

Picture Penguin: A Multi-Faceted Mobile Photo Navigation System

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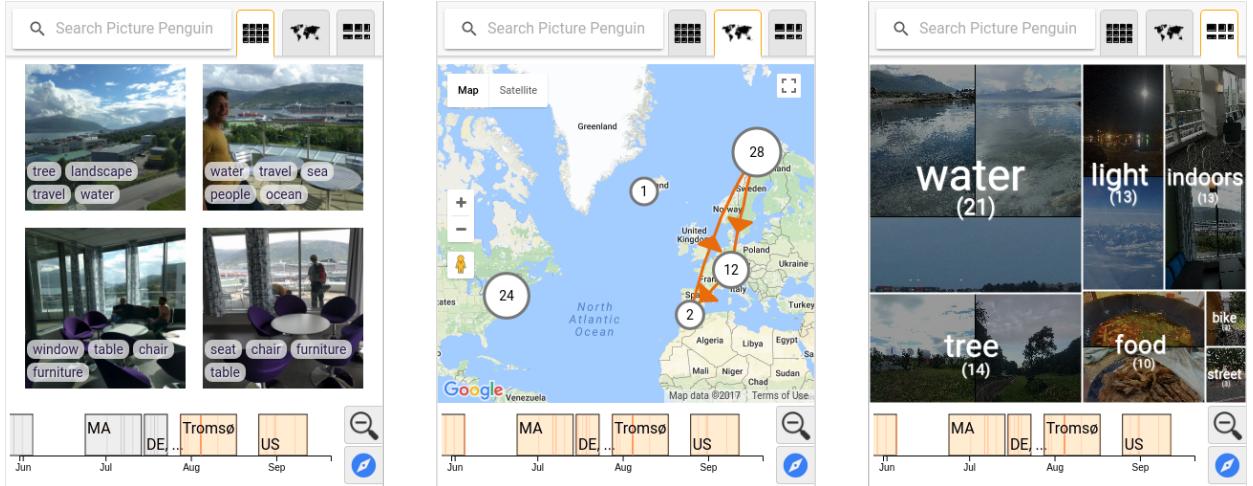


Fig. 1. Gallery, Map and Tag Treemap views of Picture Penguin. The gallery view displays thumbnails of photos and provides context through chronological ordering, content labels, and pop-out highlighting of photos visible in the timeline. The map view displays photos taken in Massachusetts, Iceland, Germany, Spain, Norway, Germany, and again Massachusetts, in chronological order. The timeline view provides information about when and how many photos were taken at a given time. The map view additionally detects, auto-segments, and highlights a trip from Germany to Spain to Norway and back. Finally, the interactive hierarchical label treemap view displays groups of photos with common contents taken during this timespan MB: what is "types"? MS: is this better?, and previews select photos in each of the tags. MS: do you not like 'encourages filtering'?

Abstract—Multi-faceted data, such as a photo's location, timestamp, and content, are difficult to navigate, particularly when a user has a joint search and interactive exploration task. This task is even more difficult to accomplish when confined to a small mobile display. In this paper we present Picture Penguin, a novel personal photo navigation system that enables search and filtering through linked and combined views of temporal, geo-spatial and contextual information using timeline, maps, gallery and tree maps. Spatial and non-spatial data are linked in a seamless and coherent manner in a hybrid timeline and map. Together, these features promote efficient photo finding, even without complete knowledge of the information, such as when the date of a photo is unknown. Picture Penguin scales to large photo collections and reduces complexity through clustering and data summarization techniques, and runs as both a mobile and a desktop application. Photo navigation goals, platform requirements and a task taxonomy were generated through the analysis of user interviews and surveys in order to inform the design of the system.

Index Terms—photos, task analysis, non-expert audiences, mobile applications, brushing and linking, clustering, treemaps, timelines, geo-spatial data, information visualization.

1 INTRODUCTION

MB: before I forget: lets add some citations to Aude Oliva's work on photo/image memorability; the research says that people remember faces/distinct-features so justification for tags in our system plus the whole bland-images are hard to remember are justification for why we need map/timeline to help someone find the great photo they do not remember!

Photos are multi-faceted snapshots of experiences and memories, and contain different types of meta-information. For example, where and when was the photo taken? What is the setting? What is the content of

the photo? People remember different aspects of their photos, and may need to search through their collection for photos to relive moments, share experiences, or narrate a story.

With the invention of the digital camera, and inclusion of digital cameras in most contemporary smart-phones, the casual photographer now has an ever growing collection of digital photographs. Browsing and searching through these collections can sometimes be daunting, especially if you do not know exactly when you took the photograph. In some cases a person may know exactly what photo they are looking for, and in other cases they may simply need to explore and rediscover photographs of interest. These two different photo browsing goals become even more difficult when one needs to do so on the small screen of a mobile device. The task becomes even more challenging for large photo collections with many thousands of photographs. In the year 2015 alone, more than a trillion digital photographs were snapped (cite) MB: can you add more details to this statistic? where does it come from? and more than 1495 million smart-phones with cameras sold [15] MB: can we find some statistic like this to support our argument? .

In this paper we present a novel system, Picture Penguin, which enables the effective and efficient search and browsing of personal digital photo collections. Picture Penguin combines search, summary,

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the screen. The top panel contains a search bar (1) and a tab selection for the main view (2).

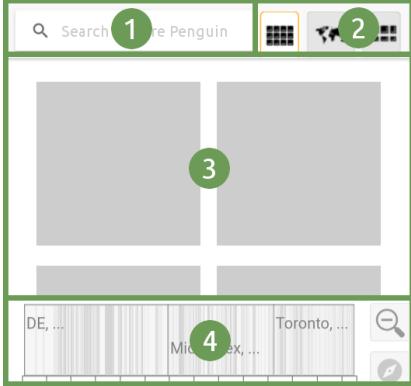


Fig. 4. The main parts of Picture Penguin's Interface: (1) Search, (2) Tab Selection, (3) Main View, and (4) Timeline.

To preserve context, search, tab selection and timeline remain visible and constant across the three different components available for the main view: Gallery, Map, and Label Map. This allows users to choose between the primary data types for navigation: image data, locations, or labels, while time is always available, as it was identified to be the most important attribute as described in the related work in Sec. 2.

Since photo data is multi-faceted and users remember different attributes about photos, it is important to provide effective ways of narrowing down a search using a combination of these attributes. For this reason, Picture Penguin uses a linked views approach that allows and encourages filtering of different attributes while providing a natural representation for each of them. This is to enable to switch between contexts, which can be beneficial in complementary situations as it allows comparisons between the views [27]. In Fig. 5, we outline each view's main data type in red: Photos in the gallery, location in map, and tags in the label map, and time in the timeline.

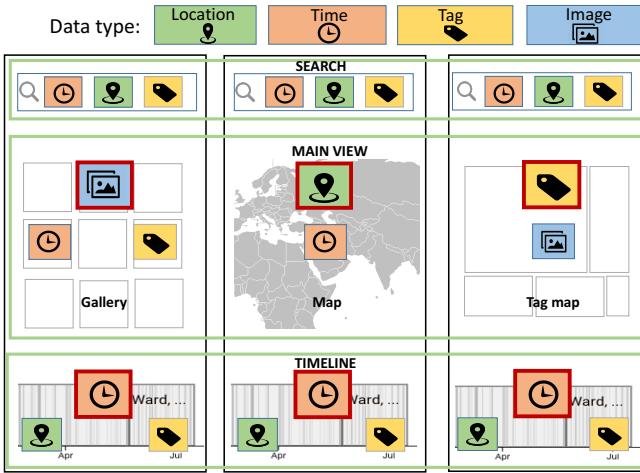


Fig. 5. Picture Penguin interface components and their primary (red outline) MB: Red outline should be bolder/thicker and secondary data types. The MB: free-form text search can interpret geospatial location, time, and content tag data. In the main view, the gallery presents image data, although it also gives a sense of time and tags through sorting and showing a small number of tags for each photo MB: This sentence is very confusing.... The map provides geolocation information as well as auto-generated “journey” paths which encode temporal order. The label treemap hierarchically sorts photos by content tags . Lastly, the timeline primarily gives a sense of time, while also summarizing either location or tag data. MB: Fabulous improvements to figure! Much better :) MB: The caption is very confusing without labeling each view name under the sketch of gallery (left), map (middle) and treemap (right). It also feels very dense - I would recommend with spread things vertically to have a bit more whitespace. We can chat more in person, too.

This way, users can filter photos by different attributes in their natural environment. However, care must be taken to not require too much mental workload from users to keep track of filters in different views, and linking and interactivity is important. In Picture Penguin, users can switch between main views without ever losing their current selection, and are always reminded of currently applied filters both in the search and in the timeline. Once a small enough set of photos is identified, the system navigates users to the gallery, where the selected photos can be viewed and enjoyed.

To achieve this narrow selection, it has to be possible to zoom in on the attributes to filter by. Fig. 6 shows narrowing down on a search using map, treemap, and timeline.

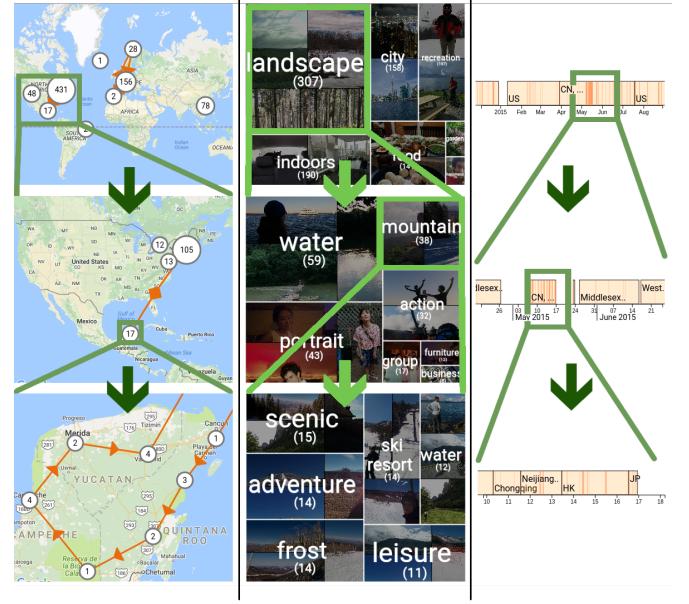


Fig. 6. Demonstration of how a user can narrow-down their search utilizing the hierarchical clustering and visualization techniques in the map view, label treemap view, and timeline. All three components provide additional details on demand by re-computing the summarizing clusters to allow the user to make a specific selection.

In the following, each of the components will be explained in more detail as we reveal some of the design iterations and considerations.

4.3 Search

The search is indexed over the photos' labels and metadata to make it possible to search using tags, time and location. The search also supports the use of multiple keywords using “and” “or” logic operators, while single spaces are assumed to be “and”. These operators are helpful in case of complex query where a user could be looking for photos of mountains in Colorado and search for “Colorado Mountains”. Another use case is if a user does not have complete information and e.g. searches for a photo taken in either Boston or Cambridge.

4.4 Timeline

Time information was identified as the most common bit of information by participants of the user interviews. This motivated making an informative timeline an essential component of the user interview [FTIMELINE].

In addition to allowing users to select particular time frames, we see the timeline as an opportunity to provide context by revealing temporal photo taking behaviours, summarizing this information in one view. An initial design .. MS: talk about the line / area charts

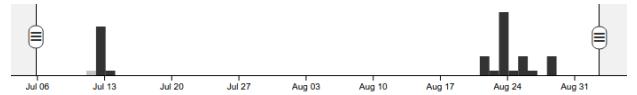


Fig. 7. Initial design of a timeline that attempts to show temporal trends.

