

# My Digital Photos: Where and When?

Neil O'Hare<sup>1</sup>, Cathal Gurrin<sup>1</sup>, Hyowon Lee<sup>1</sup>, Noel Murphy<sup>1</sup>, Alan F. Smeaton<sup>1,2</sup>, Gareth J.F. Jones<sup>1,2</sup>

Centre for Digital Video Processing<sup>1</sup>, Adaptive Information Cluster<sup>2</sup>

Dublin City University

Glasnevin, Dublin 9, Ireland

{first.last} @computing.dcu.ie

## ABSTRACT

In recent years digital cameras have seen an enormous rise in popularity, leading to a huge increase in the quantity of digital photos being taken. This brings with it the challenge of organising these large collections. We present work which organises personal digital photo collections based on date/time and GPS location, which we believe will become a key organisational methodology over the next few years as consumer digital cameras evolve to incorporate GPS and as cameras in mobile phones spread further. The accompanying video illustrates the results of our research into digital photo management tools which contains a series of screen and user interactions highlighting how a user utilises the tools we are developing to manage a personal archive of digital photos.

## Categories and Subject Descriptors

H.5.1 [Multimedia Information Systems]: Information Interfaces and Presentation – *Multimedia Information System*.

## General Terms

Management, Human Factors.

## Keywords

Digital Photo Collections, GPS, Content Browsing.

## 1. INTRODUCTION

Recent years have seen a revolution in photography with a move away from analog film towards digital technologies resulting in the accumulation of large numbers of personal digital photos. While digital storage offers ample storage capacity, technology for managing digital photos has not kept pace with capture and storage advances. The MediAssist project at the Centre for Digital Video Processing (CDVP) at Dublin City University is developing tools to enable users to efficiently search their photo archives. Our research utilises automatically generated contextual metadata for organising and searching personal photo collections. Key among this context data is location of photo capture and date/time of photo capture. In this paper and in the accompanying video, we present a usage scenario for our digital photo management tools.

## 2. LOCATION-AWARE ARCHIVES

The basis for our photo management is the automated labeling of image context, in particular the time and location of photo capture, and then using that to derive additional context information. The key benefits of labeling digital photos with their location are that it enables us to support a number of access methodologies; search by location (county, town/city, even street),

and search by proximity to a location or to other photos. By using such information the browsing space (number of photos that a user has to browse) when seeking a particular photo or photos, can be drastically reduced.

By integrating location with time, additional metadata can be generated which can further automatically annotate the digital photo, such as 'daylight status', weather or indoor/outdoor classification. Standard astronomical algorithms calculate sunrise/sunset times for any location on any date, enabling us to associate a light status with each photo (daylight/darkness/dawn/dusk). In addition, given that there are about 10,500 international weather stations all over the globe which constantly log weather data, we annotate each photo with the weather data from the nearest weather station at the time the photo was taken. Indoor/outdoor classification is inferred from metadata stored by the digital camera in JPEG EXIF headers, which reflects the ambient light levels when a picture was taken.

This system described in this paper addresses the challenges of exploiting this metadata in an intuitive user interface, allowing for complex query formulation with the aim of managing personal digital photo archives, also providing facilities to manually override the automatically extracted metadata if desired.

### 2.1 Archive Construction

In order to create a location-stamped personal digital photo archive, a GPS-enabled digital camera is required. While these are available, they are expensive, so pending the arrival to market of consumer digital cameras with integrated GPS, we use a separate GPS device and then automatically match photos taken from a camera with their location extracted from a GPS tracklog when uploading to a PC [1].

### 2.2 Benefits of Location-aware Archives

A key assumption of our work is that integrating context, using location, will better support user search and browsing than the more conventional time-based organisation alone. In order to test this assumption we conducted a user experiment to evaluate how beneficial location information was in managing a personal photo archive. The results of this experiment show that searches using location are consistently faster than using time alone (approximately twice as fast), use significantly fewer query iterations and result in a much higher level of user satisfaction [2]. This small experiment clearly illustrates how useful location information is to an archive of digital photos and that it is possible to drastically reduce the user interaction and, by extension, the users' cognitive load when querying and browsing these archives.

### 3. PHOTO MANAGEMENT TOOLS

A number of experimental photo management tools have been developed as part of our research. In this paper we present our web-based desktop interface and our mobile interface.

#### 3.1 Desktop Web-based Retrieval System

The desktop version of the MediAssist system allows users to efficiently and easily browse through their archive of personal photos on their desktop PC using the location, time and other automatically extracted contextual information.

The user is presented with basic search options allowing the adjusting of location and time aspects of the query. More advanced search options are provided if the user requires. Clicking on the 'ADVANCED' button opens up a panel where the user can further specify weather (Sunny, Cloudy, Rainy, Snowy), light status (Dawn, Daylight, Dusk, Night), and Indoor/Outdoor for the photos. Also provided in the ADVANCED panel are time filters with which the user can specify particular date and time intervals corresponding to their partial recall of the temporal context of a photo-capturing event. For example the user could search for all photos taken in the evening, at the weekend, during the summer.

A simple form of query preview [3] is provided for the user to be able to see, before the system retrieves any photos, the effect of any alterations to the query. Query preview is especially useful in our system where the total number of photos in the collection is very large (some users have over 1,000 photos). When the user is happy with the query, the 'VIEW' button is clicked to see the result photo set on the right side of the screen. In presenting the result photos, four different views are used to help the user more easily navigate the results:

- 'Event List', as a default view which organizes the filtered photos as 'events' in which the photos are grouped together based on time proximity, using an approach similar to that proposed in [4]. Each event is summarized by a label (location and date/time) and five representative thumbnails automatically extracted from the event photos.
- 'Event Detail' is presented when the user selects an entry in the Event List, and is composed of full set of photos in the event automatically organized into sub-events.
- 'Individual Photo List' is an optional view where the thumbnail size photos are presented without any particular event grouping, but sorted by date/time.
- 'Photo Detail' is an enlarged single photo view presented when the user selects one of the thumbnail size photos in any of the above views. Arrow buttons allow jumping to previous/next photos in this view.

In all of the above presentation options, each photo (thumbnail size or enlarged) is presented with accompanying tag information in the form of icons, giving the user feedback about the features automatically associated with each photo. If the user wants to change or update any of the automatically tagged information for a single photo or a group of photos, s/he can do by clicking on a small notebook icon on top right of a photo or a group of photos. This overrides the automatic methods and saves the newly tagged information for a photo or a group of photos. More details on the provided features and user's interaction with them is described in the accompanying video.

#### 3.2 PDA Retrieval System

Due to the increasing proliferation of mobile phones and PDAs, we believe support for mobile access to be a key feature of future digital photo management tools. Consequently we have developed PDA tools to manage photo archives. When developing for mobile devices we have followed design guidelines which take into account the unique constraints of mobile devices, such as the minimisation of user input (where applicable) and the provision of simple user selections or hyperlinking, instead of requiring complex user interactions [2]. Our mobile interface follows these guidelines by supporting the following access methodologies:

- 'My Favorites', the first screen a user sees when accessing their archive using a mobile device. This is a personalized thumbnail listing of the top ten most popular photos based on a user's interaction history.
- Search & Browse functionality, where location and automatic annotations support searching, with time used to organize search results for subsequent browsing.

### 4. CONCLUSIONS

In this paper we have presented output of research carried out at the CDVP on the management of personal digital photo archives generated by location-aware cameras. All context information employed is automatically generated using date/time and location of photo capture, as well as metadata from JPEG EXIF headers. We believe that within a few years consumer digital cameras will have GPS capabilities and that location-based organisation will replace date/time based organisation.

Our future work in this area will include the integration of specific content analysis tools to identify re-occurring known faces or known buildings, and the integration of mapping tools into both mobile and desktop interfaces. Other important challenges are to leverage context metadata to improve on the performance of these content analysis tools, and explore possibilities for semi-automatic annotation techniques to achieve both the efficiency of automatic analysis techniques and the accuracy of manual annotation.

### 5. ACKNOWLEDGEMENTS

The support of the Informatics Directorate of Enterprise Ireland is gratefully acknowledged. This work is partly supported by Science Foundation Ireland under grant 03/IN.-3/I361.

### 6. REFERENCES

- [1] Toyama, K., Logan, R., Roseway, A., and Anandan, P. Geographic location tags in images. ACM Multimedia 2003, New York, October 2003.
- [2] Gurrin, C., Jones, G., Lee, H., O'Hare, N., Smeaton, A.F., and Murphy, N. Mobile Access to Personal Digital Photograph Archives. MobileHCI 2005, Salzburg, Austria, 19-22 Sept 2005.
- [3] Doan, K., Plaisant, C. and Shneiderman, B. Query previews for networked information services. Advances in Digital Libraries Conference, IEEE, Los Alamitos, CA. May 1996
- [4] Graham, A., Garcia-Molina, H., Paepcke, A. and Winograd, T. Time as Essence for Photo Browsing Through Personal Digital Libraries. ACM Joint Conference on Digital Libraries. July, 2002