

# Posterity: Balancing Historical Context and Visual Dynamism While Visualizing a Collection of American Labor Posters

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**Abstract**—Visual archives of political movements are rich cultural resources, yet often difficult to explore at scale due to complex visual semantics and limited interaction models. We present *Posterity*, an interactive visualization system for 784 digitized American labor posters (1900–2010), designed to support both historical contextualization and visual-semantic exploration. *Posterity* integrates curated metadata, CLIP-based multimodal embeddings, and unsupervised clustering to offer three coordinated views: a timeline aligned with key labor events, a 3D semantic cloud, and a similarity spiral responsive to image-, object-, or gesture-based input. Together, these views enable users to trace recurring visual motifs, discover rhetorical patterns, and explore labor movement narratives from multiple entry points. While developed for labor posters, the approach demonstrates potential for adaptation to other visual cultural heritage collections, particularly those with rich metadata and symbolic content.

**Keywords**-digital humanities; image visualization; image interpretation; historical records; similarity retrieval

## I. INTRODUCTION

Posters have long served as tools of political expression, conveying complex messages through bold visual language and ideological cues. In the American labor movement, posters from the 20th and early 21st centuries chronicle narratives of solidarity, protest, and aspiration. Yet despite their historical significance, these visual artifacts are often difficult to explore at scale. Existing digital archives tend to rely on static grids or keyword searches, limiting users' ability to uncover latent patterns in design, rhetoric, or iconography.

Recent cultural analytics systems such as VIKUS Viewer [1] and PixPlot [2] offer more dynamic access to image archives through embedding-driven spatial layouts. These systems improve access to cultural datasets, but often emphasize visual clustering over historical framing and offer limited mechanisms for interaction grounded in gesture, personal imagery, or symbolic input. This challenge is particularly salient for political poster collections, where communicative power often relies on cultural references and ideological cues that may be opaque to general audiences. Too little context risks superficial engagement; too much can overwhelm and hinder exploration. We seek to address

this tension by integrating multimodal similarity search with historically grounded views, balancing open-ended discovery with contextual framing that supports interpretability.

We present *Posterity*, a visualization system for exploring a curated collection of 784 digitized American labor posters from 1900 to 2010. *Posterity* supports both historical contextualization and visual-semantic interaction by combining human-labeled metadata with CLIP-based image-text embeddings via a trimodal visualization approach. The system offers three coordinated views: a contextualized timeline, a visual-semantic 3D cloud, and a similarity spiral responsive to gesture- or image-based input. This trimodal interface allows users to navigate across time, theme, and visual similarity, surfacing both dominant and overlooked narratives in labor history.

Our contributions are: (1) A multimodal embedding pipeline using CLIP to unify visual and textual features of historical poster collections; (2) An interactive visualization system that integrates temporal, thematic, and gesture-based exploration modes; (3) A case study demonstrating how visual-semantic retrieval can reveal design motifs, rhetorical tropes, and sociopolitical patterns.

## II. BACKGROUND

### A. Access and Engagement with Labor Posters

Access to American labor art has historically been fragmented across union archives, private collections, and specialized libraries such as the Walter P. Reuther Library and the Tamiment Library [3], [4]. Before digitization, researchers had to physically visit these sites, often relying on limited metadata, which made discovery and comparison challenging. Efforts in the late twentieth century, such as the work of Cushing and Drescher in *Agitate! Educate! Organize!* [5] and Cushing's digital archive Docspopuli.org [6] helped broaden access by cataloging and digitizing scattered collections. Today, resources like the Library of Congress's Yanker Poster Collection and the Center for the Study of Political Graphics offer online databases and thematic exhibits, while platforms like Labor Arts curate posters into educational paths [7], [8]. Despite these advances, most digital repositories still organize posters in static grids or

simple lists, limiting opportunities for dynamic exploration, discovery of visual relationships, and contextual analysis, demonstrating the need for more engaging, context-rich visualization tools.

### B. Visualization Techniques Supporting Studies of Social Movements

Visual analytics tools are central to social movement research, supporting pattern detection and public engagement [9], [10]. Projects such as *Mapping American Social Movements* [11], *Labor Action Tracker* [12], and visualizations for movements like civil rights, climate justice, or #MeToo [13]–[15] primarily visualize tabular event data in spatial or temporal charts, but visualizations for digital collections are expanding beyond lists and grids. For example, *VIKUS Viewer* organizes art and media collections thematically and temporally for dynamic exploration [1], while *Photogrammar* employs point cloud layouts to surface spatial and contextual relationships among historical photographs [16]. Spiral and 3D layouts further increase analytic power: spiral timelines enhance detection of trends and recurring cycles [17], and immersive 3D layouts facilitate rapid correlation and navigation in large visual archives [18]. Alongside these interfaces, computer vision models such as Computational Neural Networks (CNNs), Vision Transformers, and Contrastive Language-Image Pre-Training (CLIP) have enabled image similarity search and automated clustering for large image collections [19]–[21], focusing on numeric or textual metadata, but their application on interactive, history-focused visualizations in studies of social movements remains unexplored. Our work bridges this gap by integrating multimodal CLIP embeddings with interactive visualizations, enabling users to explore labor movement posters by chronology, theme, and visual similarity, thus exploring motifs and stylistic trends across time and context for research and education purposes.

## III. DESIGN OBJECTIVES

Our visualization system is designed to support educators, researchers, students, and the general public in exploring the historical, aesthetic, and ideological dimensions of American labor posters. Through early-stage feedback from archivists and informal user walkthroughs, we identified common challenges with existing poster collections, including limited metadata, static grid-based navigation, and a lack of contextual framing. These insights, combined with principles from exploratory visual analysis, informed three core design objectives for *Posterity*.

### DO1 Support Multidimensional Exploration for Interactions:

Users should be able to explore posters by dynamic organizational modes, filter posters by time, theme, or metadata with responsive controls, and customize their input to

explore in real time, to gain multiple perspectives on the data.

### (DO2) Reveal Visual and Semantic Patterns at Scale:

The system should help users identify clusters, trends, and outliers in poster design, enabling both overview and focused analysis, making patterns and recurring motifs across time and movement visible.

### (DO3) Connect Visual Artifacts to Historical Contexts:

The system should leverage metadata and external historical events to enhance users' understanding of the broader contexts in which the posters were created and used.

#### A. Implementation

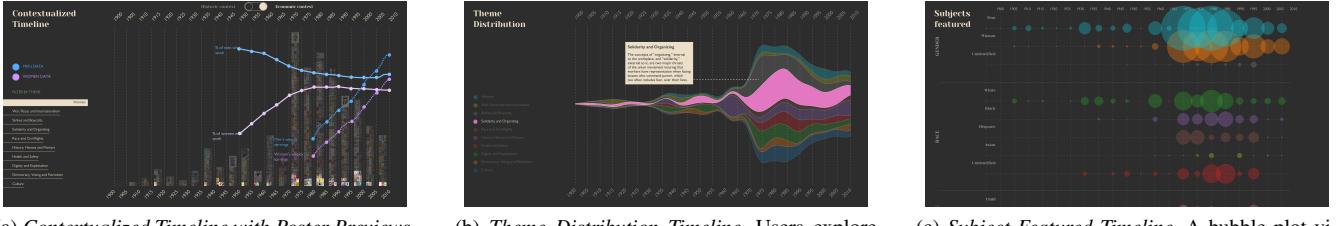
Our design process began with low-fidelity sketches on paper to explore potential interaction flows and visualization strategies. These initial concepts evolved through multiple iterations, incorporating feedback from instructors and peers. A mid-fidelity prototype was developed in Figma before implementation in JavaScript.

We processed the dataset using Python's Pandas library, and used the Matplotlib and Seaborn libraries to prototype visual encodings of poster frequency, theme distribution, and subject representation over time. To support thematic exploration, we implemented a 3D Cloud that spatializes posters using Principal Component Analysis (PCA) applied to CLIP embeddings derived from both visual inputs and textual metadata, rendered interactively with p5.js [22]. The Similarity Spiral allows users to engage with the dataset through image-based input, such as a photo, gesture, or object. We selected OpenAI's CLIP model to support multimodal retrieval across visual and textual dimensions within a shared image–text embedding space [21]. This makes it well-suited for representing high-dimensional cultural artifacts alongside their annotated metadata [23]. These embeddings are then used to compute similarity within the poster collection, and also for comparing with the user inputs. Posters are then organized using the K-Means clustering algorithm, and the resulting layout is rendered in both 2D and 3D spirals. We have released *Posterity*'s source code under an open-source license on GitHub [24].

#### B. Visualizations and Applications

*Posterity* offers three coordinated views—timeline, 3D image cloud, and similarity spiral—designed to support complementary modes of engagement. Together, they address our design objectives (DO1–DO3) by enabling exploration across historical, thematic, and visual dimensions. (see Figures 1a–3).

1) *Timeline View*: The timeline view provides a vertically stacked, scrollable interface aligned along a shared temporal axis. It comprises three linked subviews: poster counts, theme distribution, and demographic representation. The first subview displays a bar chart showing poster production over five-year intervals from 1900 to 2010. Users can filter by



(a) *Contextualized Timeline with Poster Previews*. The interface overlays socioeconomic trends onto the theme-filtered timeline, with poster thumbnails sorted by year.

(b) *Theme Distribution Timeline*. Users explore the key poster themes over time by hovering or selecting contextual events and themes for a given period.

(c) *Subject-Featured Timeline*. A bubble plot visualizes the subjects throughout the timeline.

Figure 1: Multidimensional visualization of American labor posters and associated contexts.



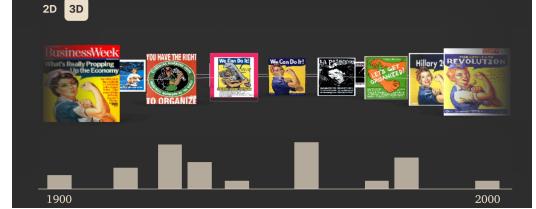
Figure 2: *3D Cloud View*. Posters are spatialized using deep neural embeddings; users “walk through” the cloud, observing clusters based on color, theme, or style.

themes and hover to preview posters or annotated historical events that provide the context of different poster production spikes (see Fig. 1a). Scrolling down reveals a streamgraph showing the distribution of themes over time. Users can explore shifts in rhetoric —such as the rise of civil rights themes in 1960s—and examine how topics like Solidarity or Exploitation varied in prevalence (see Fig. 1b). A final view shows the race and gender of the subjects depicted on the posters. This helps the user identify the under-representation of certain figures, such as the case of Asian characters before the Vietnam War. The Timeline View supports DO1 by offering temporal and thematic filters, and DO3 by embedding posters within a broader social and political context.

2) *3D Cloud View*: The 3D image cloud spatializes posters based on visual-semantic similarity, allowing users to explore thematic and stylistic clusters through open-ended navigation. Poster embeddings are computed using CLIP and reduced with PCA to form a manipulable 3D layout. Users can pan, rotate, and zoom to examine clusters and outliers, with proximity suggesting shared motifs, iconography, or tone. (Fig. 2) We offer two clustering options: one derived from CLIP-based semantic embeddings, and another based on curator-defined themes adapted from Cushing and



(a) *Similarity Spiral (2D Mode)*. When a user submits an image, the system projects semantically similar posters onto a spiral, with details about predominant themes, movements, and design features.



(b) *Similarity Spiral (3D Mode)*. Semantically similar posters are arranged in an immersive 3D spiral around the user, foregrounding the most similar at the center.

Figure 3: Spiral views based on similarity to the user's input.

Drescher's taxonomy. While the semantic layout reveals relationships learned from image-text patterns, the thematic clusters reflect human categorizations grounded in labor history, juxtaposing computational and human subjectivity in grouping high-dimensional artifacts. This view supports DO1 (multidimensional exploration) and DO2 (pattern discovery) by surfacing emergent groupings and visual affinities not immediately evident in timeline or metadata views.

3) *Similarity Spiral*: The similarity spiral supports targeted exploration by allowing users to submit an image, object, or gesture via webcam or upload. This input is encoded using CLIP and compared against the poster dataset using cosine similarity. The top-matching results are pro-

jected onto a spiral layout, available in both 2D (Fig. 3a) and immersive 3D (Fig. 3b) modes.

Accompanying panels summarize metadata across the retrieved set, including themes, movements, and design traits, with optional GPT-generated textual interpretations to support interpretive depth. Beyond retrieval, this view surfaces what is included and excluded in the model’s response, allowing users to interrogate the dataset and embedding space for patterns and omissions. It supports DO1 (multimodal exploration) and DO2 (pattern discovery), while also encouraging critical engagement.

The spiral layout was chosen for both its spatial efficiency and conceptual resonance: it evokes the cyclical nature of labor history, where visual motifs, slogans, and struggles reemerge over time, and places the user’s chosen symbol at the interpretive center of that continuity. Gesture- and image-based inputs emerged during early-stage user feedback, where participants expressed interest in more playful, embodied, and interactive modes of querying. While not designed specifically for archivists, this interaction aims to make the system more approachable for students, educators, and general users less familiar with labor history or terminology by connecting personal input to visual archival content.

4) *Exploration Flow and Use Case*: A user begins in the Timeline View, selecting a theme such as *Women* to examine poster activity around key moments like the 1995 *Equal Pay Act*. By exploring overlays of historical events and economic data, they can situate visual output within broader shifts in labor demographics, such as increases in female workforce participation. Scrolling down, the user can explore the Theme Distribution to trace how topics like *Exploitation* rise and fall over time. By clicking into the 3D Cloud View, the user navigates posters clustered by labeled semantics and themes, revealing stylistic or rhetorical relationships that span across movements and decades.

In the Interaction View, a user can submit an image, such as a raised fist gesture, and retrieve semantically similar posters displayed in a 2D or 3D spiral, centered around the user input image. Because the user’s own image or gesture becomes the query, they can also reflect on whether—and how—their identity is represented in the historical archive. For example, submitting an image as an Asian woman may surface posters depicting *Rosie the Riveter*, but rarely show figures of a similar racial background. These moments of resonance or absence are intended to prompt reflection on how political memory is visually constructed, and whose narratives are emphasized, marginalized, or omitted over time.

#### IV. DISCUSSION AND FUTURE WORK

*Posterity* demonstrates how visual archives like labor movement posters can be explored through coordinated views that support contextual, thematic, and visual-semantic

inquiry. By reducing reliance on static grids, the interface facilitates pattern recognition, visual comparison, and cross-modal discovery at scale. Informal feedback suggests that the spiral and similarity search helped users uncover unexpected connections and made visual exploration more engaging than conventional browsing. CLIP-based retrieval enabled fast clustering of posters by both content and style, surfacing rhetorical motifs across time.

However, the dataset reflects curatorial bias—sourced primarily from two archivists—which may over-represent certain themes or styles. Additionally, CLIP’s pretrained embeddings can amplify existing biases in large-scale web imagery, favoring dominant aesthetics and omitting more marginal iconography. Future work should explore metadata-aware clustering or fine-tuned models to mitigate these effects and ensure more equitable representation.

Beyond the current dataset, the system’s framework of using multimodal embeddings and coordinated temporal/thematic/similarity views can extend to other visual-centric cultural heritage collections, but further discussions with historians and subject matter experts need to be conducted to establish the potential of *Posterity* in other domains. Future work includes improving the system’s accessibility through guided walkthroughs, adaptive camera controls, and interpretive overlays. We also aim to conduct broader user studies with educators, historians, and general audiences to evaluate *Posterity*’s impact on interpretability, engagement, and learning. Ultimately, our goal is to expand the toolkit for cultural analytics and public history through scalable, interactive, and critical visual exploration.

#### V. CONCLUSION

*Posterity* offers an interactive approach to exploring large collections of digital visual archives. With embeddings and clustering, our tool presents posters with intuitive visual viewpoints, including a chronological timeline, thematic image clouds, and similarity spiral layouts. These visualization methods allow users to explore recurring themes, poster graphic styles, historical events and trends, and relationships between different periods of American labor movements. Multidimensional interface supports various navigation methods, from open-ended browsing to targeted searches with images or keywords. Users can upload photos with different gestures or images of objects, and interact with the tool as it retrieves related posters with similar input features, allowing educational and historical inquiries. Additionally, incorporating both 2D and 3D viewports improves contextual visibility for large visual datasets. Future work includes enhancing user experience, performing usability studies, and exploring applicability beyond labor posters. While developed for this dataset, *Posterity* offers a potential framework for interactive visualizations that balance historical context and visual dynamism. By enabling exploratory interaction, *Posterity* supports inquiry

into patterns of representation, absence, and symbolic recurrence in visual archives. flexible framework for exploring large visual archives. Future work, including enhancing user experience and expanding usability evaluation to strengthen user engagement and accessibility, supporting both research and public education in digital humanities.

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