminate large amounts of data (only 6% color loss), as we found larger amounts did (like the top and bottom 20th), and still provided drastic improvements in image quality. This enhanced images was then viewed qualitatively as well as run through color subtraction to see points of high variance. Finally, some trailers were pulled and color channels were mapped along the x & y axes. Interesting results were described below. In addition, we added a single, longer, video baby video at this stage as we believed that it had very interesting results in regards to children's cinema.

Movie Name	**Genre**	**Length**
Zootopia	Children	01:50
My Little Pony	Children	02:07
Peppa the Pig	Children	00:49
Little Prince	Children	02:01

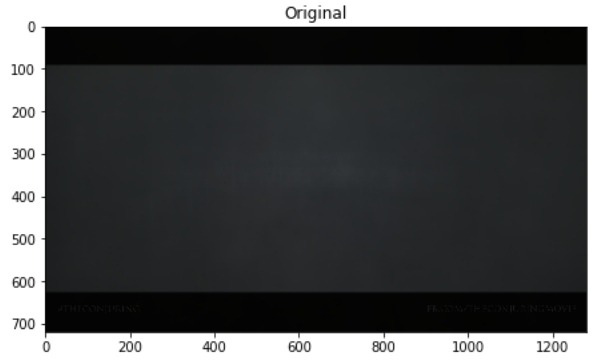
The Grinch	Children	01:55
The Lego Movie	Children	02:07
Insidious	Horror	02:15
Get Out	Horror	02:24
It	Horror	02:16
The Exorcist	Horror	02:33
The Purge	Horror	02:03
Annabelle	Horror	02:13
Annabelle 2	Horror	02:19
The Conjuring	Horror	02:19
Halloween	Horror	02:21
Babadook	Horror	02:01
Love Actually	Romance	02:04
Valentines Day	Romance	01:53
The Notebook	Romance	01:54
Dirty Dancing	Romance	01:22
Baby Sensory Video	Infant	07:55

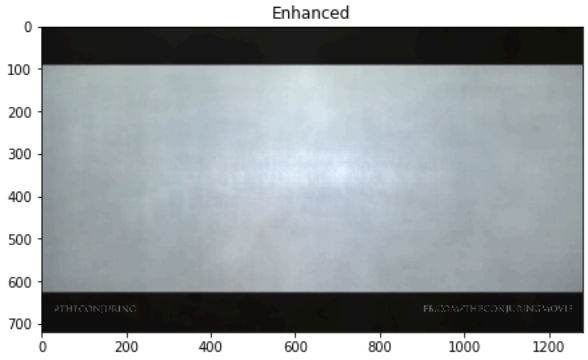
Table 1. Information about the different movie trailers we performed analysis on. Each movie had 24 frames per second. While not all movies had the same time, we do not believe this is an issue as each trailer was specifically designed by a director to both represent the feel of the film and the genre. This makes each trailer a single, unweighted, unit in our final genre aggregations instead of making the aggregations based upon length and frame count.

Results

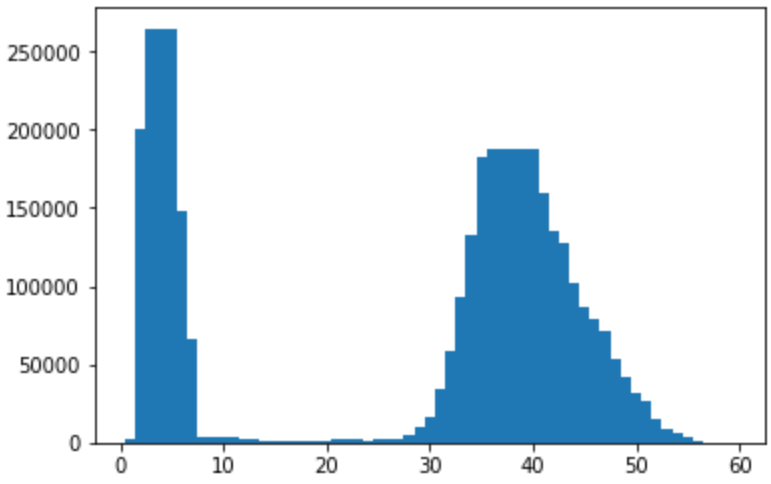
Horror Movies:

A





B



C

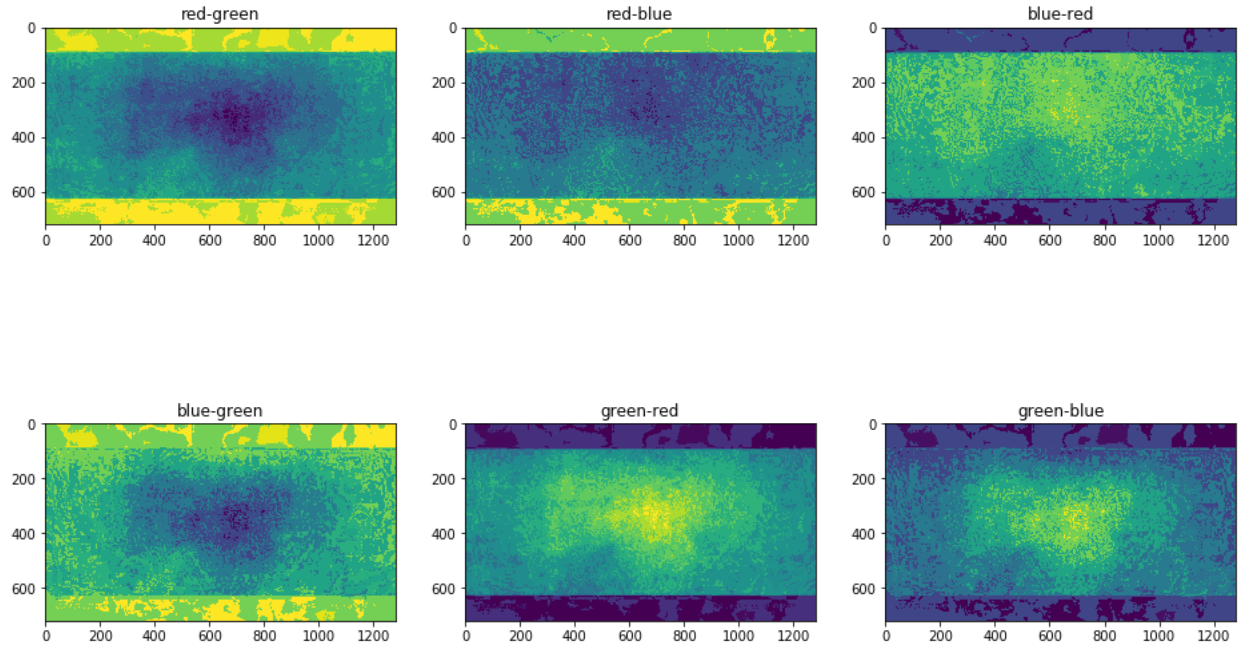


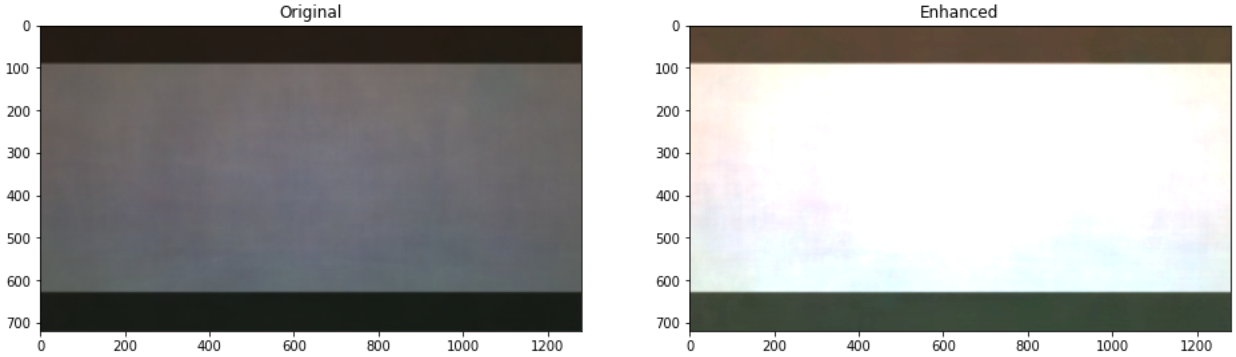
Figure 2. A) The final color agregation for all measured horror movies. Left image is the true final aggregate, right image is the enhanced image. B) Histogram of the original image with the luminosity value on the x axis and the pixel count on the y axis. C) Color subtractions of the original image to see color differentiation across the image. Higher values are yellow, and lower values are blue. Calculations made are stated above each image.

Note the tendency of horror movies to be incredibly dark. After Enhancement, it is also clear to see the tendency to have a very bright center surrounded by darkness. This contrast allows for the main characters to be seen and villains to sneak in the sides, suddenly appearing and disappearing for dramatic effect. Some of these were things such as a slow pan with the character in the middle and the villian appearing over the shoulder or in a reflection. Others were things such as a sudden entrance of a spectral hand or a quick attack from a ghost. Note also the bright words that are often shown in horror movies and how they also are centered in with dark backgrounds. This shows horror movie trailer's desire to keep the viewer's eyes in the middle of the frame so as to sneak in the aforementioned surprises. As seen in 3C, this color differentiation

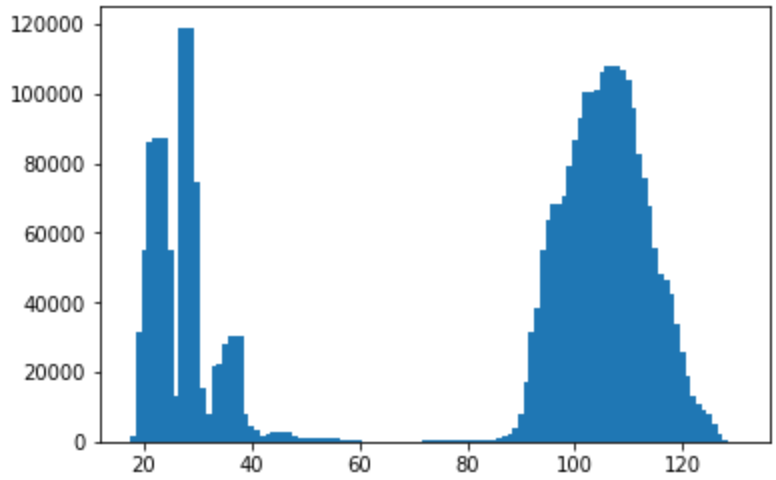
is especially pronounced, keeping high amounts of green in the center of the frame while having small amounts of blue and red dispersed into the darkness. This accents the center even further as the human eye is most sensitive to green light. This high amount of central green shows that not only the brightness of the center is taken into account, but also the specific colors are meant to intentionally draw the eyes to the middle of the shot.

Children Movies:

A



B



C

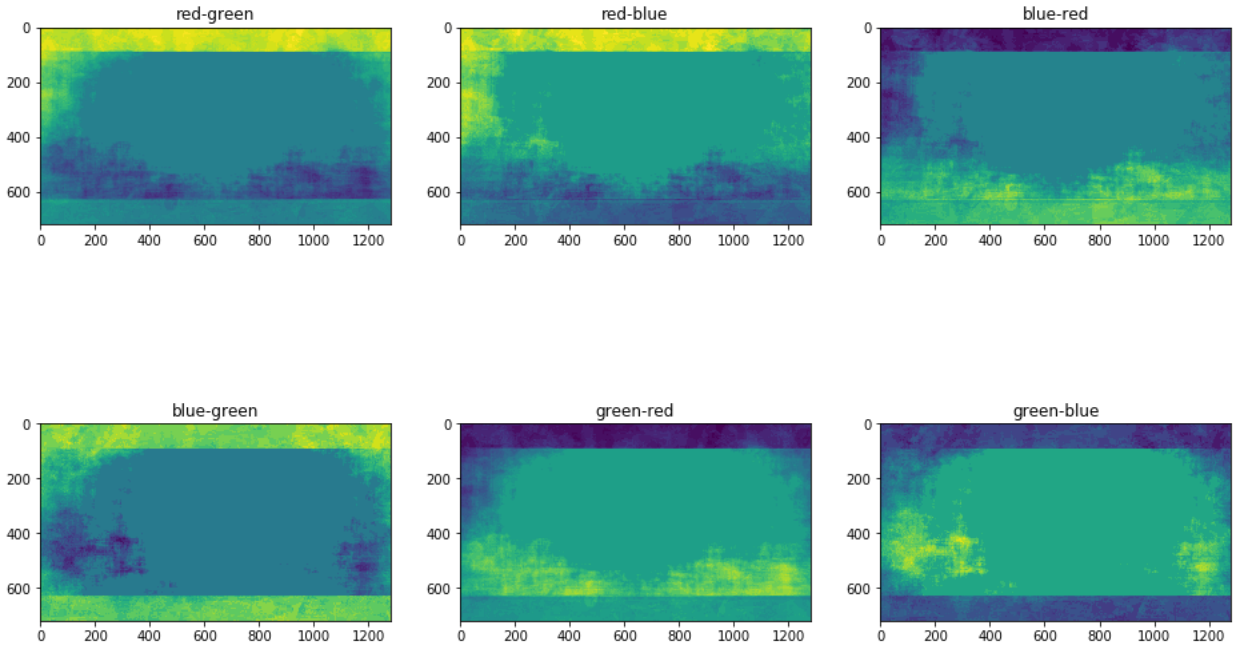


Figure 3. A) The final color agregation for all measured children's movies. Left image is the true final aggregate, right image is the enhanced image. B) Histogram of the original image with the luminosity value on the x axis and the pixel count on the y axis. C) Color subtractions of the original image to see color differentiation across the image. Higher values are yellow, and lower values are blue. Calculations made are stated above each image.

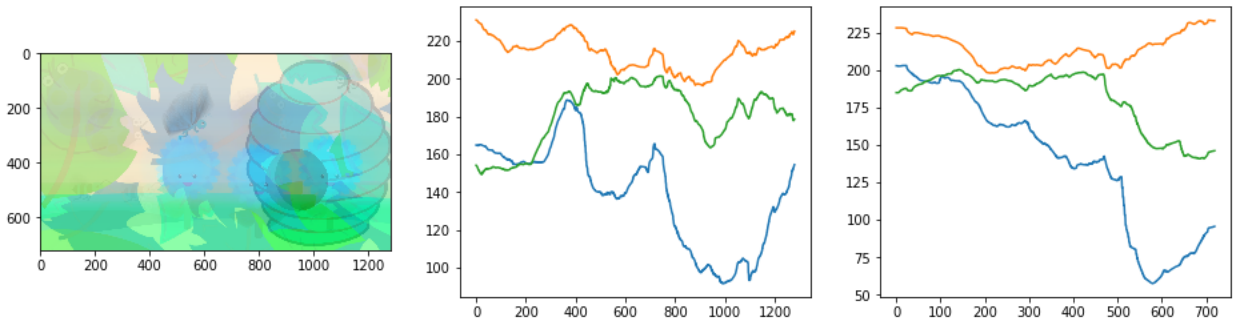


Figure 4. Video aggregate of the "Baby Sensory". Pulled from youtube.com video "Baby Sensory- Color Animation (Infant Sensory)". Left image is the aggregate, middle plot is the color values across the x axis, right plot is the color values across the y axis.

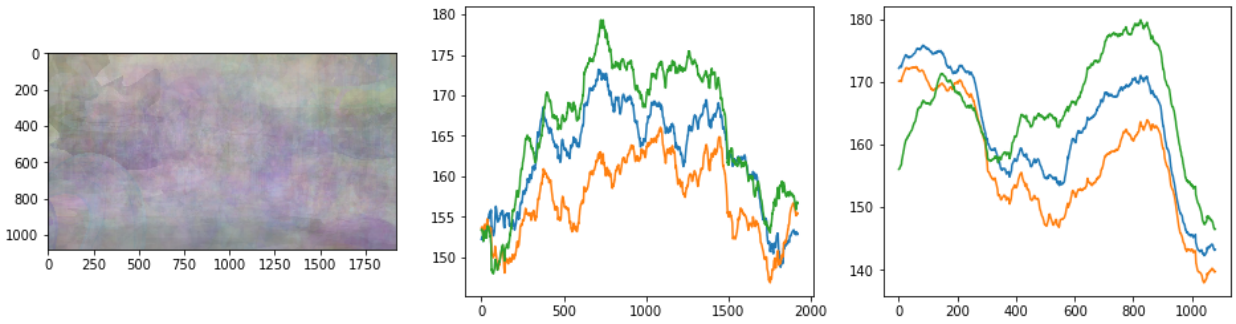


Figure 5. Video Aggregate of the "My Little Pony: The Movie". Taken from youtube.com video "My Little Pony: The Movie - Ponies Got the Beat Official Trailer #2"Left image is the aggregate, middle plot is the color values across the x axis, right plot is the color values across the y axis.

In the case of cartoons for children we also noticed different trends based on the age of the children the cartoon is targeted to. For example, the frames in the cartoons targeted for toddlers have generally less objects and the frames tended to repeat themselves. As a results, it can be noticed in the Figure 3 above that adding up all the frames results in a final image with objects that can still be clearly perceived, such as the honey bee hive, the tree trunk or the leaves. The reason for that is to help toddlers maintain the focus on the centers of interest in the story and also to encourage visual development and stimulation.

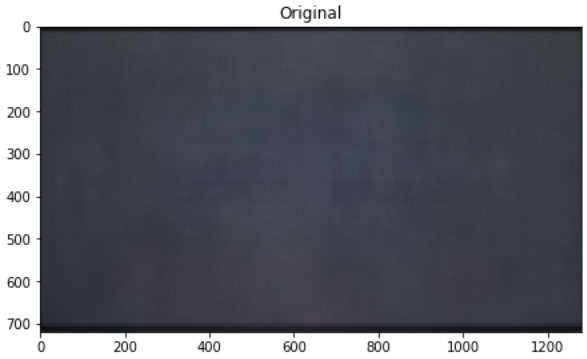
On the other hand, the movie "My Little Pony" was targeted to older children and therefore the complexity of the frames in terms of objects and colors increased. As a result, the aggregate image is smoother and no particular objects can be recognized, as noticed in Figure 4. Similarly, the movie uses predominantly bright colors like pink, blue and yellow to appeal to children.

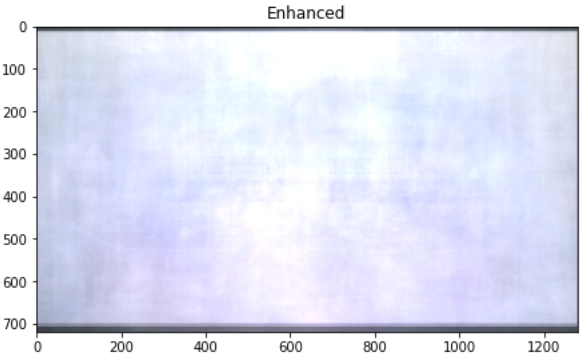
It can also be noted the difference in histograms when comparing the cartoons for children with horror movies. The cartoons have more pixels with high brightness compared with the horror movies. This makes sense, since children generally prefer brighter colors, whereas dark colors are needed to create the macabre scenery adults are looking for in a horror movie.

Overall, all the Disney movies and cartoons for children analyzed showed a pattern of having predominantly lighter and brighter colors compared to the horror movies we looked at, as we initially predicted.

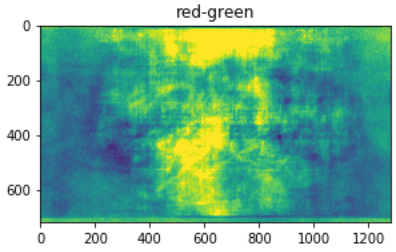
Romance:

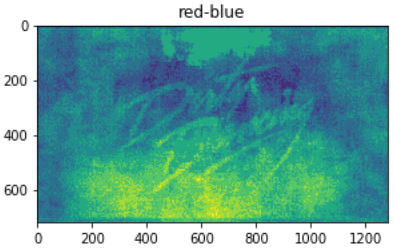
A

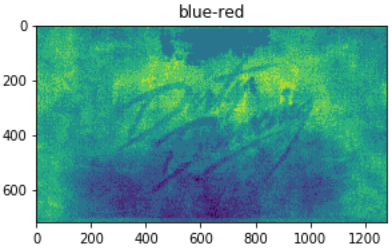


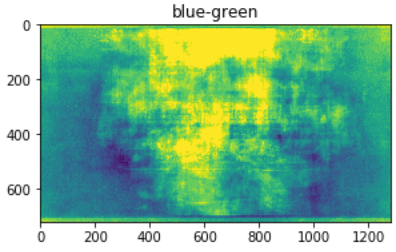


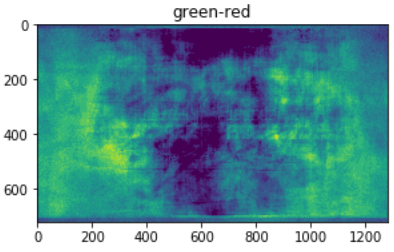
B











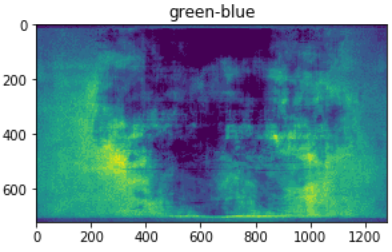


Figure 6. A) The final color agregation for all measured romance movies. Left image is the true final aggregate, right image is the enhanced image. B) Histogram of the original image with the luminosity value on the x axis and the pixel count on the y axis. C) Color subtractions of the original image to see color differentiation across the image. Higher values are yellow, and lower values are blue. Calculations made are stated above each image. Note that romance had the lowest number of films, this was largely due to romance films often having invalid shapes and had to be cut.

As expected, the results for romance movies show that the genre presents lower brightness than children's cartoons, but higher brightness than horror movies. This happens because romance movies use pastel shades like beige, pink and lilac to set up a warm mood in the scenes, which are much brighter than the dark shades used in horror movies to set up a frightening mood.

However, what makes romance movies interesting is the color variation focusing in the center of the frame. Unlike children's movies, which are generally bright across the entire frame, romance movies are bright almost exclusively in the center of the frame. This is probably because romance movies also want to draw your attention to the middle of the frame, much like horror films, but for very different purposes. Looking back upon the trailers, romantic movies want you to be looking at the characters that they are displaying, highlighting facial expressions and interactions between characters. Almost every frame of the romantic movies had a character or two in the center, it just lacked the hard, dark, outline that horror movies had. Thus, unlike children's movies that provided a large spectrum of stimulation, romantic movies were very intentional about where they wanted you to be looking and who they wanted you to be looking at.

Schedule

Original Schedule:

Sprint 1 - October 20th: Set up initial analyzer and begin testing different methods of analysis. By the end, have selected a final method of analysis.

Sprint 1 - November 5th: Finalize analyzer and begin gathering data on multiple movies.

Sprint 3 - November 19th: Comb through movies searching for commonalities among themes and ratings.

Final Presentation - December 4th or 6th

Revised Schedule:

Due to extenuating circumstances, we had to push the project back by two weeks and instead of having three sprints, we had two.

Sprint 1 - Creating single movie aggregator

Sprint 2 - An aggregator that can take several movies at a time together as well as data collection on several different films

Final Presentation - December 6th

Issues

An issue we faced was performing analysis on full movies. Complete movies were difficult to run analysis on for their large length and the amount of data we needed to store and then run tests against. We decided to mitigate this problem by operating our program on Movie Trailers, that way we can still see differences between the distinct genres.

We initially also faced issues when downloading the videos from the Youtube. Because we were using 2 different programs (https://www.onlinevideoconverter.com and https://www.apowersoft .com/online-video-downloader) the videos we were installing were in different formats and thus the results were unreliable. Afterwards we switched to using only the https://www.onlinevideoconverter.com in order to eliminate these discrepancies. In addition, some trailers only had an incorrect format. We found that these movies had a common problem, they were all older. This made many of the romantic trailers we selected, such as "Titanic" & "50 First Dates", unable to merge with the other trailers. We were able to get around some of these issues by finding remastered editions of the trailers, but even these would often have issues. In the end, we had to decide to just have fewer romantic movies.

Another issue we encountered was, after our first analysis of the trailers, we were left with just a gray image. To fix this, we enhanced the images through flattening. We also had problems formating the videos: when running our analysis on the trailers, we realized that if all the videos were not in the same format, we were unable to process the them. We solved this dilemma by converting all our trailers with the same video converter. This ensured that all our trailers were in the same format and we were able to continue our analysis.

Future

If we had more time for this project, we would have made a full website with several different options for the user. At the top of the website, there would be preprocessed movies of distinct genres to display the difference in color patterns to give the user an idea of what the website is used for. The user would be able submit a YouTube url of a movie or video and then the website would produce an image. The website would also produce some statistics about the image, such as the image's symmetry, diversity of color, if any areas have a large amount of a particular color, and general brightness of the image. A specific analysis we would perform is on the differences in color at the beginning of movie compared to at the end. For example, horror movies tend to be very bright in the beginning, and then get darker throughout the film.

For now we only looked at two movie genres: horror and children cartoons but we are also planning on extending the list to multiple genres and further look into the differences between them.

References

https://www.premiumbeat.com/blog/beginners-guide-to-frame-rates/
https://thecolorsofmotion.com
https://www.raymond.cc/blog/extract-video-frames-to-images-using-vlc-media-player/
https://s3.amazonaws.com/academia.edu.documents/38646306/colorassociation-students.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1538249225&Signature=SAmOI54q1w3dl550NXdGLEYNwMg%3D&response-content-disposition=inline%3B%20filename%3DRELATIONSHIP_BETWEEN_COLOR_AND_EMOTION_A.pdf

https://nofilmschool.com/2016/09/infographic-reveals-connection-between-color-and-emotion