

SleuthTalk: Identifying Historical Photos with Intelligent Shortlists, Private Collaboration, and Structured Feedback

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ABSTRACT

Identifying people in photographs is an important task in many fields, including history, journalism, genealogy, and collecting, but accurate person identification remains challenging. Researchers especially struggle with the “last-mile problem” of historical person identification, where they must make a selection among a small number of highly similar candidates. We present SleuthTalk, a web-based collaboration tool integrated into the public website Civil War Photo Sleuth which addresses the last-mile problem in historical person identification by providing support for shortlisting potential candidates from face recognition results, private collaborative workspaces, and structured feedback.

CCS CONCEPTS

• **Human-centered computing** → **Collaborative and social computing systems and tools**; • **Applied computing** → *Arts and humanities*; • **Computing methodologies** → *Biometrics*.

KEYWORDS

Crowdsourcing, human-AI collaboration, facial recognition, last mile problem, collaboration

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1 INTRODUCTION AND RELATED WORK

Identifying people in photographs is an important task in many fields, including historical scholarship, investigative journalism, human rights work, and law enforcement. However, because of the large numbers of potential candidates and the poor quality or lack of source evidence, person identification in photos can be challenging, and misidentifications can have severe negative consequences [1, 6].

Traditionally, person identification in photographs has been a largely manual process for investigators in law enforcement, history, and other fields. More recently, researchers have begun to combine the complementary strengths of crowdsourced human intelligence and AI-based face recognition. In prior work, [4] developed a web-based platform, Civil War Photo Sleuth (CWPS),¹ combining both crowdsourcing and facial recognition technology to identify American Civil War-era soldier photos. They found that users were able to successfully identify hundreds of unknown photos using CWPS’s “haystack model” person identification pipeline. Despite these successes, the hybrid crowd-AI pipeline also produced some false positives and misidentified photos. Especially when users work with a set of similar faces, it is difficult for users to decide among a subset of promising high-similarity candidates. This challenge is known as the “last-mile problem” of facial recognition, similar to problems in transportation and telecommunications.

Given this challenge, Mohanty et al. [3] developed a follow-up system, Second Opinion, aimed at directly supporting the last mile of person identification. In this tool, the researchers combined experts and crowdsourcing and use the workflow of “seed, gather, and analyze” to help users to focus more in details on the Civil War soldier faces by reviewing the unique facial features and others’ feedback in a structured and organized way. According to the evaluation, crowds filtered out 75% of face recognition’s false positives, and maintained 100% recall rate. However, Second Opinion also had a number of limitations [3]. First, the software automatically selected the shortlist composed of the 5 candidates with the highest face recognition scores; users could not change the size of the shortlist nor modify its contents. Second, Second Opinion recruited paid workers from Amazon Mechanical Turk to serve as the crowd. Participants voiced that they preferred to consult personal contacts and people knowledgeable about Civil War photography, in addition to strangers, when seeking second opinions. Third, Second Opinion focused only on labeling facial feature similarities and differences; it did not allow for detailed discussions or integration of external information sources.

In this demonstration paper, we propose SleuthTalk, a new web-based system that adopts the advantages of the Second Opinion system while seeking to address some of its limitations, towards the goal of helping with the last-mile problem in historical person identification. In this new system, we first added multiple user interaction options to allow users to weigh in and pick the potential candidates for a shortlist. We also designed a private project workspace for users to invite trusted members, such as their friends or family, to work together and identify the unknown Civil War photos. This private project provides a space for users to share with

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¹<http://www.civilwarphotosleuth.com>

each other their opinions and pool their individual knowledge to get confirmation, but also help to prevent the spreading of misidentifications during the process. Extending the work from Second Opinion [3], we designed a structured feedback section to allow users to compare each candidate in detail by looking into the facial features, as well as a space to share the other sources outside of CWPS and resolve conflicting opinions. Using a poll feature, project creators can collect and organize members' decisions and select the winning candidate.

2 SYSTEM DESIGN

SleuthTalk is a novel extension built upon the web application Civil War Photo Sleuth [4]. SleuthTalk focuses on helping users address the last-mile problem in historical person identification with three key components: an intelligent user interface for shortlisting potential candidates (Section 2.1); a private workspace to collaborate and discuss with other users (Section 2.2); and structured feedback for fine-grained comparison and aggregation of analysis (Section 2.3).

2.1 Intelligent Shortlists

After the user uploads a new unknown Civil War photo, CWPS retrieves all the facially similar results in a descending order based on the similarity score (confidence score) calculated by the Microsoft Cognitive Services Face API while also satisfying the search filters. Users can carefully inspect individual search results to determine whether they are facially similar to the query photo and whether the biographical information (e.g., military service records) line up with the visual clues of the query photo (e.g., uniform insignia). However, prior work has shown that the correct match is often ranked beyond the top-5 and top-50 face recognition results [4, 5]. SleuthTalk provides an intelligent user interface to allow users add any potential matches to a shortlist from the facial recognition results and then create a project for analyzing these shortlisted candidates in a focused manner.

To accomplish these goals, when a user runs a search for a query photo, each result contains an “Add to Shortlist” button on hover. Clicking the button causes the candidate to be added to the shortlist; the background of that candidate's search result changes color, and the candidate is added to a floating container on the right side of the screen. Once a shortlist is created, the user can create a project by clicking the “Create Project” button either at the top of the search results list, or at the bottom of the floating container.

After the user creates the new project, SleuthTalk will display each selected candidate under the “Shortlisted Candidates” section. We display the biography information and the photo thumbnail (face) in each candidate card (see Figure 1). However, if multiple faces link to one candidate, we use the vertical carousel to display all the thumbnails, one at a time, which can be cycled by clicking up and down arrows. Bubble icons indicate the number of available photos (faces) for a candidate. When the user refreshes the project page, all the shortlisted candidates will be randomly sorted to avoid a common bias where people always focus more attention on the first candidate. We also provide an option for users to sort the candidates in various popular ways, e.g., by the time they were added, or the number of votes in the poll.

If users want to add more candidates after the project is created, any project member can click on the “Add Candidate” button and follow the same process using the search results page to add a new candidate. Users can also archive (and un-archive) candidates on the shortlist if they change their minds. SleuthTalk displays the previous votes and other information for these candidates in the Archived section.

Users can have one project per shortlist (i.e., per photo). It follows that multiple users can each have a different shortlist for the same photo, allowing different social networks to explore the same photo mystery from different perspectives.

2.2 Private Collaborative Workspace

2.2.1 Controlled Access. In prior work [3], users of CWPS stated that it would be helpful if they knew more about the expertise of the person who is providing the second opinion. Moreover, CWPS users were more likely to discuss the identity of the unknown photo with their family and friends. Therefore, we designed SleuthTalk to be a private workspace for them to invite and collaborate with project members of their choice, but otherwise exclude other users from viewing the project and discussion. Additionally, creating a team leverages the benefits of multiple perspectives and can help the project creator avoid mistakes because of the individual's limited knowledge and the possibility of confirmation bias and overlooking the facial comparisons. The project leader can invite up to 9 team members by clicking on the “Add Member” button. This interface allows them to invite CWPS users with existing accounts by typing their name, username or email; an auto-complete feature allows users to quickly find the one they are looking for. Further, users can invite non-CWPS users simply by providing their email address.

In SleuthTalk, invited users who have not yet accepted can only view the information on the project page at that time. Once users accept the invitation, they are allowed to interact with other team members on the page and view the rest of the information. Other CWPS users who are not project members cannot view votes, discussion, or other related information on this project page because of privacy settings.

When the project creator finalizes the identity as the winning candidate, the identity of the unknown photo finally becomes public information to everyone on CWPS. However, other CWPS users who are not project members can still not view the details of the project page. We use this approach to set up the private collaborative workspace to prevent misidentification during the discussion before the user finalizes the identity; but this “publishing” mechanism provides a way to share the results with the broader public for them of benefit.

2.2.2 Discussion Support. Even though we designed SleuthTalk to help the user easily view other people's opinions on facial similarity for each candidate, we also add a discussion section to allow users to have more detailed open-ended conversation, share information sources, and resolve conflicting opinions. Users can also refer to specific photo comparisons via hashtags. For example, if the user wants to see the comparison vote and the facial feature selections between the unknown photo and photo 13249, users can put hashtag “#13249” in the discussion thread to help others to quickly view the information in Figure 5 as a modal dialog box.

The interface is divided into several sections. At the top, there's a header with 'Pick your top candidate for Photo 24509', 'Yet to vote:' with a user icon, and a 'Reset Poll' button. Below this is a 'None of the candidates' button with a counter '0' and a 'Sort by:' dropdown. The main content area is split into three columns. The left column shows a candidate profile for John Singleton Mosby, including a 'Voted' button and a list of units served (CS, 43rd, VA, Cavalry). The middle column is a poll titled 'Can Photo 24509 be identified as John Singleton Mosby?' with a bar chart showing confidence levels: 'No - Highly Confident' (0), 'No - Slightly Confident' (0), 'Not Sure' (0), 'Yes - Slightly Confident' (1), and 'Yes - Highly Confident' (0). A 'View Details' button is at the bottom. The right column shows a photo carousel for 'Photo 31118' with a 'Show Comparison' button.

Figure 1: Shortlisted Candidates. From right to left is shown the photo carousel, identification vote results, biographical profile, and poll results. Clicking "Show Comparison" displays the comparison vote results.

2.3 Structured Feedback

2.3.1 Facial Feature Comparison. There is a two-step process to compare two photos on the current CWPS website. First, users need to compare the two photos based on only facial similarity, and second, they express how confident they are about the photo's identity (ID), incorporating broader context about the proposed ID's biography. According to prior work, comparing facial features gives users more confidence in making an identity [3]. Therefore, in addition to the current two steps, we add a third step to the process, allowing users to compare fine-grained facial features (see Figure 2). In this step, we provide an auto-completed list of 7 default feature examples in the beginning (hair, eyes, nose, ear, facial hair, eyebrow, jawline), and more user-generated options as users provide additional facial features, so that we can avoid having the same facial feature with slightly different names when we display the comparison details [2]. We expect that users may deliberate and carefully compare the two photos for facial similarity by completing this step.

After the user has compared each candidate and provided a vote, we build on existing designs from CWPS to use a horizontal histogram to visualize the results about a user's confidence in an ID (see Figure 3) and the information about how two photos are similar according to both the community and face recognition (see Figure 4).

In addition, SleuthTalk displays the facial features that every project member selected during the comparison process, including the name of the facial feature, similarity, cropping box, and comments (see Figure 5). We expect that displaying the facial features that other project members selected can help users to narrow down the shortlisted candidates.

2.3.2 Identification Poll and Final Decision. Finally, we designed SleuthTalk's identification poll section to help users collect and visualize one other's opinions on the final identity of the unknown photo. Any members who finishes comparing all the candidates can then start the identification poll. Then SleuthTalk displays the poll section only to the users who finished comparing, so that we can show the task step-by-step to avoid any confusion for the users who are still working on comparing the candidates. All the poll votes are displayed on the left side of each candidates' card (see Figure 1). Users can only vote for a maximum of one candidate in the poll section, but we also provide an option for the user to vote on none of the candidates if they could not find a strong match in the shortlist. SleuthTalk requires at least half of the project members to vote on the candidate to proceed to the next step.

Once at least half of the project members vote on the candidates, SleuthTalk displays further instructions. If there is no tie and we have a winning candidate, the system displays a button for the project creator to finalize the identity of the unknown photo as the winning candidate, and share the identity with the public in CWPS.

3 PRELIMINARY EVALUATION AND FUTURE WORK

We conducted an exploratory, mixed-methods evaluation of SleuthTalk. We recruited six participants with diverse experience levels in identifying Civil War photos. Participants were instructed to create at least one SleuthTalk project to identify an unknown photo and were free to invite anyone to be a part of their project team. Participants were given one week to reach a decision by conducting the final poll. We collected and examined the log data for each project and conducted semi-structured interviews with all participants.

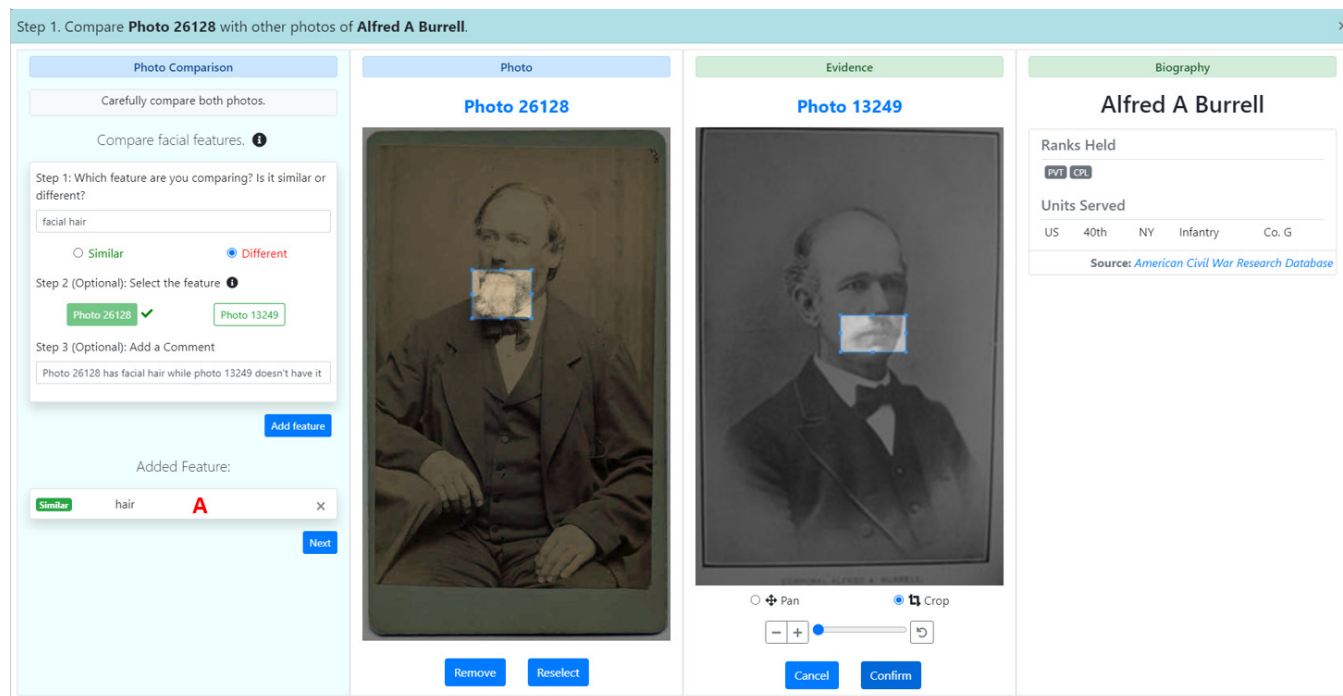


Figure 2: Facial Feature Selection and Comparison. Users first label and categorize a facial feature of interest, then select it using a cropping tool in one or both photos, and finally provide an optional comment. These steps are repeated for as many features as desired.

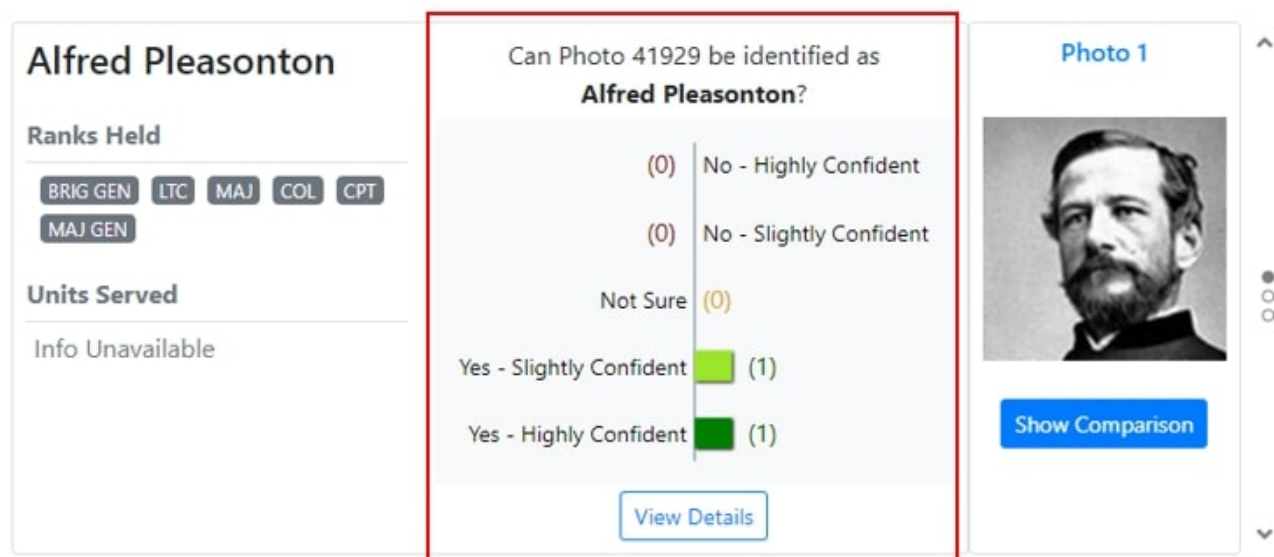


Figure 3: Identification Vote in Candidate Card.

Data analysis is ongoing, but preliminary findings indicate that SleuthTalk provides substantial value in helping participants manage the last-mile problem. Participants created 9 projects and sent 45 project member invitations, a mix of strangers, friends, and

family. They added 37 candidates, selected 254 facial features, and cast 125 identification votes. Project creators described changing their minds in response to members' feedback and discussion, and described how SleuthTalk complemented the broader ecosystem

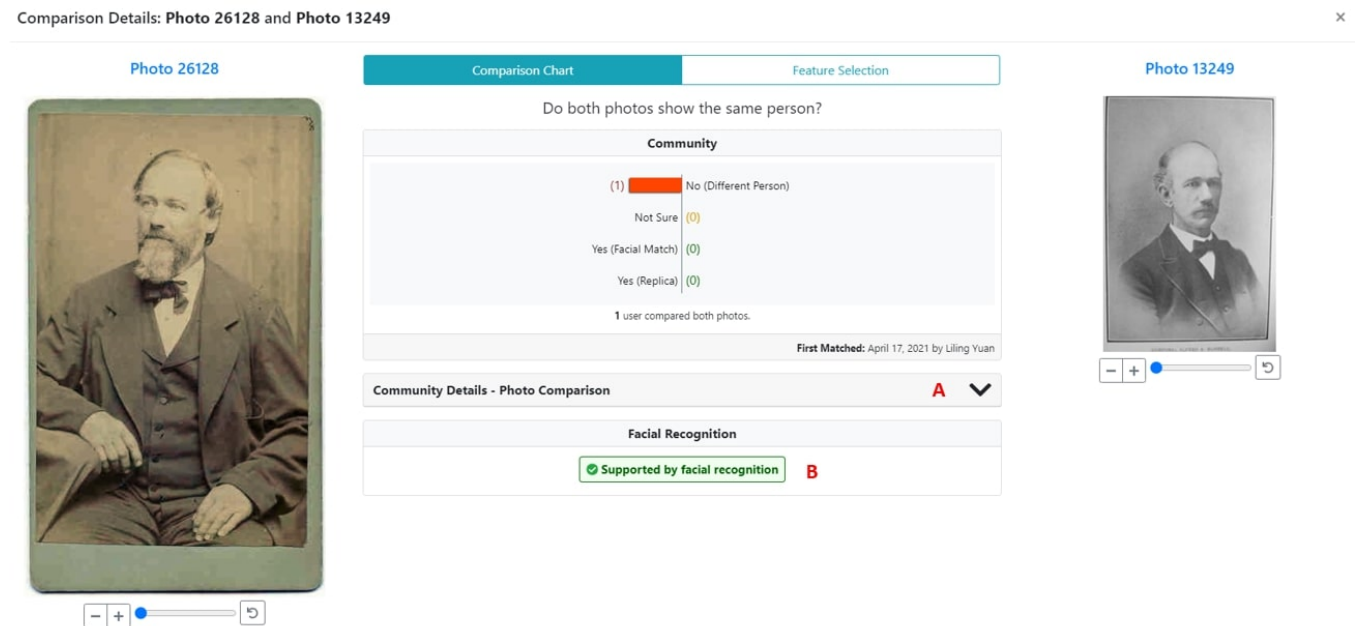


Figure 4: Facial Comparison Chart. User can click section A to see the comparison vote details. SleuthTalk shows whether the two photos are supported by facial recognition in section B.

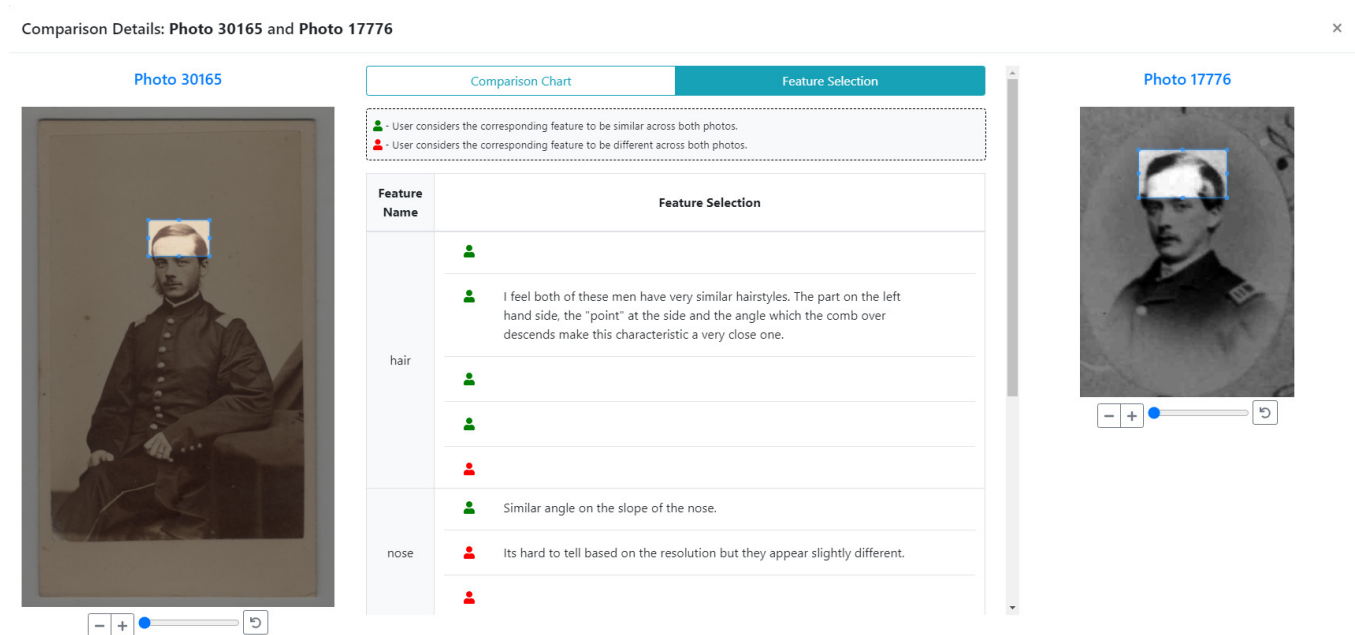


Figure 5: Comparison Vote Results. User can hover the selection to view the cropping detail, and a table aggregates the detailed comments by feature.

of CWPS and social media groups in supporting historical person identification. Beyond this preliminary evaluation, future work will include a large-scale deployment SleuthTalk in Summer 2021,

making it available to all of CWPS's more than 15,000 registered users.

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