Artitude: A Novel Art Database Exploration Experience

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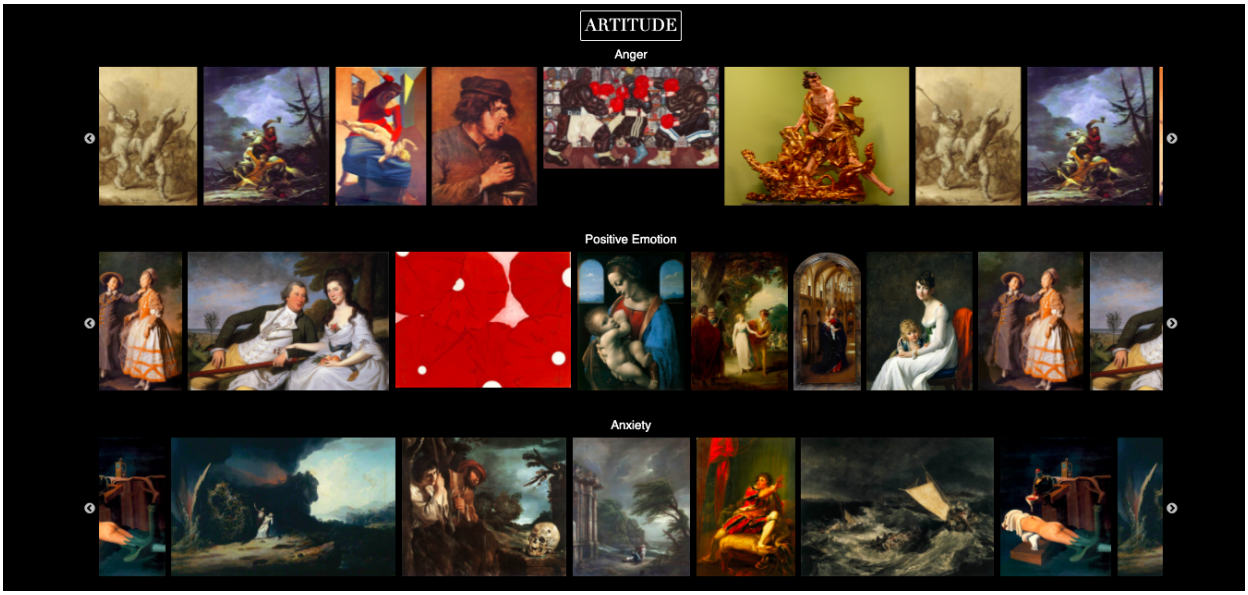

Fig. 1. A screenshot from our *Carousel* interface.

Abstract—In this paper we present *Artitude*, an interactive web application that creates a novel engagement with art collections. In contrast with presentations that organize art by genre, medium, or style, Artitude lets users visually organize a database of visual art in terms of a series of affect parameters that describe the emotional content of the artworks. We present Artitude's three main interaction methods, each of which provides a different type of guided navigation through the dataset. Our *Sliders* interface encourages users to explore the database by manipulating five sliders that correspond to five affect qualities (love, positive emotion, anger, anxiety, sadness). The *Carousel* interface provides a tour through a subset of art pieces with the highest emotional valence along one affect vector. Finally, our *Gradient* interface gives the user the ability to explore the affect space spanned by narrator-selected pieces of visual art. Together, these three methods act as a playful exploration mechanic that presents art in unexpected ways, showing serendipitous connections between diverse artworks within the collection. These serendipitous connections can increase a user's feelings of engagement and excitement. We describe the text analysis technology that enables our affect-based interactions, provide details on the three interaction methods, discuss the findings of an open-ended survey used to provide initial feedback on the project, and finally, we consider future directions and implementations for this work. This project is under active development at http://www.artitude.tech.

Index Terms—Affective visualization, visual art, exploration mechanic

1 Introduction

Artitude is an interactive project that investigates affective visual interfaces for art collections. The term "affect" refers to the psychological concept that defines an experiential response, for example, a feeling, an impression, a mood, or an emotion [25]. Affect is often understood in terms of positive and negative emotions that engage or repel, with arousal indicating the magnitude of an emotion. In addition to increasing emotional engagement, affective visualization has been explored to improve the understanding of scientific data and to communicate science to non-experts [8, 28]. Here, we more specifically use the term "affect" to denote various sensations and emotions evoked by art, and we use "affect vectors" as a way to describe qualities of artwork, which enables us to develop new interfaces that can provide a more meaningful visualization and deeper experiences than more traditional visualizations of archives, which tend to focus on either providing an overview of a collection, or on categorizing artworks solely by, say, genre or time period.

Our application presents three interaction methods, each with a different level of curation. The varying narrator (researcher) curation is designed to give the user more or less control when exploring a dataset through the emotional qualities that describe the art. More curation evokes a more passive feeling of a "guided tour", while less curation enables self-guided exploration. Art is often organized by genre, medium, or style. These methods have been used in museums, books, and catalogues to help viewers learn about historical events, art movements, and political ideologies. While these organization methods are practical, they lack surprise and playfulness. The design goal of

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Artitude is to provide exploratory interactions based fundamentally on the experience the art invokes.

In developing Artitude, we are motivated by the following research questions:

- How can playfulness and curiosity be incorporated as design values?
- Can technology be used to explore art by the way it makes us feel?

The contributions of this paper are:

1. We define a process for distilling affect vectors from art
2. We introduce an interactive application with three interactive modes that lets users explore art via its affective content
3. We provide initial results that suggests that users find affective interactions with art collections to be sensible, novel, and fun

Section 2 grounds our work in research done to design surprising, playful, and engaging interactions and novel retrieval methods. Section 3 discusses our development process and our technique for generating affect vectors associated with each piece in a database of visual art. Section 4 discusses our implementation methods and our three interaction methods, Sliders, Carousel, and Gradient. Section 5 discusses our metrics for success and the results from a survey taken by 19 undergraduate and graduate students in arts-related programs. Finally, Section 6 discusses future developments.

2 BACKGROUND & RELATED WORK

2.1 Digital Experience Schemas

Research in digitally augmented museum experiences is growing [20, 21]. New interactive experiences can be facilitated by developments in technology [17, 32]. In 2014, the Cooper Hewitt museum released the Pen, a digital device that has a stylus end for drawing on large tables in the museum, and a sensor end that reads NFC tags in object labels and uploads them to the web for viewers to access at home. The Pen was built following interaction principles "Make interactive experiences social and multi-player", "Give visitors explicit permission to play", and "Work in conjunction with the web and offer a 'persistence of visit'" [6]. Museums increasingly use technology to create experiences that continue after the visitor has left the building. For example, researchers at MUSEON in the Netherlands created data souvenirs to prolong engagement and that are intended to traverse the material-digital boundary [24]. Multichannel experiences have been developed by connecting to users through stationary kiosks, personal mobile devices like a smartphone or tablet [13], and allowing remote digital participation to mediate museum visitor experiences in real time [22]. Catalogs of interaction strategies have been developed that describe digitally augmented museum content strategies to create more meaningful experiences for visitors [26]. Continuing technological developments will further enable this trend.

2.2 Playful Interactions with Art

There has also been recent development in web applications, mobile applications, and data visualizations that provide information while also engaging the user emotionally [4, 11, 16, 31]. In March 2020, The Getty Center issued a "Quarantine Challenge": use household objects to recreate artwork from the Getty's Online Collection. Thousands responded, playfully reproducing Cézanne and Vermeer with pugs, gin, and toilet paper [33]. Many people posed in their re-creations, taking on the poses and facial expressions of the subjects and imagining themselves as the focal point of a piece of art. Similarly, Google Art & Culture released a Mobile application called "Art Selfie" - advertised as "a playful way to discover art" [1]. After installing the app, the user can take a selfie and the app will present the user with several similar faces from paintings, along with information about the art and where it's located [18]. Museums and Researchers have also partnered to develop virtual tours that allow the user to move through a physical space, and see art in context [5, 27]. As a way to expand digital engagement with visitors, the Los Angeles County Museum of Art has partnered with Snap, Inc. to combine photos of art from the collections with phrases from popular culture [10] and installations that use the sounds and look of Snapchat [14]. Virtual and digital experiences provide a way for users to playfully engage with art. Digital experiences have the ability to increase feelings of agency and interaction which can lead to an increase in feelings of presence [3].Artitude allows the user to experience affective content, which we hope will lead to increased appreciation and understanding of art.

2.3 Synesthesia Research

Synesthesia is a psychological condition affecting approximately 4% of the population [2]. Medically, it is a rare experience where one property of a stimulus evokes a second experience not associated with the first [2]. Recently, the term has begun to be used to explore cross-modal interactions and translating content between different senses [30]. For example, Forbes and Odai introduce Annular Genealogy, an interactive multimedia composition that conflates the aural and visual modalities [9]. While our project does not explicitly bridge sensory modalities, it does translate from one sensory modality, vision, into the profoundly different language of emotion and experience. The underlying technology used in Artitude was inspired by work in this area. Its interactive interfaces rely on technology for associating affect with images. Our mechanism of applying sentiment analysis to descriptive texts was inspired by work on 'deep synesthesia', which is the concept of using deep learning models to transform content between different input and output modalities. In particular, Shapiro et al. [29] uses textual descriptions of touch data to capture its affective content (the descriptions provided supervised data for a learned transformation), and a retrieval mechanism to translate haptic touch into lyric poetry. The retrieval mechanism found the closest match between the affective signatures of the touch input and of lyrics in a database of songs, while the mechanism used here returns the image whose affect most closely matches an affect vector obtained from the player.

3 DEVELOPMENT PROCESS

We created a technology pipeline to help us test our research questions. We began with the WikiArt Emotions Dataset, a dataset of art annotated with words describing viewers' emotional response to that art [19]. We applied the sentiment analysis application Linguistic Inquiry and Word Count (LIWC) to the textual annotations, which transformed them into a vector of numeric values representing the affective content of each art piece. We then built a retrieval function for visualizing images near to each other in the affect space. Finally we built a web application that presents navigational tools to the user, to help them navigate and visualize the dataset based on their own interests and criteria.

Our dataset was compiled from WikiArt and annotated by crowdworkers for the paper "WikiArt Emotions: An Annotated Dataset of Emotions Evoked by Art" by Dr. Saif M. Mohammad and Dr. Svetlana Kiritchenko. The annotated dataset we used has 4015 images of art representing 22 categories of art divided into 4 broad styles: Renaissance, Post-Renaissance, Modern, and Contemporary. Each piece of art was annotated by ten crowdworkers, and mechanisms were put in place to avoid malicious annotations [19]. The crowdworkers were presented with a set of 20 emotion words chosen by Dr. Mohammad and Dr. Kiritchenko. The words fall into three categories: "Positive emotions", "negative emotions", and "other/mixed". The full list of emotions can be seen in Table 1. The crowdworkers were told to annotate based on "all emotions that the image of art brings to mind" and "all emotions that the art as a whole (title and image) brings to mind" [19].

We transformed WikiArt Emotions Dataset into our desired format. We removed superfluous data and wrote two helper Python scripts to organize the data by Art ID and merge all emotion words into one column. We were left with an average of 57.125 affect words for each of the 4015 pieces of art. One of those pieces, "Boy Restraining a Dog" by George Harvey, is shown in Figure 2, along with the collected annotations (40 words) about this painting from the crowdworkers.

Table 1. The full list of emotion words for use in annotation in the WikiArt Emotions Dataset

Positive:	
	- “Gratitude”
	- “Happiness”
	- “Humility”
	- “Love”
	- “Optimism”
	- “Trust”
Negative:	
	- “Anger”
	- “Arrogance”
	- “Disgust”
	- “Fear”
	- “Pessimism”
	- “Regret”
	- “Sadness”
	- “Shame”
Other/Mixed:	
	- “Agreeableness”
	- “Anticipation”
	- “Disagreeableness”
	- “Shyness”
	- “Surprise”
	- “Neutral”

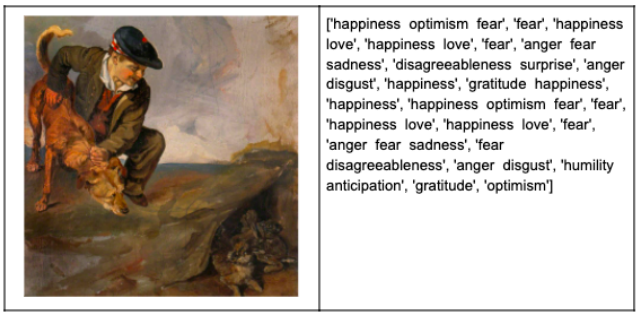

Fig. 2. An example image from our dataset: “Boy Restraining a Dog” by George Harvey and all crowdworker annotations. Descriptions from each crowdworker are separated by a comma.

We applied the text analysis application Linguistic Inquiry and Word Count (LIWC) to do sentiment analysis. LIWC is a proprietary hand-engineered model that analyzes an input text (small or large) and describes its content via a vector of numeric scores. The version that we used, LIWC15, is the most recent and analyzes pieces of text into (0-99) scores in 92 categories, which include 41 categories of psychological constructs. The psychological constructs category is further partitioned into affective processes (ex: anxiety), social processes (ex: family), cognitive processes (ex: tentative), perceptual processes (ex: see), biological processes (ex: body), drives (ex: power), time orientations (ex: past focus), and relativity (ex: motion) [23].

Using LIWC, we processed the crowdsourced content and generated data for all 92 categories. We then selected a subset of categories where the data has variation in each dimension, and the categories are interesting as a group. We aimed to have a majority of images in our dataset to map to a distinct vector, instead of many of them mapping to zero or identical scores . From the “affective processes” subcategory we chose anger, anxiety, positive emotion, sadness, and from the “drives” subcategory we chose affiliation (which we rename “Love” on the front-end of the website). For example, the resulting affect vector for “Boy Restraining a Dog” is Positive Emotion: 43.18, Anxiety: 20.45, Anger: 9.09, Sadness: 4.55, Love: 10.

4 IMPLEMENTATION & INTERACTION METHODS

4.1 Implementation

Our three user interaction methods are running on an EC2 instance on AWS, accessible at http://www.artitude.tech. We built the front end of the website using HTML, CSS, and JavaScript and deployed the application on a Flask server. The website includes an “About” section to share information about the motivation and purpose of this project, as well as how to navigate the site.

To explore our design values of playfulness and curiosity we built 3 interaction methods for retrieving images from our dataset and the corresponding user interface. These interaction methods are designed to give variable amounts of control to users. The less control a user has, the more guided of an experience they will have. This might ensure a positive experience, but will remove the sense of agency and exploration. The less structured interaction methods will allow users more control, so they might have a more playful experience, but also might be confused and or disappointed. We see playfulness as being associated with surprise, and so one technique we employ is purposefully omitting written directions on the website. We rely on symbols and other user interaction methods like borders and cursor changes when the user hovers over buttons [15]. This provides guidance to users, but does not explicitly inform users. We see surprise as being a non-negative disconnect between expectation and reality. Playfulness comes from an alternative space where components are not completely understood.

4.2 Sliders

We use the affect vectors generated by LIWC and retrieve the piece of art that most closely matches the affect provided by the slider values. That match is calculated with even weights on each 0-99 valued field. The function for our lookup process is shown in Equation 1.

$$TargetImage = \arg\min_{i\ \varepsilon\ images} \sum_{j}^{5} F_j(i) - S_j)^2 \qquad (1)$$

Here, S is a vector of affect values specified by sliders, while F(i) is the affect vector associated with image i, and j is the number of fields in the affect vector.

Each slider represents the value of one emotion expressed as a whole number from zero to the highest value of the emotion in our WikiArt dataset. Although each emotion field has a potential range of 0-99, as designated by LIWC, we modify the range of the sliders to range from zero to the highest value in the dataset to reduce the likelihood that the user will move a slider and not see a change in the resulting image. Each time the user moves a slider our lookup process runs and the closest image in our dataset is retrieved. The array of slider values, the affect values of the returned image, and the file name of the returned image, are also returned about the result image and the slider section. Examples of output from the slider section are seen in Figures 3 and 4.

4.3 Carousel

We built five carousels to present a more guided experience through a section of our database. On this page, the user is presented with five carousels that showcase the 15 artworks with the highest affect vectors for each emotion. The user can use buttons on the left and right carousel to view the images in a loop. This provides relatively little control for the user to explore the database, as the affective categories and images are preselected. However, the carousel allows users to choose the exploration order, within a curated experience containing images with the most intense content for each emotion. The five carousels are shown in Figure 5. We have the ability to influence the user experience by selecting carousel axes and images. We currently present the highest affective content along one emotional dimension, but we can expand this interaction method to present content along a combined axis, like low anxiety/low love, to high anxiety/high love.

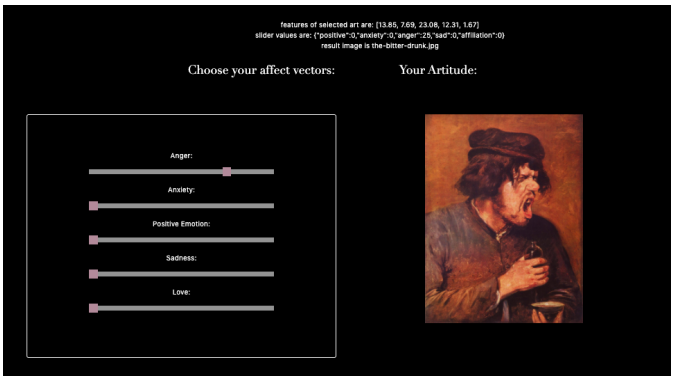

Fig. 3. A screenshot of a result image from our Slider interaction method. The anger slider value has been moved to 27 and the other sliders remain at zero. These slider values return "The Bitter Drunk" by Adriaen Brouwer. This is the image in our dataset that most closely matches the affect profile defined by the slider values.

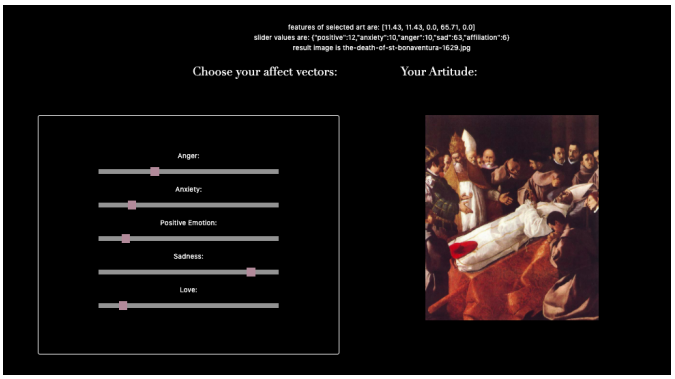

Fig. 4. A screenshot of a result image from our Slider interaction method. The slider values for sadness has been moved to 63. The result image is "The Lying-in-State of St. Bonaventura" by Francisco de Zurbarán. This is the image in our dataset that most closely matches the affect profile defined by the slider values.

4.4 Gradient

Our third interaction method is a progression illustrating incremental movement towards an anchor image. The page contains a result image between two anchor images arranged in a line, and controls for feels-more-like-this (accessed by clicking on the anchor). Clicking on either anchor image increments or decrements a coefficient, which we use to interpolate between the affect vectors associated with the anchors. To explore the affective space that the two anchor images span, we index the resulting affect vector into the database (by equation 1) and display the retrieved image at a position interpolated between the anchors. As a result, the physical position of the target image encodes the relative similarity of its affect to the affect of the two anchors. We include a button below each anchor image with a refresh icon. If the user clicks on either button, the corresponding anchor image is replaced with a random anchor image, and the result image is moved back to the center.

An example series of art from the gradient interaction method is shown in Figure 6. This represents an exploration and visualization between an artwork with a high positive emotion affect value, and an artwork with a high sadness affect value. The left anchor image is "Hip, Hip, Hurrah!" by Peder Severin Krøyer. This paining has the affect vector: Positive Emotion: 85.03, Anxiety: 1.02, Anger: 0.0, Sadness: 2.04, Love: 16.84. The anchor image on the right is "King Lear Weeping over the Dead Body of Cordelia" by James Barry. Its affect vector is Positive Emotion: 0.0, Anxiety: 21.43, Anger: 4.76, Sadness: 59.52, Love: 0.0.

5 USER FEEDBACK & DISCUSSION

As we developed our prototype, we wanted feedback from users, but were not sure how to evaluate an interactive experience of this kind. We began by developing a list of questions to gather initial user responses:

1. Do users perceive the association of images with affect as reasonable?
2. Is affect based interaction playful? Surprising? Novel?
3. Does affect based interaction expose users to new artwork they might not have encountered?
4. Does affect based interaction increase user's appreciation of art? (e.g., their understanding of art in context).

To focus on answering our initial research questions, we designed a survey to answer questions 1 and 2. However we are also interested in exploration questions 3 and 4 in our future research as we believe that insights gained from answering those questions can help us contextualize questions 1 and 2. We gathered feedback from 19 undergraduate and graduate students at the University of California, Santa Cruz. We asked the users to explore the website for about ten minutes, and then answer some questions. Because we rely on feedback from ten crowdworkers to create our affect vectors, there is a possibility that there will be a disconnect between a user's opinion of an art piece and the affect vector. To gather data on this, we asked users "Did the affect (emotion) values associated with the artworks make sense to you?". 21.1% of users responded "Yes, Definitely" and 73.7% responded "Yes, Somewhat". This supports our intuition that technology can be used to explore art by the way it makes us collectively feel. Additionally, 63.2% of users thought the result images returned in the Slider experience made sense based on the slider positions. We also hoped to understand the emotional impact of this project on users. When asked, "What words do you associate with this project?" 89.5% of users said "Playful" 68.4% said "Novel" and 36.8% said "Surprising".

The user survey we presented also illustrated flaws in our initial design. In general, users seemed intrigued by the Gradient interface, but were confused by the purpose. One user wrote that they "needed a bit more guidance", while another said "I would like a bit more context on the gradient, and what it represents/is supposed to do." This lack of clarity could be attributed to the lack of user interaction cues and button labels on the page. Overall, many users responded positively to the project:

- *Sliders was the most interesting to me and almost game like. It clearly showed how emotionally complex artwork is and brought it to a very human and personal level.*
- *What your site is is a way to look into the human experience and demystify, as well as categorize the emotional origin of these paintings*
- *Playing with the sliders also got me to reflect on why this particular work of art might be tagged with these emotions at these levels, which led me to engage with the art on a deeper level*

These initial results indicate that it is possible to explore art by its affective content, that the mapping from textual annotations to affect underlying the interaction makes sense to new users, and that the users find this method of exploring a database of visual art interesting, novel, and fun.

6 CONCLUSION & FUTURE WORK

As we continue to refine this project, we will develop larger experience with multiple slider, carousel, and gradient interactions, place them on the web, and refine through user feedback. We will also work with Human Computer Interaction researchers to better understand the impact of our design choices.

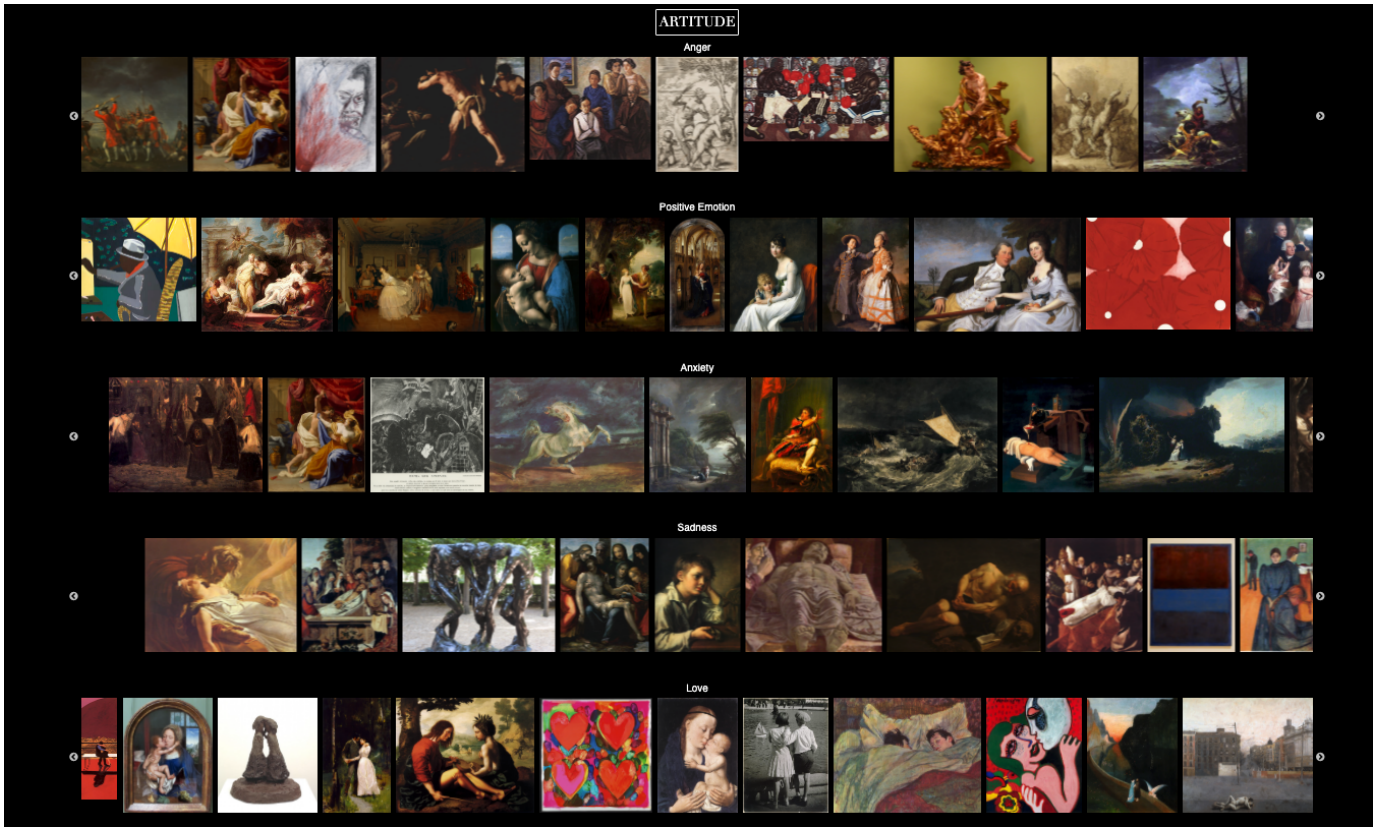

Fig. 5. A screenshot of our carousels for each of our five emotions. The fifteen images with the highest affect values for the affect are shown.

6.1 Style Transfer

We plan to expand the user experience with Artitude into the creative realm. Instead of exploring artwork accessed by its affective content, the user will be able to modify the affective content of artwork. This provides a new way to appreciate the emotional qualities of the artwork and generate new meaning. A possible implementation for this is a novel form of style transfer. Style transfer is a technique that utilizes neural networks to combine style elements from one image and content elements from another image to produce an image that preserves the content of the first image and applies the style of the second [12]. The user will select a starting image to serve as the content, and will use the sliders to choose an image and affect mapping to serve as the style. It seeks minimal changes to the seed image that share as much "style" with the source as possible. We imagine that this could be useful for casual creators as this will allow users to play with the emotional content of art they create [7].

6.2 Expanded Dataset

We hope to extend our current functionality by employing machine learning to discover a mapping from image content to affective content. In principle, this mapping would let us work with images that lack descriptive text, and develop experiences that explore new categories of imagery by its affective content (from paintings and photographs, to architecture, furniture, and shoes). One approach operates by analogy with the touch to affect work by extracting a compact image representation from a prebuilt image processor and learning a mapping from that representation to an affect vector. We can train this model on our current dataset of image, affect vector pairs [29].

6.3 Conclusion

In this paper we have presented Artitude, a novel image database visualization technique. We use our learned image to affect maps to build 3 interaction modes to allow our users to visualize connections between similar and dissimilar images by emotion. We present our results from a preliminary survey taken by 19 undergraduate and graduate students at the University of California, Santa Cruz. We consider future directions for this work, including a novel version of style transfer and a learned mapping for new artwork, which will allow us to extend our dataset. The project code is available at https://github.com/sarahmfrost/artitude.

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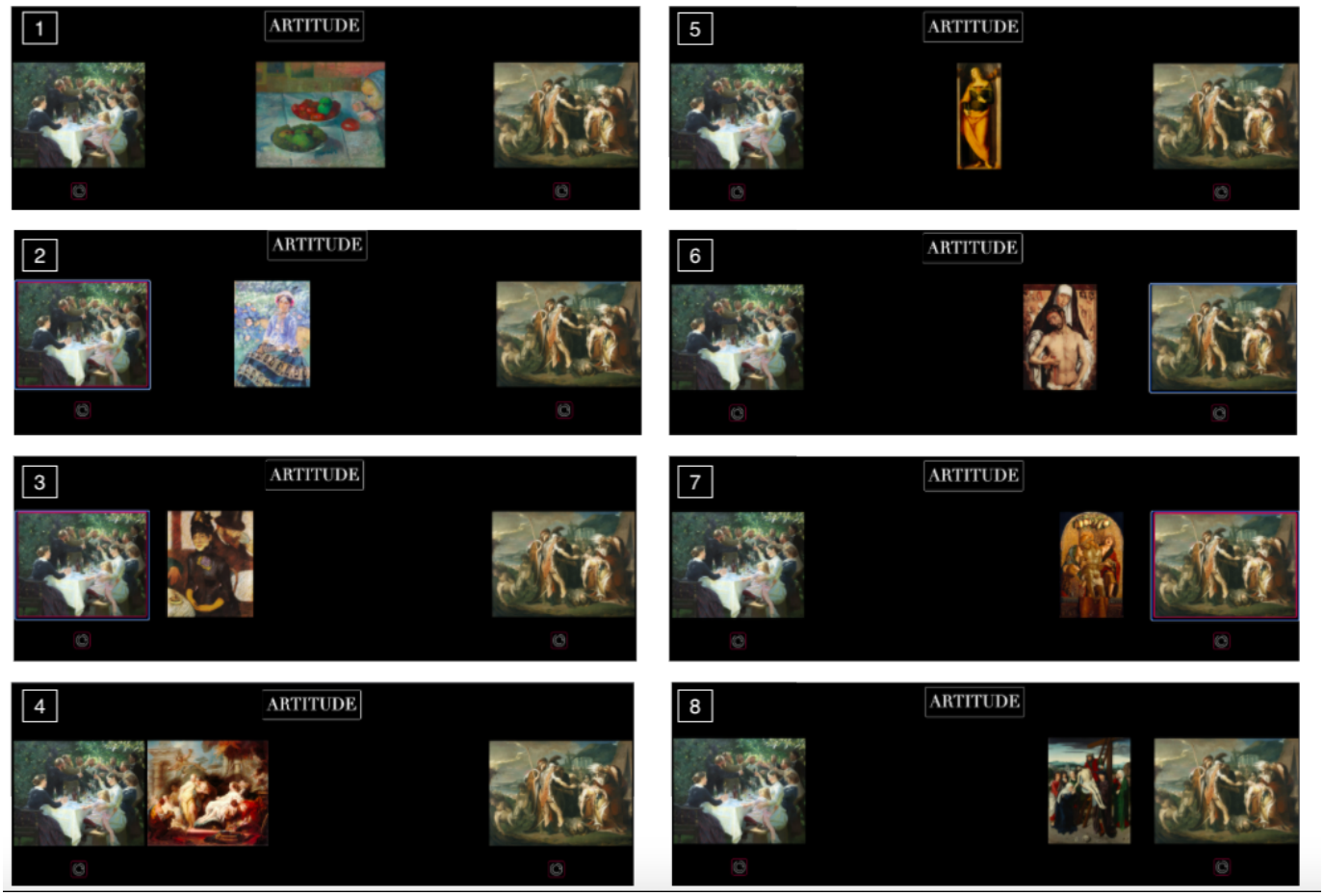

Fig. 6. A compilation of eight screenshots from the gradient interaction method. This is a sequence of images that the user might see. The upper left image, 1, is of the two anchor images and the result image. Images 2, 3, and 4 are the result of the user clicking on the left anchor image. Images 5, 6, 7, and 8 are the result of the user clicking on the right anchor image.

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