



# THE CLOSE-UP CLOUD: VISUALIZING DETAILS OF IMAGE COLLECTIONS IN DYNAMIC OVERVIEWS

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**ABSTRACT** | This paper introduces a visualization technique designed to uncover iconographic patterns prevalent within a collection, while at the same time preserving the details afforded by close looking. This process is designed to challenge the traditional understanding of these two models of viewing--overview and detail--which are often taken to be structurally opposed to one another. Digitization efforts have led to a growing number of rich cultural heritage datasets that are available online. At the same time scholars are exploring the potential of computational methods to expand the scale and scope of art historical research. In this context, data visualization is often equated with (and criticized as) a distanced perspective that diminishes the intricate and intriguing details of individual artifacts. In collaboration with a museum of applied and decorative arts, we have devised a novel interface concept for the exploration of image collections whose details are often left out of digitization initiatives as a result of the challenges they pose to scanning, in this case historical glass plate negatives. Inspired by photographic plates on a light table, the Close-up Cloud translates the art historical method of close viewing into a digital interface by combining it with a dynamic representation of quantitative iconographic patterns within an entire image collection.

**KEYWORDS** | data visualization, cultural heritage, distant viewing, user interface, photography

## Introduction

As cultural institutions have been digitizing their collections, scholars have also been investing considerable effort into the tagging of images to denote iconographic details and (art) historical context. These developments have led to an increasing number of rich datasets of cultural heritage that are successively being published online. As image recognition<sup>1</sup> and information visualization<sup>2</sup> emerge as promising research methods in digital art history, art historians seek to explore the potential of computational methods for expanding the scale and scope of art history.<sup>3</sup> These digital methods tend to be equated with a distanced, remote, or 'macro' perspective on the phenomenon.<sup>4</sup> As a result, many visualizations of collections provide high-level overviews that diminish the intricate and intriguing details of the individual artifacts.<sup>5</sup>

This paper introduces the Close-up Cloud (<https://uclab.fh-potsdam.de/closeupcloud/>), a visualization technique designed to uncover iconographic patterns prevalent within a collection while at the same time allowing close viewing of

these iconographic details. Challenging the understanding of overview and detail as inherently opposed, the intention is to account for iconographic abundance of a collection and encourage its casual exploration guided by visual cues.

For this work, we collaborated with the Museum für Kunst und Gewerbe Hamburg, a museum of applied and decorative arts, to devise a novel interface concept for the exploration of its collection of historical glass plate negatives. Inspired by experiencing the glass plate negatives on a light table, the Close-up Cloud translates the art historical method of close viewing into the digital by combining it with a dynamic representation of quantitative iconographic patterns across an entire image collection.

## Related work

Our work follows from prior research on information visualization for digital humanities, especially art history, as well as recent work on visual interfaces for cultural collections. Digital humanities, as a growing academic discipline, has

traditionally focused on the analysis of written language.<sup>6</sup> As a result, the digital humanities tools optimized for information visualization and other data science methods are mostly centered on documents and textual sources. Nevertheless, fields that deal with visual culture are only slowly making use of computational analysis.<sup>7</sup> To do so, they must grapple with the features that differentiate pictorial notation from other forms of data; images are specific and significant forms of knowledge<sup>8</sup> and are defined by an iconic difference “that emerges from the juxtaposition of the whole image and its [iconographic] details.”<sup>9</sup>

Annotating images with keywords that describe their iconography and other visual elements is a process that is interpretative and destructive at the same time, as “many elements of the image are lost in this description.”<sup>10</sup> Keywords allow the representation of images in databases further processing and comparison. Yet, textual reduction does not capture all information contained in an image. As Tilton and Arnold point out in their description of the “semantic gap” of images.<sup>11</sup> Thus, visualizations of cultural collections that focus on the textual metadata represent only those parts of a collection that were translated into text.

An approach that proposes a different method of interpreting images is the field of cultural analytics conceptualized by Lev Manovich.<sup>12</sup> In contrast to other digital humanities approaches, cultural analytics focuses *directly* on the images and their visual features. Direct visualization, a method within cultural analytics, constitutes a visualization technique that plots hundreds of images contained in cultural collections according to both visual and non-visual features.<sup>13</sup> Arguably, direct visualization “supports both close reading, selecting an individual image to examine, and distant reading, where one can view a whole set of paintings at once.”<sup>14</sup> While color patterns across a collection may become visible in the distant views of direct visualizations, they tend to reduce images to tiny thumbnails or even individual pixels, arguably restricting their qualitative and interpretative potential.<sup>15</sup> Thus, close and distant perspectives remain separated in this approach, as the scholar needs to decide which perspective they want to pursue at a given moment. Furthermore, direct visualizations often focus on low-level features of images such as color, hue and brightness.<sup>16</sup> Instead, traditional (digital) art historical inquiry is mostly centered on semantic aspects of cultural heritage by examining iconography or style of artifacts. For example, Meta-Image<sup>17</sup> follows the iconographic tradition by isolating motifs in images and comparing them with each other.<sup>18</sup> Many projects situated within this tradition refer back to Aby Warburg, who developed this approach in his Mnemosyne project in the 1920s.<sup>19</sup>

The application of digital tools in the humanities is also accompanied by a critical discourse around the digitization

of art history.<sup>20</sup> Johanna Drucker highlights that humanities scholars engaged in digital art history should not simply adopt computational tools from the STEM fields but should instead preserve a critical stance that optimizes interpretation and identifies ambiguity.<sup>21</sup> In this context, Arnold and Tilton’s framing of distant viewing as interpretation<sup>22</sup> is interesting insofar as it not only provides an important perspective on image quantifications in the digital humanities, but also challenges the understanding of distanced perspectives as inherently objective.

Besides scholarly uses of collection visualizations, there is growing interest in interfaces for casual visualization of cultural heritage data, which has become a dedicated research area in itself.<sup>23</sup> These interfaces are designed to publically mediate cultural heritage, allowing participants to ‘browse’ a collection. In spite of the efforts of many museums digitizing their collections and making them available online, less effort has been put into developing meaningful ways of presenting them. Yet, there has been considerable research on overcoming ‘ungenerous’ search-based interfaces. In this context, interdisciplinary teams of cultural scholars and experts in information visualization devise novel ways of visualizing digital cultural collections.<sup>24</sup>

While museum websites tend to have an information architecture characterized by “one-way streets,”<sup>25</sup> specialized information generated for internal use by museum experts is still exposed with little guidance for those unfamiliar with classification systems.<sup>26</sup> In contrast, the concept of ‘generous interfaces’ suggests an inviting approach to publishing collections as interactive visualizations<sup>27</sup> that allow for ‘rich-prospect browsing’<sup>28</sup> and serendipitous discoveries.<sup>29</sup> For example, the Manly Images interface provides an overview of a historical photo collection by revealing samples within a tabular visualization.<sup>30</sup> The sample images act as proxies for the entire collection and the tabular layout clustered by decade or frequent terms provides a high-level overview. Zoomable visualizations of collections can convey an overview of temporal and topical trends in a collection and provide access to visual details of objects.<sup>31</sup> However, the close and distant perspectives remain mutually exclusive as collection interfaces tend to separate high-resolution imagery and high-level overviews.

Famously prioritized in Shneiderman’s visual information seeking mantra (“overview first, zoom and filter, then details on demand”<sup>32</sup>), the notion of overview has been widely discussed—and largely accepted—in the realm of information visualization. The overview may privilege an information space, a phase or outcome of analysis work, a technical visualization component, or a specific aspect of an information space.<sup>33</sup> The idea of an overview representing an entire collection can be contrasted with the role of the preview, which

“acts as a surrogate for a single object of interest.”<sup>34</sup> While the long-standing primacy of overviews is being challenged by alternative concepts such as monadic views<sup>35</sup> and ‘innerviews,’<sup>36</sup> we seek to investigate the seemingly paradoxical potential of overviews to reveal details of collection artifacts.

## Towards a new overview

Our research aims to devise a kind of overview that does not distance the viewer from a collection, but rather invites them to appreciate and explore the details of the artifacts. To pursue this ambition, we formed an interdisciplinary team with backgrounds in design, media studies, and computing. First, we reflected on current approaches to display cultural collections and the kinds of interactivity and forms of visual representation they offer.<sup>37</sup> While many visualizations of cultural heritage data already feature a combination of overviews and previews, there is no interface that actually guides the viewer towards the details of the individual images. Through establishing a collaboration with the Museum für Kunst und Gewerbe Hamburg we were able to pursue these ideas with a collection of historic glass plate negatives. Our intention was to carefully consider the specific mediality of this collection to inspire new interface concepts that break out of the monotony of search-oriented interfaces<sup>38</sup> in turn supporting casual and curious exploration.<sup>39</sup>

We set ourselves three main design goals (DG1-3) that informed the subsequent research:

1. **Guide the viewer to details.** The visual representation should highlight specific details of the collection objects and create awareness for their iconography. High-resolution images should be made available to encourage viewers to spend more time observing the individual object and its aspects.
2. **Expose the unique character of the collection.** Every collection is different and the visualization should reveal the specificity of the collection by representing the thematic and aesthetic patterns across the different objects.
3. **Support open-ended exploration.** Based on what ‘speaks to the eyes,’ the visual interface should allow for different user paths through the collection. Akin to associative thinking, the interface should be an invitation to a journey at varying granularity, linking visual patterns across the entire collection within the details of individual objects.

To begin, we organized a co-design workshop and invited the museum expert familiar with the collection. All collection items were printed out and the participants were encouraged to create their own arrangements from the abundant

collection.<sup>40</sup> In the presentation of the individual arrangements, the first experimental ideas grew, and we developed perspectives on the collection that reflected our varied backgrounds in museum and media studies, communication, and interface design. In a second meeting, we visited the museum to learn more about the collection’s specifics and to physically encounter some of the 1700 glass plate negatives. Haptically experiencing the physical objects, viewing them on a light table that brought the details of the depicted objects to the fore, fascinated the entire team and structured the subsequent design of the final interface.

## A collection of historic glass plate negatives

The first employee of the Museum für Kunst und Gewerbe Hamburg was Wilhelm Weimar, a draftsman. He began to document the museum’s collection in 1883, initially by making sketches and (from 1897 onward) through photography. Weimar acquired the technique autodidactically, but his eye was trained to set three-dimensional art works to stage. Besides his daily work, he also established a new focus on the medium of photography. During this career transition, he also began to collect daguerrotypes, which had already come to be seen as historical artifacts by 1900. As a result, the museum has one of the earliest photographic collections in Germany, which Weimar built up.<sup>41</sup>

Weimar’s main task from 1897 until 1915 was to photograph the decorative art objects and today, around 1700 glass plate negatives in three different sizes exist. The largest plates in the collection measure 18x24 cm; they form the largest part of the collection (around 1000 plates). These plates were digitized in the last three years and are housed in the collection of the Department of Photography and New Media. Besides documenting the collection, the negatives give insights on the tools Weimar used, and they additionally reveal his aspiration to produce objective images (“ein getreues Abbild der Natur”<sup>42</sup>). The quality of these photographic art reproductions was always important to him and he emphasized that the negatives should be as accurate as possible.<sup>43</sup> A long exposure time created very sharp and well-illuminated shots. Not only the retouched prints but the negatives themselves are valuable museum objects. They have turned from working material into collection objects in their own right. Besides their materiality, their historical claim to objectivity contributed to their reappraisal.

As the photographs served as proxies for real objects and the depicted artworks were seen as examples of good design for craftsmen, it was important that the photographs made the ornamental details visible. Weimar focused on the plasticity of the objects and did not uncouple the ornament

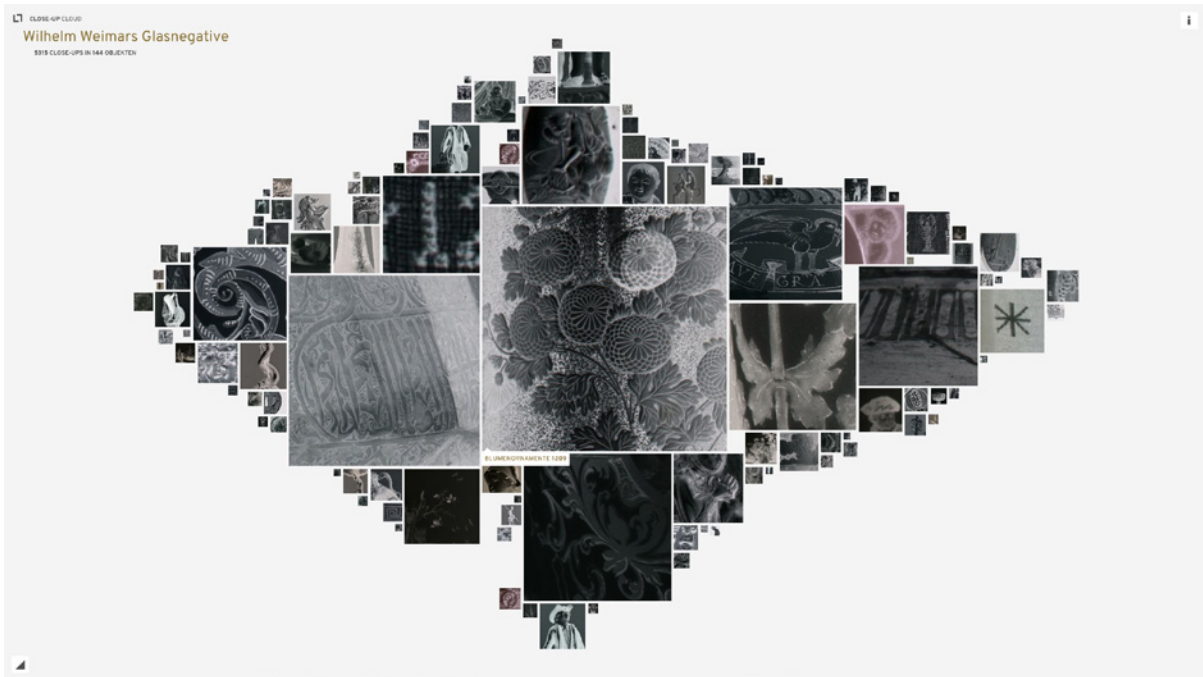


Figure 1: The Collection view features a cloud of close-ups. Hovering over a close-up displays the respective tag and its frequency within the collection. For instance, the tag “Blumenornamente” (flower ornaments) occurs 1209 times. The size of a given close-up represents the frequency of the respective tag across the collection.

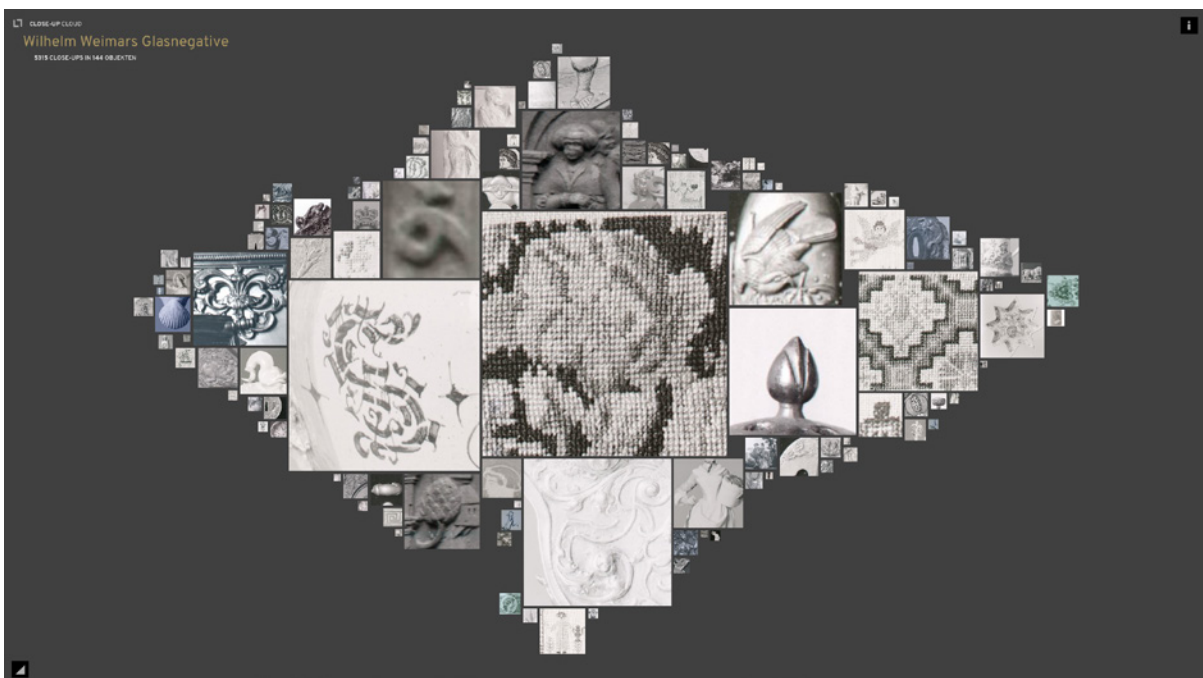


Figure 2: All stages of the Close-up Cloud can also be explored in an inverted mode featuring a darker background and the positive versions of the glass plate negatives.

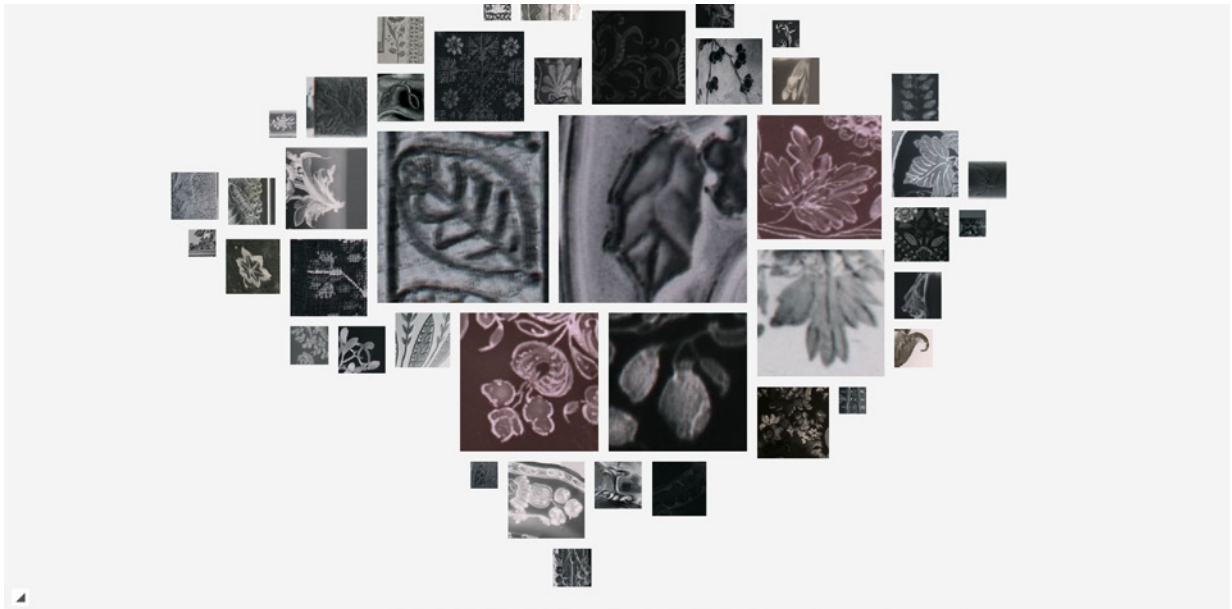


Figure 3: The Tag view displays all glass plate negatives annotated with the same tag (in this case "Pflanzenornamente") in a new cloud-like arrangement. The size of a given close-up represents the relative frequency of the tag for this object.

from shape and function.<sup>44</sup> As he photographed only with daylight, the objects are shown with a light shadow on the negatives. The sharpness of the high-quality negatives reveal many details of the decorative art objects.

During the digitization process, the museum expert tagged the images with descriptive iconographic terms from a controlled vocabulary, of which many refer to specific details of the art works. For the visualization, the museum expert selected 144 glass plate negatives. They represent a proportional distribution of the museum departments and their artworks that Weimar photographed for the museum's art reproductions. The visualization shows glass plate negatives that depict objects from Ancient Art, European Decorative Arts and Sculpture, East Asia, Islamic Art, Art Nouveau, Fashion and Musical Instruments.

During the various exchanges with the museum, it was the combination of the rich visual imagery of the objects depicted in the negatives and the detailed iconographic tags that informed and inspired the visualization design process.

## An overview of details – Combining close and distant viewing

The Close-up Cloud features three views: Collection, Tag, and Object view. While illuminating different characteristics of the collection, the three views are designed to support both horizontal exploration and vertical immersion.<sup>45</sup> Central to our technique are the iconographic tags that we manually linked to specific regions in the respective images and created digital crops that serve as close-ups. We devised an overview of details that combines the quantification and visualization

of iconographic details with the possibility of a close viewing of these details, thus, focusing on the semantics of image collections.

The initial stage of the interface, the collection view, provides a high-level overview of the selected 144 negatives (see Figure 1). This overview does not display the collection's full images, but a cloud of extracted close-ups, sourced from the iconographic tags connected to the originating images. Akin to word clouds that represent tag frequency as font size, the area size of a close-up image represents the respective tag's relative frequency within the collection and creates an "abstraction of primary objects"<sup>46</sup> [DG2]. Without requiring any user interaction, this view progressively exposes the entirety of tagged close-ups in the collection,<sup>47</sup> as each visual representation of a tag holds an array of all close-ups belonging to the tag. Over time, each depiction is replaced by another, continuously creating new collages of details. With no need for interaction, one can already make sense of the collection through "passive contemplation".<sup>48</sup> It is possible to zoom into and pan around the interface, which allows examination at various desired granularities. Hovering over one close-up reveals a tooltip with the tag itself and the number of close-ups for this tag in the collection.

An icon in the lower left corner allows the inversion of the colors of the glass plate negatives, converting them into positive images that correspond with human viewing habits (see Figure 2). In this inverted mode, the background color of the interface changes to a dark gray that is inspired by Weimar's photographic experiments with different gray backgrounds.<sup>49</sup> Clicking or tapping a close-up removes all other images from the display, leaving only the selected one, which subsequently moves to the center before the interface shifts into the tag view.



Figure 4: The Object view reveals the originating image.



Figure 5: Hovering over a tagged detail highlights all details annotated with the same tag.

The selected image transitions into the Tag view (see Figure 3). Clustered around the chosen close-up, other depictions of the tag spread out and position themselves in another cloud-like arrangement. Here, each image represents one group of close-ups, originating from the same source. In the tag view, the area assumed by an image represents the number of instances of this tag in a source. This number is reflected in the tooltip along with the title of the glass plate negative. The data in the top left corner indicates the number of close-ups and objects belonging to the selected tag. Selecting a close-up will lead to the Object view, through a transition that is initiated by moving the image to the center of the display.

All close-ups belonging to the selection spread out from the center and move to their coordinates in the original image. The image is faded in only after the transition of the close-ups is finished and subsequently reveals the context of the selected close-ups. The previously selected tag and its close-ups no longer serve as metonyms of their source,<sup>50</sup> but are re-embedded into its original context (see Figure 4). The viewer is now encouraged to connect recurring collection patterns with their instances in the originating image. Akin to the other views, the Object view can also be zoomed and panned, giving the viewer the facility to contemplate the object at any desired granularity [DG1]. These interactions can expand the image to fill the complete size of the canvas, and in this way, maximize the level of visible detail. In the top left corner of the screen, the title of the selected glass plate negative is displayed. A number below the title indicates how many close-ups occur in this image. Hovering over a tagged area highlights every close-up with the same tag by setting all other parts of the image as semi-transparent (see Figure 5). The hovering also displays a tooltip with the tag for supporting the viewer in identifying the details.

When clicking on a detail, the viewer is directed to the respective Tag view. Since all stages are interconnected, transitions between them are gradually animated, and an open-ended exploration of the collection thus becomes possible [DG3]. When clicking on parts of the image where no detail is tagged, all close-ups are briefly highlighted, guiding the viewer towards the details of an image, which also act as portals to related objects [DG1].

An icon in the lower right corner provides access to object information in the form of a list of metadata fields belonging to the glass plate negative (such as title, photographer, location and date). Through a link in the column, the user can open the museum's collection website to the page with the respective glass plate negative.

The prototype is implemented in the form of a web-based application using the JavaScript libraries Vue.js as the application framework, PixiJS for animated and interac-

tive graphics, and D3.js for force-directed layouts.<sup>51</sup> For the purpose of prototyping, the interface was first developed for a desktop screen with a minimal resolution of 1280 by 720 pixels. Later, the application became responsive to different screen sizes and also gained basic support for touch input. The cloud layout is a physics simulation of 2D squares with varying sizes that share a common point of attraction at the center of the screen. Before the simulation starts, all close-ups are initially placed on an outward spiral path, originating at the center of the screen. The close-ups are ordered by size, putting the largest ones in the center of the screen. The further the spiral path advances, the smaller the close-ups will get. The aspect ratio of the screen is included as a factor in the initial positions, in order to adapt the layout to landscape and portrait orientations. The layout generation is not pre-calculated, and generates different cloud layouts for every visitor with a slight random factor. Unlike typical force-directed layouts, we chose not to animate the layout's iterative generation to let viewers focus on the visual details in the close-ups.

## Feedback

A central aspect of our research process is iterative co-design, during which prototyping and testing alternate. In order to validate the merit of an 'overview of details,' assess its potential for exploring cultural collections, and suggest possible improvements, we solicited ten participants; five professionals with expertise in museology, photo collections, information visualization, photography, and museum education and five interested laypeople. We met the participants in person for sessions of about thirty minutes, divided in two parts: a ten-minute exploration of the prototype applying the talk-aloud method<sup>52</sup> and a semi-structured interview lasting about twenty minutes. Apart from a range of refinements, the version used during the feedback interviews lacked animated transitions between the views.

In general, all participants understood that the Collection view showed extracted fragments of an entire image with the purpose of highlighting details. Many participants referred to the predominant imagery focus as "appealing" and described the Collection view as "well structured" and "organized." While some of them started by searching for more information about the collection, most of them commented that they started to follow an "associative logic." Regarding the design choices of the interface, the textual descriptions of the close-ups were appreciated, since some of them were too abstract or hard to identify due to the framing and visual decontextualization. The information hierarchy and the fact that the entire single object could be seen in the third view generated mixed responses. While one participant considered the approach "innovative" and many enjoyed the "accidental" discovery of the collection, another participant found this procedure



irritating and others were frustrated after encountering a repeated or a previously seen object.

One prevalent reaction in both groups of experts and laypeople was an appreciation of the high quality of the digitized glass plate negatives and the possibility to examine them from very close using the zoom-in function in the Object view. While browsing across different objects, some participants highlighted the efficiency of the tags in guiding the eye to details, which would have been missed otherwise. One expert reported that she felt encouraged to spend more time looking at the tagged details of the object, but would be even more interested in creating new tags herself.

In regard to potential users of such an interface, two main groups were mentioned. Considering the “accidental” discovery of the single objects and that no prior knowledge is required to navigate through the interface, the tool was deemed to be attractive for members of the general public interested in art collections. In addition, participants noted that the quantitative approach (combined with the strong thematic association generated between distinctive objects) would be of interest to art historians or other experts researching iconography. Furthermore, according to one expert, the overview of the collection’s thematic diversity, not only highlights its prevailing themes, but also raises awareness of uncommon and “marginal” motifs.

## Discussion

The evaluation of the first prototype allowed us to test whether our design goals had been reached and to implement new features in the second iteration. In the following, we reflect on the realization of our three design goals.

The first design goal (Guide the viewer to details) that aimed at raising awareness of the iconographic abundance of the collection has been accomplished, as the feedback from the evaluation suggests. In our approach towards the overview, we strove for a combination of qualitative and quantitative elements. Arranging the close-ups into a frequency-based collage provides quantitative information about the entire collection. However, the quantification of the collections’ iconographic details results in an accentuation of the most occurring ones. Less frequently occurring details are literally pushed to the margins of the Close-up Cloud, a well-known phenomenon in other visualizations.<sup>53</sup> Furthermore, viewers can only experience the collection along the parameters of a standardized and controlled art historical vocabulary, which determines the details of an image that can be tagged and subsequently explored. The perspective on the iconography of the collection that the Close-up Cloud affords should therefore be understood as one particular interpretation of the collection.<sup>54</sup>

The second design goal (Expose the unique character of the collection) was realized by working closely with the museum expert, therefore ensuring “cultural sensitivity”<sup>55</sup> throughout the design process. The inspiration for the design of the Close-up Cloud was largely drawn from the experience of seeing glass plate negatives on a light table. In the process of creating the close-ups, we decided to work with a specific selection of the initially provided tags. Even when revealing unique characteristics of the collection, “abstract” tags that cannot be linked to specific image coordinates in the depicted art works, were removed. In addition, tags that include the entire object are excluded. The visualization highlights details of the depicted objects but not the object of the glass plate negative itself. Five out of ten participants in the evaluation wondered about the different gray-tones of the negatives in the Collection view. This indicates that there is a need for more information introducing the collection and a stronger focus on the specifics of the glass plate negatives themselves.

The third goal (Support open-ended exploration) was generally confirmed by the evaluation results. Yet, critical feedback suggested including more hints on interaction possibilities to prevent frustration. Following these remarks, we specifically focused on improving the affordances of the interface in the second iteration for enhancing open-ended exploration.

## Conclusion

With this work we have presented an approach towards visualizations of cultural collections that seeks to overcome the supposed incompatibility of overview and detail. Widespread digitization efforts of cultural institutions have resulted in the emergence of digital collections containing high-resolution images, often rich in iconographic details. However, the majority of cultural institutions do not yet grasp the full potential of their comprehensive cultural heritage data. Instead, many collection interfaces are still based on search, and collection visualizations tend to foster distant viewing. With our research, we attempt to counter this tendency by proposing a novel approach towards the overview. It consists of a visualization concept that is conceived to provide a high-level overview of the collection’s iconography, while at the same time facilitating close viewing of tagged details of the depicted decorative art. Thus, our main contribution is a visualization technique that provides an overview of a collection by means of its iconographic details.

The unique potential of this visualization technique lies in its use of visual features for the exploration of digitized cultural collections. It is set apart from more common visualizations of cultural heritage that are merely explorable along textual elements. Through this approach, we strive for supporting both scholars and curious laypeople in exploring a collection that is unfamiliar to them. The visualization technique of

Close-up Cloud highlights the rich details of tagged image collections and invites the viewer on a serendipitous journey. While exploring the collection, viewers can familiarize themselves with the iconography and develop a sense for recurrent figurative elements, as well as for marginal motifs. High-level abstraction, such as art historical iconography, becomes tangible.

We understand the Close-up Cloud as a contribution to the ongoing discussion about the role of visualization in the humanities.<sup>56</sup> Through bridging the supposed dichotomy of overview and detail, our visualization technique demonstrates a novel way of creating visualizations that are designed towards humanistic epistemology.<sup>57</sup>

For future work, the integration of computer vision is a promising direction and for the application of the Close-up Cloud as a research instrument for digital art history. Whereas the current interface was designed for casual exploration of the collection with novices and intermediates as target audience in mind, feedback from the evaluation of an early prototype suggests that the Close-up Cloud is also of interest to art historians and museum experts. The presented visualization technique is also conceivable as an extension of digital research environments that focus on supporting cultural scholars in examining the iconography of digitized cultural heritage.

## NOTES

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