Experience Explorer: Context-Based Browsing of Personal Media

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Abstract. We designed and built a system for browsing digital content and activity data created and gathered with mobile phones. We evaluated the system with 13 users to study the value of the context-based visualizations in real life. In addition to supporting reminiscing, content aggregated on the map revealed life patterns supporting reflection. Aggregation of items from several people also revealed common interests among friends.

Keywords: Personal content, context, lifelogging, self reflection, user study.

1 Introduction

People want to be able to reminisce and reflect on the important events and every day incidents in their lives. Modern technology supports recording of a wide variety of content types. Furthermore, a mobile phone can be used for recording the user's context as well. In addition to private reminiscing, the social uses of lifelogs have been identified as important [1], but little research has been carried out on them.

In this paper we present a system for browsing personal media, enhanced by using context information recorded by a mobile phone for organizing the content items. The system is designed for browsing the user's own content as well as content that the user's friends have shared with him or her. In addition, we describe a user trial that studied what kind of value the gathered content and one's recorded context, visualized in relation to friends, time and location, would provide for users.

2 Related Work

2.1 Previous Lifelogging Systems

The ability to store all the relevant documents, photos and messages during one's life has enticed people from the days of Vannevar Bush [2]. His iconic article described a vision of Memex, a desk-sized tool for storing documents on microfilm and searching

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them effectively. Since then, several “memex”-like approaches have also been presented for desktop computers; MyLifeBits, for example, stores all the viewed photos, read documents and listened audio [3]. Typically, lifelogging systems focus on browsing the user’s private content, and do not include features for sharing the content. Furthermore, early lifelogging systems tend to make only limited use of the information about one’s social interactions.

Current mobile phones are exceptionally well suited for recording the owner’s life events. In addition to being almost always carried, a mobile phone includes a considerable amount of information about the owner’s communications and social connections. In addition to content and activities, a mobile phone suits well for recording the context of the user. Context can be defined as any information that characterizes the situation of, for example, a person [4]. As an example, a system called Affective Diary records the user's movement, level of arousal and names of Bluetooth devices around the user [5]. It combines this context information with content, like photos and SMS messages, to create visualizations of the user’s activity [5].

2.2 Browsing the Lifelogs

While storing digital memories automatically, the vast amount of the content quickly becomes a challenge. The items valuable for reminiscing become easily obscured with the irrelevant items [6]. When looking for means to cope with that, people and location have been identified as important memory cues in searching photos [7]. Furthermore, people tend to group their photos based on events and later on they rely on the event grouping when browsing the photos [8]. The strong tie between the content and the event in which it has been captured suggests that browsing should be supported simply by automatically grouping the content by events [9].

Timeline view for presenting stored content about one's life is a natural and well established approach used in many research systems such as MyLifeBits [3], LifeLines [10], Lifestreams [11] and Stuff I’ve Seen [12]. While the basic idea of the implementations is the same, different visualization methods and additional information have been used to increase the value of the view. LifeLines uses the thickness and color of the line to indicate the significance of the events presented on the lines [10]. Stuff I've Seen displays search results with a preview of each item in chronological order, indexing the results with landmark events from, for example, the user's personal calendar [12], [13].

2.3 Value of Lifelogs

Photos are a common trigger for reminiscing and lately one of the most popular research approaches to lifelogging is the continuous visual capturing of one’s life with a wearable camera [14], [15], [16]. The findings of Kalnikaité et al. [16] suggest, however, that different data types and views to the data support different types of remembering, from detailed recalling to inferring the past events and habitual patterns. They suggest that image data should be the cornerstone of lifelogs, but richer recordings about the past should be collected. Lifelogs can support general recalling of emotionally valuable events, but they have been shown to help in self-reflection as well [17].

Digital memories are often shared with the people who were present at the time of capture [17]. Hence, the information should be shown and provided as a preset when selecting recipients for sharing. Recently, popular photo browsing applications like iPhoto and Picasa have incorporated face recognition to enhance the photos with information about who appear in them. Although the described type of content analysis works for photos, it requires some manual work from the user, and with a variety of media types, different methods are needed for determining who was there.

3 Experience Explorer

We built a system called Experience Explorer (ExEx) for recording and browsing digital memories and visualizing one's life history in relation to friends. The system is designed for browsing the user's own content and content shared to him or her by friends. The information about the user's context and interactions with friends is used to support event-based finding of content, to invite reflecting on one's past actions, and to provide an overview of one's social life. The possibilities to follow other users' life too closely are, however, minimized. Discussion on the general privacy issues of the logging system has been published separately [18].

3.1 System Components

The system consists of three main components: (1) a persistent context logging client on the mobile phone, (2) a central server hosting the data collected with the logging client, and (3) a desktop web application for browsing the collected data.

For logging the context data, we use Nokia Simple Context Collector. Its client runs as a background task in the user's S60 phone and periodically samples context data such as GPS location, network cell ID, and the surrounding Bluetooth (BT) and Wireless Local Area Network (WLAN) device environment. In addition, it collects music listening data, call log information and sent and received SMSs. All the data is uploaded to a network server, from where our central server fetches it and stores the resulting context information in a database.

In addition to the context data, our server scans selected third-party services, such as Flickr, for personal digital media uploaded by the users. The metadata about each content item is harvested and stored into the same database as the context data. The original content remains on the third-party servers, but details such as the title, description, and thumbnails for visual content are stored in our database for indexing. A more detailed description of the platform has been published separately [19]. Having the joint dataset of context and content metadata, we apply a number of algorithms to determine relations between the users and the content items.

3.2 User Interface

The UI of ExEx is implemented in Adobe Flex and has three main views: the lifethreads, map, and item info views. The lifethreads and map views are used for browsing content previews and for selecting items to be viewed individually in the item info view or to be shared within the system. The content item types supported by

the system are photos, videos, listened-to music tracks, text messages, phone calls and location tracks (i.e. sequences of stored GPS coordinates).

Lifethreads View. The lifethreads view presents items in chronological order on user's own and his or her friends' lifethreads. User's own lifethread is drawn vertically on the left, with his or her items laid on the line (see Fig. 1). The more there are items created with similar timestamps, the wider the user's lifethread is at that point. Friends' lifethreads (in the middle and on the right in the Fig. 1) are displayed next to the user's lifethread, with items in similar vertical chronological order. The horizontal position of the friends' lifethreads at each point of time depends on the friend's distance from the user at that time. The user has several options for selecting the distance criteria used in the visualization: physical distance visualizes how far the user's friends have been from the user geographically, communication activity shows how much the user has communicated with each of the friends, and music taste shows how similar the user's music taste has been with the friends during the viewed time. When using the physical distance as the closeness criteria, the approach aims to visually group together all the items created in a same event, providing a more complete picture of a shared experience than a single user's items would.

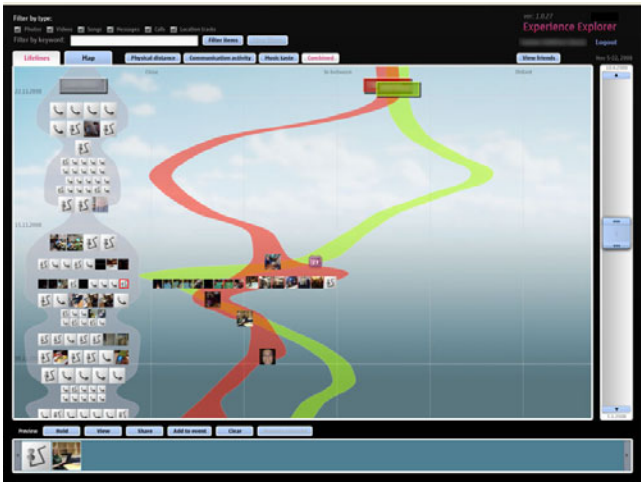

Fig. 1. Lifethreads view

In the case of photos and videos, the items are presented as thumbnails, and for the rest of the media types, as icons. By holding the mouse cursor over an item, a tooltip is displayed. The items can be selected for closer viewing in the item info view by double clicking them.

Map View. The map view lays the items out on top of map graphics to the locations they were created. The location is induced from recorded context data, matching it to the creation time of the item. As the user's context is continuously recorded, the location can often be deduced on the basis of the recorded GPS data at or around the

creation time. When the GPS signal is blocked, the system reverts to the WLAN access points and the mobile network cell IDs. For both of these, it determines the location of each base station based on the GPS data recorded, by any user, while within the range of that base station.

Items are displayed as thumbnails or icons similarly as in the lifethreads view. To avoid filling the map with hundreds of overlapping paths, GPS tracks are shown as icons, instead of drawing the full path on the map.

Item Info View. The item info view displays a larger version of the item in question and the metadata related to it. The location of the item is shown on a small map below the item. Also, a list of friends who were present at the time of creation is displayed. Next to the friends, thumbnails and icons of related items from oneself and others are displayed.

The content shown in the related content is selected using multiple criteria: geographical proximity, similarity of creation time, similarity of surrounding Bluetooth context, and the number of similar tags or keywords. Each item is scored based on the sum of these individual criteria, and the results are presented with the highest-scoring item first.

Privacy Considerations. The intention was to provide as rich information about one's social connections as possible within the acceptable limits of privacy. A user's exact location at a certain time is visible only for those friends with whom the user has explicitly shared a GPS track or an item with location information. The location of a user is, however, used for the visualization of the lifethreads showing the user's distance to one's friends, and for listing the friends present at an item creation.

4 Evaluation

A user trial was conducted in Finland to evaluate the system. It focused on the reminiscing and self-reflection value that the context-related UI components provided users as well as on gaining insight to the optimal ways to present the information.

4.1 Method

The study consisted of two phases: 6 to 9 weeks of gathering content for browsing and 8 to 12 days of using the full system including the ExEx web application for browsing the content. To provide the users with enough content for reminiscing and reflecting on their lives, the content collection and logging started early. The moment the implementation of the web application reached the level of quality to deploy to the users, the second phase started.

During the study, the users had Nokia Simple Context Collector running on their mobile phones. They also used ShoZu (www.shozu.com) for tagging the photos and videos with GPS coordinates and uploading them to Flickr, which was used for storing the users' photos. During the first phase, participants could browse their photos and videos only in Flickr, but in the second phase all their stored content was automatically visible to them in ExEx as well The users were lent Nokia N95 8GB

multimedia phones and compensated for flat rate data plans for the duration of the study. Participants paid the rest of their phone bill, i.e. calls and SMSs, normally.

The first phase started with a group interview. After the participants had their data plans activated, we met them again and gave the phones. The instructions were to use the phone as they would normally do, but upload the photos that they took to Flickr. In addition, if they were listening to music while on the move, they were asked to use the phone as their primary player. In the end of the phase, participants were met individually to introduce the desktop web application for browsing the content. They signed into ExEx with a laptop and were able to see their data for the first time. After describing how they interpret the different elements in the UI, small tasks were given to them. For example, they were asked to check with whom they had communicated most around the time the study started. The aim was to find out usability problems and to ensure that all users familiarize themselves with the core functionalities of the system. During the tasks, the users were asked to think aloud as much as they could.

In the second phase, the users used ExEx individually for 8 to 12 days. The usage of the different UI components was logged. The participants filled in a diary about their usage and experiences. After this, the users were met individually for the last time for interviewing them on their experience on using the web application.

The interviews were recorded and transcribed for analysis. The observations from the usage and diaries, as well as the interview quotes from the sessions were grouped and conclusions were made by reviewing the appearing salient themes.

4.2 Participants

The participants were recruited via mailing lists. From the groups who signed up, we selected three groups of friends to participate in the study. Two groups had five participants and one had three so the total was 13 users. 11 of the users were male and two were female (the skew mostly due to a last minute cancellation by one of the groups). Their ages varied from 19 to 32 years (average of 23). 10 of the users were students and three participants were in working life (factory worker, IT consultant and surveying engineer). Participants were all active media consumers and familiar with social media sites. Two of them were active Flickr users already before the study and three had Flickr accounts but had just tried the service a couple of times.

4.3 Results

By the end of the trial, the logging had been running 7.5 to 11 weeks depending on the user (including both phases of the trial). During that time, on average 1997 items were logged for each user. The differences between the users were quite large, as 3 of the users had less than 1000 items and one had more than 6000 items to browse. Differences were mainly caused by the varying music listening habits of the participants. Some users listened only to a couple of albums during the trial, whereas some listened to music many hours a day. Each user had on average 427 calls, 320 SMSs, 70 photos, 1.3 videos, 1087 music tracks and 91 location tracks to browse from themselves. In addition, they had some items their friends had made visible to them. The shared items were mainly photos, although some sharing experiments with the other media types were done as well.

According to the diary data, the participants used ExEx 2 to 5 times during the individual usage period. The sessions lasted from 5 to 20 minutes and each user's total usage time was between 21 and 70 minutes. In addition, the users used the system in the both interviews for about 45 minutes each. The actual usage was not as active as we had hoped for but the users were well familiar with all the features of the system and everyone had enough experience to reflect on their own needs for such systems.

The considered benefits of the logging not only included utilitarian uses of one's personal log, like reducing memory load, or personal reflection related issues like seeing where one has been and how one has been using the phone, but the information related to one's friends was considered equally important. The following sections discuss in more detail the interplay of reminiscing, personal reflection and information about friends. In addition, the roles of individual items and aggregated visualizations are considered. The changes that the logging caused to the participants' every day behavior is discussed separately in another paper [18].

Reminiscing. Lifelogging tools naturally lend themselves to reminiscing past events. The most evocative item types in our study were reported to be the photos and SMSs. Photos were mentioned by two thirds of the users and the SMSs by one third. The special value of the photos was highlighted by the usage logs as well. For example, 42% of clicks on related items in the item info view were done on images, twice as many as on the second most popular type: messages (20%).

The chosen presentation style naturally had an effect on the value of the individual items. Seeing only the time and the name of the caller of a phone call did not trigger many memories, whereas some information about the contents of the call might have.

In everyday life, content items and phone interactions clustered on the map were more intriguing for the participants than the pure recorded location tracks. However, when the location track recorded a memorable event, for example when taking a tour outside of one's hometown and away from daily routines, the pure track also provided value for reminiscing. Having made the actions outside of one's daily routines and circles added to the value of content as well. For example, users who had traveled abroad were especially interested in their actions from the trip shown on the map.

"I was so looking forward to seeing the phone calls and text messages there (on the map of the service). The ones that I made when I was abroad." (female, 22 years)

Self-reflection. Another potential benefit of lifelogging tools is the reflection of one's habits they might enable. A single music track may have been listened to many times on many occasions, so displaying the plain item in the UI does not pinpoint a certain event for reminiscing as precisely as photos and messages do. However, due to the amount of music listening events logged in our study, they started to reveal participants' daily life patterns valuable for reflection.

The music and other routine actions like phone calls formed interesting and meaningful information when aggregated on map. For example, the frequent paths formed by these icons provided participants with an outsider's view of their actions:

"This is really intriguing. You can actually see my route from my home to the city center. On my way to work, there are all these, music, some text messages, phone calls, a line is formed by these, what I've done. This is really nice." (female, 22 years)

Friends' Activities and Social Context. ExEx was designed not only to collect and show the user's own actions but also to show the social context of one's life and information about one's friends' lives.

The overall importance of seeing friends' content in the system came up frequently in the interviews but was highlighted also by the number of clicks users made on friends' photos. 72% of times a user clicked a photo in the lifethreads or map views it was a photo from someone else than the user oneself.

The lifethreads view with the physical distance criteria and the related items in the item info view both gathered the user's and his or her friends' items from the same event together. The features were valued by the users:

"If there are photos from some event you get all of them conveniently since friends' items are attached as well" (male, 25 years)

Two participants mentioned in the interview that they found something previously unknown that was common among them. For example, the lifethreads view with the music track items from friends helped noticing listened-to artists common to one's friends. Again, aggregated visualization supported making the individual items meaningful in the web application.

Lifethreads vs. Map. The lifethreads and map views were seen to support each other well. Most of the users considered the lifethreads view to be the most important view of the service. The map view was used about every time the service was used, but still less than the lifethreads view. According to the logs, 63 percent of the time spent in one of the two modes was spent in lifethreads view. It was described as an easy way to get a general view of the recent activity. According to diaries and interviews, users were checking their own activity (especially music listening), whether their friends had been close, and if someone had shared new photos with them.

"Well, I start always from checking a couple of last days, has anyone been near me or published some photos recently or something" (female, 21 years)

4.4 Discussion and Future Work

Although we were able to collect data about the value the logged data and ExEx visualizations provided users, many issues would benefit from further studies. Sharing happened mostly on photos so a long-term study would be needed to get a better view of, for example, issues in location sharing. Sharing of tracks happened especially while traveling abroad, suggesting self-presentational value, but more data should be collected to get a more complete picture of social uses of lifelog data. The question of real-time sharing also came up, since one participant noticed he had been waiting at the railway station on the same evening as his friend. Information about the past supports reminiscing, but viewing and sharing of live information would support social activities.

The slow response time of the lifethreads view and the occasional unpredictable changes in the closeness visualization were criticized and had reduced the motivation of some of the participants to use the system more extensively. However, the view to one's social activity clearly provided value, and insights on implementing similar visualizations were gained.

5 Conclusions

In this paper, we discuss how automatically captured context data can be used in the UI for organizing personal content in a meaningful way, as well as in visualizing one's life history in relation to friends to support reminiscing and self reflection.

In our study, items with evocative contents, like photos and SMSs, were inherently valuable for reminiscing of singular events. Furthermore the aggregation and location-based presentation of the content increased also the value of logged actions, like phone calls and music tracks. When aggregated on the map they revealed life patterns supporting reflection. Since the system allowed sharing of items with friends, the reminiscing of joint experiences could be based on items from several participants.

The results show that lifelog information recordable with current mobile phones visualized in appropriate ways would not only support reminiscing, but also assist users to realize new things about their own life patterns and themselves. Moreover, as social encounters and communication with others play an essential role in people's lives, the information about the user's friends was also highly appreciated in the study. Hence, taking into account the privacy needs, lifelogging systems should support sharing and showing content from friends as well.

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