A Framework for Sharing and Storing Serendipity Moments in Human Life Memory

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Abstract — **Every person has their own serendipitous moments; joyful moments that they hope can be kept in their mind forever. Unfortunately our memory can sometimes fail to retrieve all the details of when, where and why something happened. Today, with advances in technology, we are able to capture our serendipitous moments as digital images, videos, audio, text and as other forms of data, making use of the huge capacities of storage available to us. In this paper, we describe a system that can make personal serendipity moments available to be shared with trusted peer group members. We propose a flexible and scalable system for storing serendipitous moments in a human life memory framework and share them with friends without the need for a central server through a peer-to-peer network.**

Keywords — **human life memories, lifetime store, multimedia storage, multimedia annotation, personal information systems, information retrieval**

1. INTRODUCTION

Serendipity is a word which originated from an obscure Persian fairytale “The Three Princes of Serendip” in the 10th century. This Arabian tale concerns three princes; as they travelled they were always making discoveries, through accident and sagacity. One of the most famous examples of serendipity is Christopher Columbus' discovery of America when he was looking for India. On the other hand, according to the Encarta English dictionary [1], serendipity is a “natural gift for making discoveries quite by accident”, and according to Dictionanry.com [2], serendipity means “good fortune or luck”. This word also became Britain’s favourite word according to *The Word*, London's Festival of Literature 2000, which commissioned a nationwide survey, reported by BBC online news on 18 September, 2000 [3].

The need to capture serendipitous moments, and to save and share them with others in digital ways has become important through the necessity to remember so many things such as names of people, places and events, and to identify relevant information and evidence in our minds. Without a digital means to store joyful moments there is a possibility that we might forget or lose them forever.

The novelty of our work therefore lies in the consideration of memory relationships, both within an individual’s serendipitous moments and across the serendipitous moments of multiple individuals, as a primary consideration of our life memory database system. We believe the use of a peer-to-peer network structure as a means to reflect such relationships to be unique, yet with genuine benefits in regards to the identification of relevant memories and sharing of memories between individuals.

The remainder of this paper will be structured as follows. In the next section we will present a system description and provide a scenario demonstrating the strengths of our peer-to-peer design in identifying relevant memories, and show how this might be beneficial for the sharing of memories between individuals. In Section 3 we present our own design, building on this existing work that we have described. Finally we will conclude and suggest future work in Section 4.

2. BACKGROUND INFORMATION AND PREVIOUS WORK

As explained in the UK Grand Challenge in Computing 2003 [4], there is a real need for the development of techniques for storing personal serendipity moments and other lifetime memories in a manner that is robust to changes in hardware, operating systems and indexing strategies. The computer and programs that operate on the data will change frequently over a human lifetime, but the data must outlast the systems that analyze it.

There are three fundamental questions that we need to solve in the design of systems for management of serendipitous moments (personal life memories), as follows.

i. How to capture serendipitous moments?

ii. How to store and manipulate them in the future?

iii. How to share them with friends or other people?

Our research project, called "Sharing Lifetime Memories through P2P" [5] is designed to support the capture, storage, retrieval, reporting, annotation, story creation and file sharing of life memories through a peer-to-peer network. This project will provide a tool to support all three fundamental questions above. Through the rapid growth in use of digital cameras (video and static photography), smart mobile phones and digital storage (memory cards and hard disks), we can capture almost every second of our life experience. We can even share the most joyful or saddest moments of our lives with others (trusted members) through peer-to-peer networking. Serendipitous moments in our lifetime experience can be captured and can be shared with friends through our Lifetime memory system that we are developing. The system will support capture, storage, retrieval, reporting, annotation, story creation and sharing through a peer-to-peer network.

The rest of this section will cover some of the existing work in some of these areas and our approach to them together with several interesting cases in which our proposed life memory system would be most appreciated.

i. Data capture

The "MyLifeBits" [6-8] and "Total Recall" [9] systems continuously record personal experiences (memories) by using personal sensors (e.g. a special camera and microphone). In this project, we use active capture methods to capture our lifetime experiences, especially personal serendipitous moments. Active capture means people capturing photo or video on their own initiative. Active capture is very effective for allowing someone to recall an event back in the future. It can be more personally meaningful compared to passive images captured using an automatic sensor camera [10].

We use a Sony Cyber-shot DSC T200 8.1 Megapixel digital camera with the features of face and smile detection, anti blur mode and red eye reduction. It can be paired with a GPS device to establish photo locations. The Sony GPS-CS1 can be used to record where shots were taken and allows them to be displayed where they belong on a world map based on latitude and longitude. Currently we use a 1.0 Giga Byte memory stick PRO Duo, which can store up to approximately 341 pure photos (at 3264 × 2448 resolution). This camera is small and light, is convenient to carry around the neck and easy to operate for the capture of photographs and video. A serendipitous moment is not a well planned situation and it can happen at any time and any place. Therefore it is important that the camera can be easily left in standby mode, to allow pictures or video of serendipitous moments to be shot at any time or place.

ii. Data storage

Adar et al. [11] in their Haystack project emphasize the relationship between an individual and their environment. When an individual interacts with the environment, Haystack gathers data about those interactions and uses this metadata to further personalize the retrieval process. Another project, Lifestreams [12], is a personal store that abandons hierarchy in favour of time-based visualization. The project supports a form of saved query to filter what is viewed.

In our system, everything we capture, we store into a database on a personal computer hard disk which we call the memory. The database can store content and metadata for a variety of item types, including contacts, documents, email, events, photos, music, and video. There is an option for users either to edit their raw data to make it more interesting and compress them into an appropriate format or to immediately store photos or video directly to the database. A user must add annotations of a specific name, feeling or expression to their media data. This is important for future use of that media data, as without annotation, the data will be difficult to search by retrieving or querying from the database. For example, suppose I captured a serendipitous moment at my sister's wedding several years ago. I may have difficulty in remembering when that photo was captured if there are no clues to the event. We can therefore annotate that image with a date, (e.g. "November 1990") and a feeling or expression (e.g. "Happy"). As we store memories in our brain, we also attach them to other related memories, such as "unforgettable moment in life," and thus concepts with older memories. In the permanent database, we tag annotated data with GPS location and where the event happened (e.g. "ABC Club"), the event name (e.g. "Noraini's Wedding 1999") and its relationships with other data. We can then retrieve the concept at a later date by following some of the pointers that trace the various meaning codes and decoding the stored information to regain meaning. Media data with proper annotation can be short-listed into a group when the user retrieves data by date, event, expression, etc. Returning to the example, if I want to retrieve my serendipitous moment, I can put "happy" or "joyful moment" in the retrieval text box of the photograph, then the system will list all the photos with that annotation and also other

related media connected with other pointers so that one hint may allow me to recover the whole meaning. The user can then utilise instance links to relate all of the digital data (photo, video, audio, GPS location and images) when retrieving all information related to the memory of interest.

iii. Data sharing

Many researchers refer to Napster [13] and Gnutella [14] for peer–to-peer networking and file sharing. In their early generations, they used central servers to allow file sharing to occur. Xian-Sheng et al. [15] propose a web system where users not only can share but also can author their personal media but still using such a central server. There are increased security, system management and copyright issues involved with the use of a central server which we aim to avoid. In our system, we share our media content through peer-to-peer networking without using a central server.

We will now consider a scenario to demonstrate how our system works in sharing serendipitous moments. In July 2007 I took photographs at my friend's wedding. On that occasion, I bumped into my other friends Jundi and Ida. Though the serendipity lies not in seeing them at the wedding party, but rather how we met in the first place. Ten years ago, I was also the cameraman for Jundi and Ida, and now they already have two children. At this point in time, Ida had a desire to share her memories of her wedding ceremony with her friends. She started to retrieve all of her wedding photos and videos. By using the system, she can retrieve easily her collections of photographs and videos by name, event, date, file type and size, expression and location. When she retrieved photos with expression mode and chose "Happy", she would realize that in addition to sharing her serendipitous moments during her wedding ceremony, she can also share serendipitous moments during birthday parties and other events.

When the database is ready, Ida can make her serendipitous moments available to share within the peer group. Ida can also invite other peer members to share their serendipitous moments not just from wedding and birthday ceremonies but any serendipitous moment that may exist in their lifetime memories. As a result, many peer members contribute to share their serendipitous moments by sharing photos and videos through the system. In addition, when a user captures their serendipitous moment or their lifetime activity and pairs with the GPS receiver, the user can see the location and movement on a map by date. The user can retrieve peer groups and their own serendipitous moments and ask the system to generate a report on how many of them are similar.

Back to the scenario, Ida can retrieve a personal photo or video map by month or year using GPS locations and create location metadata. She can also download shared files from her peer group and map movement by month or year in a split window and activate the function that traces two different individuals' movements. When one of the peer members shares their metadata location with Ida she may discover that at certain dates or locations they were present at the same place, even if they were not aware of it at the time. As a result, they can share their stories behind the scenes. The advantage of the system is that a user can track back to where they were at a specific date, establish who they met with, what happened and correlate this movement between two or more people even if it happened many years earlier.

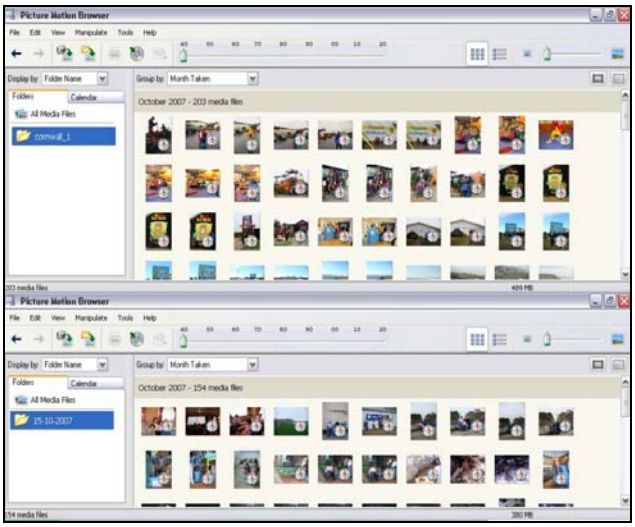

Figure 1. Correlated memory interface: photos from two peer group members are displayed next to each other.

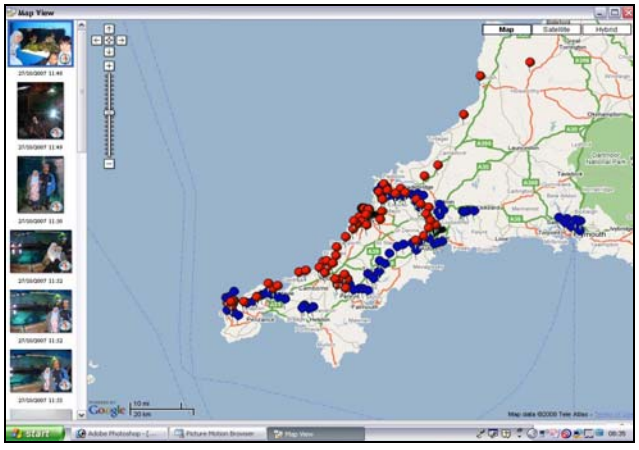

Figure 2. Map interface: red dots for Ida's GPS points and blue dots for another peer member's GPS points.

The user can also display a satellite image and zoom to various levels. Figure 1 shows a split window for two individuals' photos including GPS locations. Figure 2 shows the location logs for two different people with photos and GPS locations marked on a map where tracing location was activated. Figure 3 shows the location at increased magnification, using a satellite image for the photo locations using GPS data.

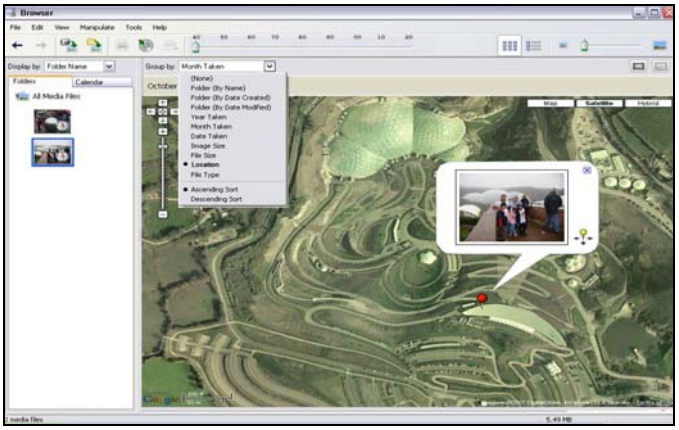

Figure 3. Displaying photo location using Google maps.

3. SYSTEM DESIGN

We consider the use of JXTA peer-to-peer networking technology for the system since JXTA [16] provides an open set of peer-to-peer protocols that enable any devices on the network to communicate, collaborate, and share resources. JXTA peers create a virtual, ad hoc network on top of existing networks, hiding their underlying complexity. In the JXTA virtual network, any peer can interact with other peers, regardless of location, type of device, or operating environment. Even when some peers and resources are located behind firewalls or are on different network transports. JXTA supports multi-platform operation and avoids the constraints of hierarchical client-server architectures.

From the point of view of this project, the most important characteristics are that JXTA technology can run on any device, including cell phones, PDAs, two-way pagers, electronic sensors, desktop computers, and servers. It is based on proven technologies and standards such as HTTP, TCP/IP and XML, and JXTA technology is not dependent on any particular programming language, networking platform, or system platform and can work with any combination of these. Using peer groups we can establish a set of peers with naming within the group and mechanisms to create policies for creation and deletion, membership, advertising and discovery of other peer groups and peer nodes, communication, security, and content sharing.

Returning again to our scenario, Ida is working on her personal computer at home and has several peer members within her group using similar devices. By using JXTA peer-to-peer networking, she can also share her serendipitous moment with other peer members who are using different platforms or devices. For example, Ida can communicate with Azizan using a different operating system and even with Ahmad using a mobile phone. Figure 4 shows how Ida, Azizan and Ahmad can share their serendipity content through the use of a JXTA Virtual Network which can support multiple peer group platforms.

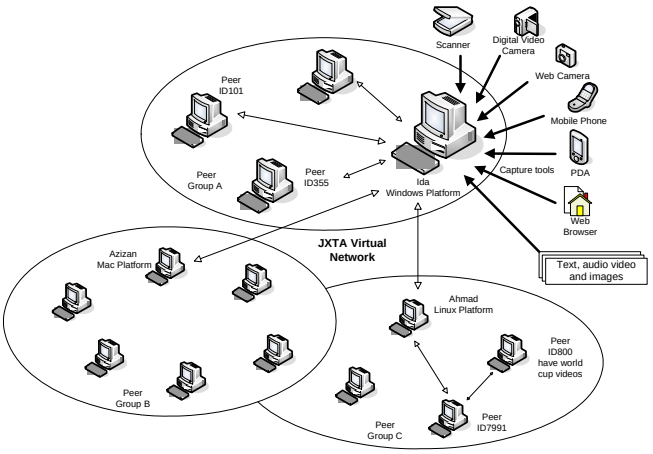

Figure 4. The JXTA peer-to-peer platform for sharing serendipitous moments.

- Security

The system is divided into two sections: one acting as a personal database system (updating personal media content online or offline) and the other one for sharing media content within a peer group. A user is required to log in using username and password to access the personal database area. Users also need to log in to the system (web based) as a peer group to share media content. Figure 5 shows this separation of data access through the use of username and password.

- Personal Database Management

Currently, we have developed a web based manual loading media entry interface. First the user needs to log in to the system after which they can start uploading all or selected media to the system. In our design, each specific piece of media content (such as photographs, video, audio, text, or e-mails) is stored in specialized tables in a relational implementation.

Another table is created to store events, along with related information such as different attributes such as event name, location, start and end time, expression, and links to other media. Relationships between various events are also captured here. Date and time is attributed to the media content automatically ensuring it can be easily sorted by the system. Photo and video properties (latitude and longitude, date taken and modified, file name, size, etc.) can be displayed by clicking using the right mouse button. The user can display the locations of their photos or videos by activating the online link button to Google maps.

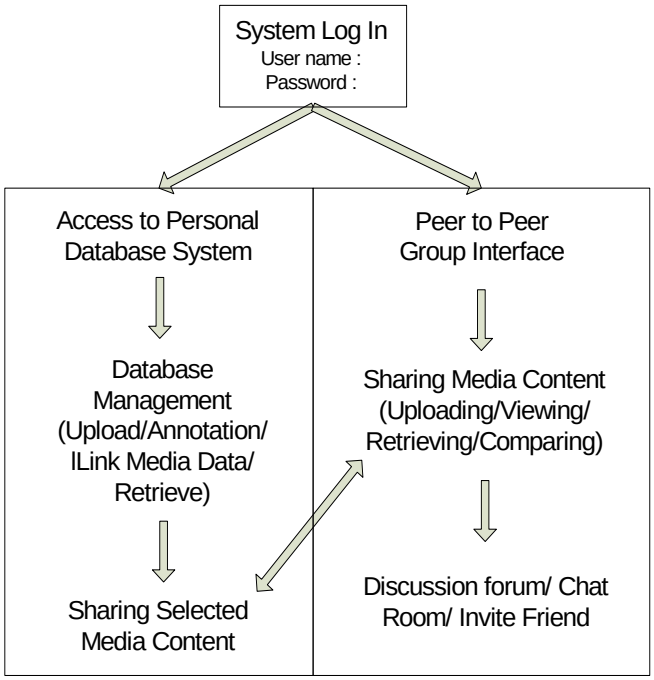

Figure 5. Security and Data flow for the system.

The system gives an option to the user to annotate their media content by completing the text fields for names, events, comments, and by choosing from a drop down list to set a suitable expression (happy, sad, natural, etc.). Figure 6 shows the record insertion form for direct access to the user database. The system provides direct manipulation techniques to facilitate natural user-system interactions. In this paradigm, users can directly perform different kinds of operations on items (events) of interest. Furthermore, combining the query and presentation space alleviates the cognitive load from the user's perspective, unlike traditional query environments. The user can display the time a photo was taken with a person's GPS recorder location to create location metadata. Photos can also be linked to calendar events to indicate a photo of the event, effectively turning the calendar into a photo diary.

- User Interface

The design of the interface has been chosen to support user interest and intention with heterogeneous multimedia data. The user can explore and relate to their serendipitous moments and life activities with friends. The use of an event model allows information to be presented to users in a manner that is independent of media and data source. In the interface various views of the data (such as those across time, event, or other attributes) are tightly linked to each other, so that interactions in terms of any one of them are instantaneously reflected in all the views (for example, selecting an event by time leads it to be highlighted in the spatial view). This is essential for maintaining context and helping the user build their own serendipity moment and life time experience database.

- System Report

The system supports exploration and allowing users to define information at varying resolutions of time, location and event. With a database, one can also create reports to understand the contents of the user's serendipity moment (lifetime) store and how annotation, filtering, extraction, viewing relations, and details-on demand have been provided in order to help users look in depth at their lifetime database. The reports can be provided in the form of log files, charts, graphs or text lists. The system generates charts for the collected data properties in case a user wants to see the pattern of their serendipitous moments and lifetime experiences, and this can be particularly useful in helping them to compare with friends, discover new serendipitous moments, evaluate, change or improve their lives.

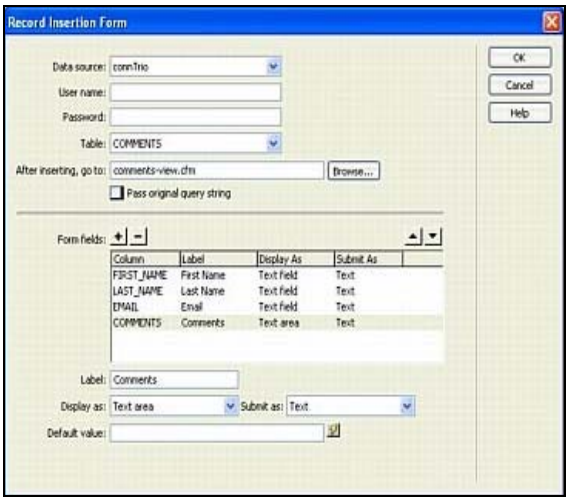

Figure 6. Record insertion form for the database.

4. CONCLUSIONS AND FUTURE WORK

The sharing of life experiences from the serendipity scenario described earlier can become a reality through the use of our proposed system using a peer-to-peer networking environment. We believe that our system already answers all three fundamental questions raised in the introduction for the design of systems for management of serendipitous moments. Such capabilities can be used to improve communication between people, to understand personal improvement coordination among family and friends, and can be an important resource for future generations.

We are continuing to develop the system and interface in several directions. One area for improvement is annotation. Annotation must be made as easy as possible and we intend to consider methods to allow such annotation while requiring less effort from the user. Face and object detection is an interesting area to be explored and may provide a further form of semi automatic or fully automatic annotation, in addition to current GPS data. Using such techniques, the potential for ease of content correlation and retrieval as the lifetime database increases in size can be improved significantly for the user.

Another area for improvement is the user interface. We are exploring different visual presentations to provide a more user-driven experience and increase user-friendliness. The user interface system for face and object detection is also of interest. A “person in a photo or video” can be recognized and used to automatically connect to other content media and personal information.

Additionally, more powerful capabilities, such as access by metadata – including written and spoken comments about an item – and the ability to organize items in multiple ways, might allow the system to undertake deeper searches outside of a peer group and to discover further serendipitous moments of a more unexpected nature.

REFERENCES

[1] MSN Encarta: Online Encyclopaedia, Dictionary, Atlas, and Homework [cited 6 November 2007]; Available from: http://encarta.msn.com.

[2] Dictionari.com [cited 6 November 2007]; Available from: http://Dictionary.com.

[3] UK's favourite word is a surprise [cited 6 November 2007]; Available from: http://news.bbc.co.uk/1/hi/uk/930319.stm.

[4] E. R. Andrew Fitzgibbon, "Memories for life: Managing information over a human lifetime," presented at Grand Challenges in Computing Research, and Grand Challenges in Computing Education, Newcastle, 2003.

[5] A.Ismail, M.Merabti, D.Llewellyn-Jones, "Sharing Human Life Memories using Peer-to-Peer Networking," presented at the 8th Annual Postgraduate Symposium on the Convergence of Telecommunications, Networking and Broadcasting, June 2007.

[6] R. L. Jim Gemmell, Gordon Bell "The MyLifeBits lifetime store," Proceedings of the 2003 ACM SIGMM workshop on Experiential Telepresence ETP '03 November 2003.

[7] G. B. Jim Gemmell, Roger Lueder "MyLifeBits: a personal database for everything," *Communications of the ACM*, vol. 49, January 2006.

[8] G. B. Jim Gemmell, Roger Lueder, Steven Drucker, Curtis Wong, "MyLifeBits: fulfilling the Memex vision," presented at Proceedings of the Tenth ACM International Conference on Multimedia MULTIMEDIA '02 December 2002.

[9] D. G. K. William C. Cheng, Leana Golubchik, "Total recall: are privacy changes inevitable?" Proceedings of the 1st ACM Workshop on Continuous Archival and Retrieval of Personal Experiences CARPE'04 October 2004.

[10] A. F. Abigail J. Sellen, Mike Aitken, Steve Hodges, Carsten Rother, Ken Wood "Do life-logging technologies support memory for the past?: an experimental study using sensecam," Proceedings of the SIGCHI Conference on Human Factors in Computing Systems CHI '07 April 2007.

[11] D. K. Eytan Adar, Lynn Andrea Stein "Haystack: per-user information environments," Proceedings of the Eighth International Conference on Information and Knowledge Management CIKM '99 November 1999.

[12] D. G. Eric Freeman, "LifeStreams : A storage model for Personal Data," *ACM Sigmond Record*, vol. 25 pp. 80-86, March 1996.

[13] Measuring and analyzing the characteristics of Napster and Gnutella hosts [cited 13 July 2006]; Available from:www.mpi-sws.mpg.de/~gummadi/papers/mm.pdf.

[14] The Annotated Gnutella Protocol Specification v0.4 [cited 13 July 2006]; Available from:http://rfc-gnutella.sourceforge.net/developer/stable/index.html.

[15] S. L. Xian-Sheng Hua, "Personal media sharing and authoring on the web," Proceedings of the 13th Annual ACM International Conference on Multimedia November 2005.

[16] Project JXTA: A Technology Overview. [cited March 2007]; Available from:http://www.jxta.org/project.