Sarvas, R., and Turpeinen, M. Social metadata for personal photography. IEEE Computer, submitted for publication on October 15th, 2006.

Social Metadata for Personal Photography

Risto Sarvas, Marko Turpeinen
Helsinki Institute for Information Technology HIIT
P.O.Box 9800, 02015 TKK, Finland
{risto.sarvas, marko.turpeinen}@hiit.fi

ABSTRACT

The increasing number of media creation devices is adding to the organization and media management problem for personal media. Content describing metadata is seen as the most prominent answer to this problem. However, current metadata standards have shortcomings when it comes to the domain of personal media. This is because the standards are designed for public and professional uses of media and in personal media some fundamental principles about public and professional media and metadata do not hold true. Based on our studies and literature on people's photography habits we propose to use social information as a metadata resource for storing, retrieving, and enabling new applications. We argue that information on social activity around personal media is both important to the end-users and enables new kinds of applications for solving the personal media management problem, and that future work on personal media metadata should take into account the social information related to the media.

Author Keywords

content metadata, personal media, media management, social metadata, consumer photography.

INTRODUCTION

Personal photography (*i.e.*, consumer photography) is going through a gradual revolution. The number and the types of cameras in a household are increasing. There is the old film camera, the new digital camera, and the new generations of mobile phones have typically cameras as well. There were estimated 70 million digital still cameras shipped [11] and 295 million camera phones sold in 2005 [3]. The number of pictures taken has increased significantly, partly because people tend to have more than one camera, and mainly because digital technology lets people take as many pictures as they want without any development costs of film.

The changes that digitalization has brought to personal photography do not end in the capture process. Broadband access at home and office has made it easier to share and receive pictures, and camera phones have enabled picture sharing while mobile. With digitalization, the photography infrastructure has been plugged into the whole information technology infrastructure, thus making it possible to create, share, and receive photographs in a wide variety of ways.

The well-known problem facing consumer photography is how could personal photos be organized so that they could be easily searched and browsed for the vast variety of uses people have for photographs? The most prominent answer is to use metadata to describe the contents of the media. However, in this paper we point out that some fundamental assumptions and principles about content metadata, most of which is currently designed for public and professional use, do not hold true in the domain of personal media.

Our research question is that with shortcomings in the current metadata standards for personal media, especially photographs, what kind of information people would find important and could that information be easily acquired or generated. Based on our studies and user data, in addition to literature on snapshot photography, we propose the use of *social information* in the form of *social metadata* to complement media content metadata. The contribution of this paper is to show the shortcomings of current metadata standards for personal media and to propose a solution by using social information as metadata. To ground our concept of social metadata we go through the commercial photo sharing system *PhotosToFriends*. We argue that social information is important for the users for both short and long term uses, and we discuss how the social information in the system could be implemented as social metadata.

Related Work

Much of the previous work done on personal media management with metadata is through constructing systems – commercial services and academic prototypes. All of the popular commercial systems use time and date metadata as the means for organization. Some of them, such as Adobe Photoshop Album, enable the user to create also content describing metadata such as people, places and events. Academic prototypes (see, *e.g.*, [4, 12, 13]) have leveraged the temporal metadata further by clustering the media taken within a time frame, location metadata is also used as means for organization by using GPS coordinates or mobile phone cell information, and work has also been done on facilitating the user creation of metadata by user interface design and automating parts of the metadata creation process. In these systems the metadata used is about the contents of the media – mainly people, places, and events.

None of these systems take into account the social activity and information around the media in organizing and managing the personal media.

PERSONAL MEDIA IS A DOMAIN OF ITS OWN

Foote in his article [6] applies Sturgeon's law to public media: ninety percent of media is crud. However, this does not hold true in personal photos. How many would agree that ninety percent of their personal photos are crud? This is even truer in the age of cheap digital storage where almost every photo is stored and only the absolute failures are deleted. Foote talks about professional and publicly available media, not personal media created by the end-user herself. The creation of media by consumers themselves is significantly different from professional media creation. Although the problems with semantic metadata are similar in both domains (*i.e.*, cost of obtaining metadata, subjectivity of human annotations, restrictiveness of formalized schemata, longevity, privacy, and standardization [15]) there are differences in the characteristics of these problems. This reflects into the principles in designing metadata for consumer media:

- the metadata should be private,
- it is highly semantic because it is personal,
- its creation can not be fully automated,
- metadata is a non-trivial concept for the average consumer to learn, and
- it has different uses than metadata for professional media.

Firstly, consumer photos are self-created and private. Although more personal media is being published on blogs and web pages, the majority of people use their photos for private purposes within a limited circle of people: friends, family, colleagues etc. This means that the *metadata* associated with the photos should support these same private purposes. The metadata does not necessarily have to be objective and understandable by outsiders or people not familiar to the creator of the media.

Information about the contents of snapshot photos is highly semantic because it is both personal and contextual. Personal in the sense that "home" is not the same location for everybody. Contextual in the sense that friends working for the same employer can be colleagues in one context and friends in another.

Due to these inherent characteristics of information about personal photographs, the semantic gap between the information acquired automatically and the information valuable to the user is perhaps even wider than in public or commercial media. To bridge the semantic gap user participation is required. For example, it is a very challenging task to infer from the EXIF metadata generated by the camera the names of people in the picture. For the user this information is obvious. On the other hand, there is ongoing work addressing this problem by looking into leveraging context information in inferring photo content information. For example, by using information about nearby Bluetooth devices to guess the people in the photo [5].

Because the user has to be involved in the metadata creation process the user's perceptions on the costs and benefits of the process play a key role. This brings about the problem of motivating the user to take a part in the metadata creation process. Unlike in public media or media in a commercial context, there is no public good or financial motivator to do the metadata creation, insertion, or annotation task. To the average photographer at home, the benefits of having metadata are neither clear nor immediate: the annotation task is often separate from the tasks that would demonstrate the benefits of metadata (*e.g.*, searching for pictures or applications leveraging metadata).

There is also the problem of educating the user to understand what metadata is and why it should matter. Content metadata is intuitively related to manually annotating paper photos, which is something that people have little time to do in the first place. In one of our user interviews a person commented: "Why should I write down who is in the picture? I remember everyone, and if I forget who someone is they are probably not that important anyway." On the other hand, all of our interviewees were familiar with the case where they would like to know the content information of some old photo (*i.e.*, who are these people, when was this taken?). Nevertheless, they had not found these situations motivating enough to increase their annotation or organization effort.

Finally, the uses for personal media are different from the uses for public or commercial media. The personal relationship to own photos is much stronger than to public media: hardly any photos are discarded or considered to have no value. Also, personal media is taken to be shared mainly in a private context within a social network: sent over email, given on CD-ROMs, and so on. There are no business models or other societal incentives, such as preserving cultural heritage, that are associated with personal media from the owner's perspective. How do current metadata standards support these consumer photo uses and address the problems described above? Hardly at all.

The Shortcomings of Current Metadata Standards

The metadata standards designed and adopted for media management, such as EXIF, MPEG-7, or IPTC, (see, *e.g.*, [19] on current standards used in consumer photography), have clear shortcomings in the domain of personal photography. Although these standards are supported by some consumer software for media management, these metadata approaches were not designed for the uses consumers have for their own personal media. They are designed for commercial media, public media, or news media.

For example, the EXIF standard provides lot of information and is supported by most consumer cameras but technical information about the state of the camera at the time of capture has little use in everyday photography. Bulterman in his article argues within the same lines: the metadata descriptions in the EXIF standard are mostly irrelevant [1]. The MPEG-7 standard provides a very extensive tool for describing multimedia and a large vocabulary of description terms. However, the standard is focused on commercially produced media, not for personal media. The IPTC standard is designed for news media. In other words, none of the major metadata standards directly support personal and self-created media.

Ongoing W3C work on image annotation focuses also very much on commercial or public media, and vocabularies and standards such as the Dublin Core and the VRA Core are examples of this. Although personal media management issues are addressed (see, *e.g.*, [10]), vocabularies that would directly support these are missing.

Personal photography is also filled with very practical problems that the standards often assume non-existent. For example, people do not necessarily have the time and date on their camera correct, or it is set to a wrong time zone when traveling. Also, getting GPS coordinates to a photo is, in practice, very difficult for the regular snapshot photographer. The personality of snapshot photos also plays a critical role in the information required by the user. This is true, for example, in the granularity and hierarchy of location information: for a tourist “Japan” might suffice as a location but for a resident of Tokyo the locations are more detailed and structured. The main cause for the problems in personal content metadata is that the metadata reflects personal life: people, places, events etc. This information is dynamic by nature because relationships to people, places, and events change over time. For example, the tourist who visited Tokyo moves to live in Tokyo and this changes the past, present, and future picture metadata. Not to mention divorce or breakup situations where photos are divided or perhaps thrown away, and the personal relationships to the people, places, and events are re-defined.

In the library and information sciences there is an ideal of objective, well-structured and time-enduring metadata for describing objects for public use. For metadata in personal media this ideal is not applicable – the metadata and its structure are too personal, contextual, and dynamic. This means that personal metadata is less standard among people than metadata for public media. Secondly, because personal information and relationships change, the task of managing the dynamic metadata and ontologies is a burden to the end user; there is no other person or technology to do the job. None of the current metadata standards take these issues into account, and therefore, are limited as facilitating media management in personal photography.

Photo Use is Social Use

To design metadata for personal media, the uses people have for their own media should be understood. It is not enough to extend the uses and scenarios for public media to the consumer domain. Studies on traditional family photography [2, 9], and new uses for digital and mobile photos [7, 12, 16, 17], show that consumer photos are taken, shared, and re-used often in a social context. Photos are taken to commemorate special events, to share experiences, given as gifts, to initiate interaction, sent as jokes, stored as parts of family histories and so on. Practically most uses for photos involve people, either from the social networks of friends, family, colleagues *etc*., or people outside these traditional networks, for example, new relationships formed through instant messaging or social networking websites.

Old film-based paper photos have been traditionally shared with a limited number of people – much due to the physical nature of the media. With digital technology it has become possible to share pictures on the Internet with unknown people. Especially camera phones have created new ways to share and publish photos. Although the personal publishing and blogging phenomena have been widely discussed and hyped, it should not be assumed that all the photographers in the world want to publish their pictures in the Internet. In other words, the traditional private use of photographs should not be overlooked because it is these traditions and conventions that new uses are based on.

To summarize, the uses people have for their personal media is social. Therefore, taking advantage of the possibility to capture social activity with current media sharing technology suggests using social information as means for facilitating the old and new uses for personal media.

SOCIAL METADATA

In our previous studies on mobile photos and media sharing we have interviewed over twenty people on their photography habits and photographs, and studied the photo sharing of over 140 people [17, 18, 20]. Going through our data we have raised the question what metadata is useful and valuable to the snapshot photographer, and what information people would like to use and keep associated with their media. In addition to the information about who, where, when, and at what event the picture was taken, people in our studies have showed increasing interest in the social information about the photos: who was the picture shared with, what did they say about it, did they like it, and so on. As digital pictures are shared and discussed over computer networks it has become possible for programs to capture this social information.

To solve the media management problem in personal media, *content metadata* about the pictures should be complemented with *social metadata*. Content metadata, which is intuitive and important for the users, focuses mainly on the information at the time of capture. Social metadata is about what happens to the picture after the capture. After all, it is after the capture that the meaning of the photo is constructed socially. The use of social information as media metadata has not, to the best of our knowledge, been taken into account in any of the current metadata standards or related work on personal photography.

Social metadata is storing information about social interaction related to media objects and their collections in a structured and accessible form that is independent of any specific software implementation. Social metadata concerns people and the relationships to other people and media objects. For example, information about whom the user has selected to share a photograph with. To give a general definition, social metadata is information on people's interaction with other people using the media objects. This includes visits to compiled collections of media (*e.g.*, photo galleries and archives) or viewing of individual pictures. People also have different kinds of discussions related to the photos: there may be comments and replies to them, explicit links between photos, or other information. It is also possible to generate implicit social metrics that are based on multiple people viewing the media objects, such as popularity of photos or the number of recipients of a photo message. Social metadata also enables applications such as social navigation of media or describing social networks and their dynamics.

The concept of social metadata has become viable through media sharing applications and services that make it possible to record user activity around media. Photo sharing web services such as *Flickr*, *Snapfish*, or *PhotosToFriends* make it possible to track and record what people do with personal media after capture: the sharing, discussing, and viewing. We see the use of social information as metadata having significant potential in facilitating personal media management: it is intuitive and important information for the users and it is, to a certain degree, available as user logs in media sharing systems. An actual metadata schema or a vocabulary for social metadata we see as important future work and not within the scope of this paper.

Are Tags or Logs Social Metadata?

Related to personal media metadata is the use of user-created tags and "folksonomies" in sites like *Flickr*, *MyWeb 2.0*, and *del.icio.us*. In these sites, the people publishing the content tag it with their own keywords that can be whatever and they are not pre-structured in any way. Typically the tagging is done because of social motivations, and the tags have an implicit message which is understood in a social context. For example, photos tagged "family" might mean pictures of a specific family. For a public audience it is not clear whether the pictures are *of* a family or *for* a family to view. Therefore, there is a level of ambiguity present in user tags.

The concept of social metadata is closer to user logs than user tags. It is information about the social activity and interaction around photos or sets of photos, and often similar information is recorded, stored, and shown in log data. We see system logs the key in generating social metadata. The difference between logs and social metadata is that the latter is described in a standardized language and only the relevant information is selected. In the following section we give an example of social information and social metadata in a commercial media sharing system.

THE EXAMPLE CASE OF *PHOTOSTOFRIENDS*

To provide a concrete example we describe the social information created, recorded, and showed to the users in a photo sharing service *PhotosToFriends*. The service started out as a research and service prototype *MobShare* which was designed jointly by us and Futurice [18] and it was later developed to the commercial service *PhotosToFriends*. Currently the service is the Finnish photo sharing site *Kuvaboxi* with over fifty thousand users. At the time of this study *PhotosToFriends* had over ten thousand users, majority of them Finnish. *PhotosToFriends* is used here as an example because it shows the importance of social information in sharing personal photographs and it has a substantial number of users to get quantitative data grounded on actual use. For a detailed description of the service see [17, 18].

The Basic Features

PhotosToFriends is based on an architecture where the pictures are shared, discussed, and viewed on a web server. The apparent characteristic of this architecture is having all the users' pictures in one place for socializing around the media. The pictures are stored and shared in galleries. The service does not publish the images but limits access to the picture galleries on an individual basis: for each gallery, the user has to explicitly choose the people who have access to the gallery (*i.e.*, who the gallery is shared with).

Once a new picture gallery is shared, the people associated with the gallery get a notification to their phone or email. To view the pictures, the user logs into the service website. There she will have her personal view of all of her own galleries and the galleries shared with her (see Figure 1). By clicking a thumbnail in a gallery the picture is shown in a pop-up window with a textbox for comments. Next to the thumbnail is a counter that shows how many times the picture has been clicked open. On top of the thumbnails there is a list of the people who the gallery is shared with. If the gallery is the user's own, the user can see the last time each person visited the gallery. Any pictures or comments that have been shared since the user's last visit are colored red to help in finding the latest social activity.

As a result of the controlled user access, for each gallery there is a distinguishable group of individuals associated with it, and for all the individuals it is possible to record what pictures they viewed and what comments they wrote and when. These features (*i.e.*, individual user identification, commenting, viewing, and organization into galleries) are common in photo sharing sites in general.

Social Activity and Social Information

In *PhotosToFriends*, social activity is posting photos to the galleries, writing comments, visiting galleries, and clicking a thumbnail to view a photo. This activity is recorded and shown to the users: everyone can see the other people the gallery is shared with, and who has commented what and when, and the owner of the gallery can see who has visited the gallery and when. This social information has grown to be a key feature in the service. This information is used, on the one hand, to immediately notify users that there is ongoing activity around the photos. On the other hand, the information is stored next to the photos for long-term uses such as recording personal history. For example, the user can go back to old galleries and reminisce the comments and visits in the gallery. The social information has immediate value as facilitating ongoing social activity around the photos, and also, long-term value as storing the shared experiences and past social activity.

Figure 2 shows quantitative data how the social activity in a *PhotosToFriends* gallery develops over time. The figure shows both the immediate social activity in the very first days after a gallery has been created and shared (*e.g.*, circa 90% of photo posts/uploads and 50-60% of comments in the first week). It also indicates the interest in past social activity (*i.e.*, the percentage of passive visits saturates towards 100% slower than the more active posts or comments).

Our qualitative user studies with the preceding *MobShare* system [17] support this view of immediate interest and long-term interest. The galleries were most active the first week when the benefits of having social information were immediate: the users wanted to participate in the collective viewing and commenting. After the first week the posting and commenting faded away but visiting the galleries lasted longer. This supports the view that people are interested in the social activity also after the activity has faded: looking back at the photos and the social activity that happened.

Social Metadata for *PhotosToFriends*

Based on the social information available in *PhotosToFriends*, a simple example of social metadata on each photograph would be: the comments and their authors, the visitors who saw the photo and their times of visits, the number of views of a photo, and the gallery where the photo was. This information is already all available in the system, but not as metadata that could be used by third party developers or downloaded with each photo. If this metadata would be available in a standardized language, the storage of important information, such as comments, would not rely on the service provider. Also, the availability of such simple metadata would open up opportunities for developing new applications, such as automated photo books with comments and knowledge on the popularity of each photo and the social network it was shared in.

Nevertheless, through this example we have shown that social information has both immediate and long term value for the snapshot photographer, and that this social information can be generated from the social activity common in media sharing services.

DISCUSSION

We identify three categories of use for content metadata in personal photos:

1. The *storage* of information, especially long-term storage and preservation of information about the media. For example, when someone picks up an old photo and wants to know who the people in the photo are and when it was taken.
2. To enable *organization* of media collections so that they can be easily, intuitively, and even entertainingly searched, browsed, and viewed.
3. To enable *new applications* that re-use the media and the metadata, such as, media diaries or photo books.

The concept of social metadata fits well into these three categories. Storing and showing the social information has long-term and immediate value. For example, which one *is* the most popular photo and which one *was* the most popular photo. Secondly, it can be used to organize and retrieve media. For example, to find all the galleries shared with certain people, or to find the most commented photo. Thirdly, it enables new applications such as depicting social networks and their dynamics, or measuring the importance of photos based on the number of views and sharing.

Open Issues

Nevertheless, social metadata is not without its problems. First, social information is dynamic by nature. There will be new comments, new people, more views *etc*. There is no time limit to the social life of a photo after capture. How to keep up with the growing and changing information? With personal media such as photos, the metadata should be designed to last for decades.

This requirement for longevity brings forth another issue: to share or export photos and the social metadata there should be a standard way of describing the social metadata. The social information should not be application specific data. The implementation issues in creating a vocabulary or an ontology for social metadata remains for future work. However, the social information in user logs of media sharing services could be used in implementing social metadata.

A third open issue is managing the privacy. This is a shared problem for all personal metadata, but for social metadata it is especially important, because it stores information about the social lives of intimate groups of people.

Conclusions

Our objective was to show that personal media domain is significantly different from the public and commercial media domains and this should be taken into account in designing metadata for personal media such as snapshot photographs. Current metadata standards and approaches designed for public and commercial media do not support the uses people have for their personal photos. An example of this is the lack of any practical and realistic consumer applications for such metadata standards as EXIF or IPTC. Without assuming a working combination of a positioning device, face recognition, inference algorithms, and most of all, endless user motivation, the information such as exposure time or focal length is useless.

What we have proposed in this paper is to complement content metadata for personal photographs with social metadata about the photographs. Based on our user studies and constructed systems we have found that social information about media is important to the people and it is, to a certain degree, already available in media sharing systems designed for socializing.

Our contribution to metadata design is to provide a fresh and an empirically grounded perspective in understanding what information people would like to have stored with their personal photographs. We recognize the future work in solving the open issues with social metadata and the challenges in implementing and evaluating a working metadata schema. However, we see research and commercial potential of social metadata in storing important information, in facilitating media management, and in enabling a new class of applications taking advantage of the social information.

REFERENCES

1. Bulterman, D.C.A. Is It Time for a Moratorium on Metadata?, *IEEE MultiMedia*, 11(4), pp. 10-17, October/December, 2004.
2. Chalfen, R. 1987. Snapshot Versions of Life. Bowling Green State University Popular Press, OH.
3. CNET news.com. 2005. Camera phone sales on upswing. http://news.com.com/Camera+phone+sales+on+upswing/2100-1041_3-5980049.html
4. Cooper, M., Foote, J., Girgensohn, A., and Wilcox, L. 2003. Temporal event clustering for digital photo collections. In *Proceedings of the Eleventh ACM international Conference on Multimedia* (Berkeley, CA, USA, November 02 - 08, 2003). MULTIMEDIA '03. ACM Press, New York, NY, 364-373.
5. Davis, M., King, S., Good, N., and Sarvas, R. 2004. From context to content: leveraging context to infer media metadata. In *Proceedings of the 12th Annual ACM international Conference on Multimedia*. MULTIMEDIA '04. ACM Press, New York, NY, 188-195.
6. Foote, J. 2005. Kooks, Obsessives, Sturgeon's Law, and the Real Meaning of Search. *IEEE Multimedia*, 12(3), pp. 4-7, July-September, 2005.
7. Frohlich, D., Kuchinsky, A., Pering, C., Don, A., and Ariss, S. 2002. Requirements for photoware. In *Proceedings of the 2002 ACM Conference on Computer Supported Cooperative Work* (New Orleans, Louisiana, USA, November 16 - 20, 2002). CSCW '02. ACM Press, New York, NY, 166-175.
8. Furnas, G. W., Landauer, T. K., Gomez, L. M., and Dumais, S. T. 1987. The vocabulary problem in human-system communication. *Commun. ACM* 30, 11 (Nov. 1987), 964-971.
9. Hirsch, J. 1981. *Family Photographs: Content, Meaning, and Effect*. Oxford University Press, New York, NY.
10. *Image Annotation on the Semantic Web*, W3C Editor's Draft 2006/06/18, W3C 2006. http://www.w3.org/2001/sw/BestPractices/MM/image_annotation.html
11. InfoTrends/CAP Ventures. 2005. World Wide Digital Camera Forecast.
12. Kindberg, T., Spasojevic, M., Fleck, R., Sellen, A. The Ubiquitous Camera: An In-Depth Study of Camera Phone Use. *IEEE Pervasive Computing* 4(2), 2005, 42-50.
13. Kuchinsky, A., Pering, C., Creech, M. L., Freeze, D., Serra, B., and Gwizdka, J. 1999. FotoFile: a consumer multimedia organization and retrieval system. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems: the CHI Is the Limit* (Pittsburgh, Pennsylvania, United States, May 15 - 20, 1999). CHI '99. ACM Press, New York, NY, pp.496-503.
14. Naaman, M., Song, Y. J., Paepcke, A., and Garcia-Molina, H. 2004. Automatic organization for digital photographs with geographic coordinates. In *Proceedings of the 4th ACM/IEEE-CS Joint Conference on Digital Libraries* (Tuscon, AZ, USA, June 07 - 11, 2004). JCDL '04. ACM Press, New York, NY, pp. 53-62.
15. Ossenbruggen, J. van, Nack, F., Hardman, L. "That Obscure Object of Desire: Multimedia Metadata on the Web, Part 1," IEEE MultiMedia, vol. 11, no. 4, pp. 38-48, 2004.
16. Rodden, K. and Wood, K. R. 2003. How do people manage their digital photographs? In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. CHI '03. ACM Press, New York, NY, 409-416.
17. Sarvas, R., Oulasvirta, A., and Jacucci, G. 2005. Building social discourse around mobile photos: a systemic perspective. In *Proceedings of the 7th international Conference on Human Computer interaction with Mobile Devices & Services* (Salzburg,

Austria, September 19 - 22, 2005). MobileHCI '05, vol. 111. ACM Press, New York, NY, 31-38.

18. Sarvas, R., Viikari, M., Pesonen, J., and Nevanlinna, H. 2004. MobShare: controlled and immediate sharing of mobile images. In *Proceedings of the 12th Annual ACM international Conference on Multimedia* (New York, NY, USA, October 10 - 16, 2004). MULTIMEDIA '04. ACM Press, New York, NY, 724-731.

19. Tesic, J.. "Metadata Practices for Consumer Photos," *IEEE MultiMedia*, 12(3), July-September, 2005. 86-92.

20. Wilhelm, A., Takhteyev, Y., Sarvas, R., Van House, N., and Davis, M. 2004. Photo annotation on a camera phone. In *Extended Abstracts on Human Factors in Computing Systems*. CHI '04. ACM Press, New York, 1403-1406.

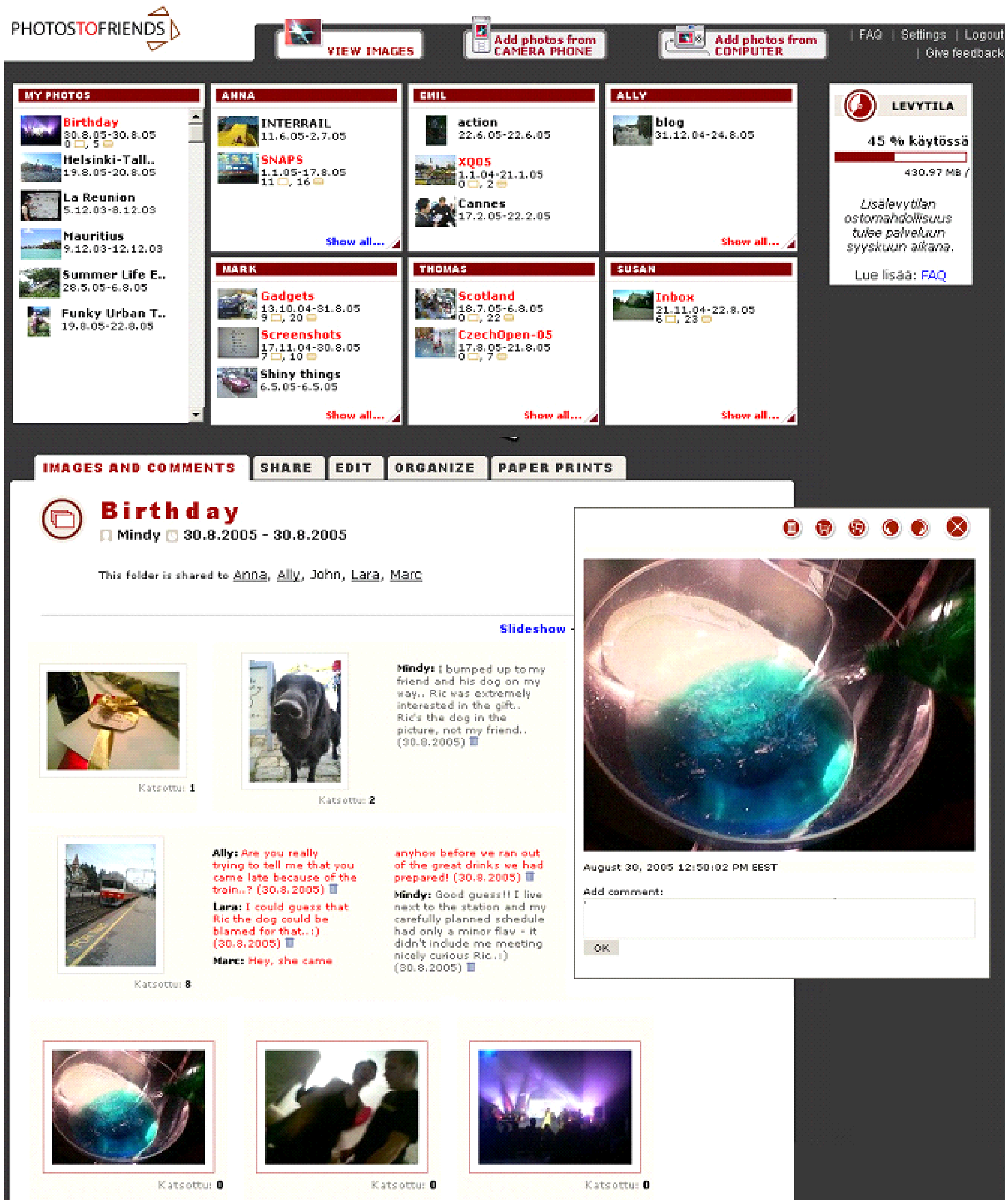

Figure 1. The web interface of *PhotosToFriends*. The user's own galleries and ones shared with her are shown on the top. New galleries, comments, and photos are marked red. The people who have visited the gallery have their names underlined, a mouse-over feature shows the date of the last visit.

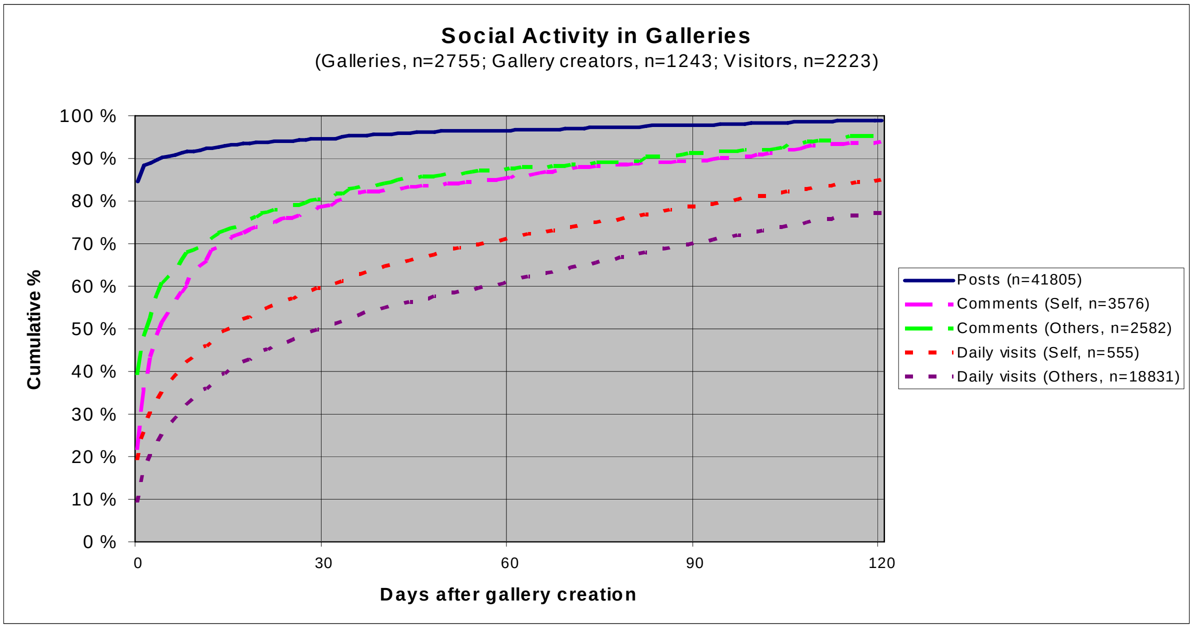

Figure 2. Cumulative data on social activity of 2755 galleries in PhotosToFriends from the day of the gallery creation to four months later. The data excludes galleries that were not shared to anyone. 'Self' in the figure means the owner of the gallery. The number of users in the sample is 2223.