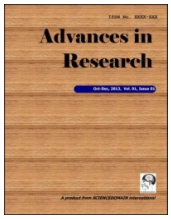

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Reminiscence Processes Using Mashups Dedicated to the Design of Lifelogging System

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Authors' contributions

This work was carried out in collaboration between all authors. Author YMC designed the study, wrote the protocol and wrote the first draft of the manuscript. Authors YJP and WJL managed the literature searches, analyses of the study performed the field trial case study and author YWC managed the experimental process and identified the results of study. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The research study is about designing and developing digital reminiscence systems that can be used by people with early-stage dementia as aiding memory tools.
Methodology: The design of a lifelogging system that captures photos, timeline and spatial information to facilitate the extraction of a salient summary consisting of good cues from the lifelog. The lifelogs mashup the selected cues for review in a way that can be utilized for memory and reminiscence support as well as strengthen the bond between a person with dementia and his family.
Results: In a field trial, we study how four different types of cues, namely visual, spatial, temporal and social context, trigger memories of recent events and resulted in better memory retention.
Conclusion: The preliminary results indicate that the system provided more opportunities for

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caregiver interaction for people with dementia, as their reminiscence processes are encouraged and that the communication with their surroundings increases in quality of life.

Keywords: Lifelog; reminiscence process; episodic memory impairment.

1. INTRODUCTION

Alzheimer's disease (AD), the most common form of dementia, is a progressive, degenerative disease of the brain. Dementia consists of symptoms that may include loss of memory, judgment and reasoning and changes in mood, behavior and communication abilities [1]. AD subtly and progressively robs people of their ability to remember their recent experiences. One of the first symptoms of the disease is recent episodic memory impairment. Episodic memory is the memory of specific experiences that you can replay in your head, in contrast to semantic memory, the memory of facts about the world. AD affects not only the individual with the disease but also his caregiver, particularly family caregivers who provide support at home. Digital reminiscence technology can be used to support recent episodic memory [2]. In particular, capture and access lifelog is a natural fit for people with episodic memory impairment. Lifelog is a social act to record and share human life events in open and public form [3]. The question that is raised is: How can we best support the recall of episodic memories by lifelogging system through external memory cues? As Sellen and Whittaker [4] suggested, episodic memories are memories of who, what, where and when and recall can be improved if one is presented with cues about the people involved in an event (e.g. social context cues), the content of the event (e.g. visual cues such as SenseCam photos), the location and the time of the event. The lifelog with spatial-temporal event enables users to look back what happened when and where. To review the "where aspect" efficiently, most services introduce map-based visualization, in which the lifelog data with spatio-temporal are displayed on a map. The other question that is raised is: What lifelog events are significant for supporting reminiscence and later recall of past activities? And how can a reminiscence process support actualization and maintenance of episodic memories? Mashups are a new kind of interactive Web application, built out of the composition of two or more existing cloud computing services and data sources [5]. In this paper, we developed lifelogging system mashup lifelog records containing digital reminiscence information with spatial-temporal lifelog. Each lifelog with location is associated with date, time and location of an event, related users, etc. The proposed mashup approach offers two advantages over reminiscence process with rich media capture. First, it imposes no burden to participants as the lifelogging system captures data continuously, rather than the user selecting when and what data to capture. Second, in doing so, it minimizes the risk of missing important moments, a common problem in reminiscence process studies. This research attempts three contributions. First, we describe lifelogging system, a digital reminiscence process that was designed with the aim of supporting the review of lifelogs in the context of reminiscence process studies. Second, through a field trial of lifelogging system we study how mashup different types of cues, namely visual, spatial, temporal and social context, trigger memories of recent events and associated reminiscence therapy (RT). Third, we translate our findings to a set of implications for the design of lifelogging system that support recall and reflection upon recent events as well as ones lying further in our past. RT often suggest keeping the lifelog records, a written journal or social interaction of experiences as a memory aid so people with AD can look back on it and remember what they did. This reminiscence processes in the lifelog, is to use wearable devices which can capture and collect data during the day of a person (mobile device, camera, GPS logger, GIS map etc). The data is then typically transferred to a local storage where it is aggregated and mashuped to form a lifelog. This data is then used in reminiscences at a later time. Example reminiscences include thinking about the pleasant experiences of their lives, interacting meaningfully with others and having dinner with friends etc. The rest of the paper is organized as follows. We introduce the related works in Section 2. Section 3 presents the design approach of the lifelogging system with mashup function, followed by the field trial case study, presented in Section 4. Finally, we conclude this paper in Section 5.

2. RELATED WORKS

Reminiscence is the process whereby an individual recalls the past, previous events, people. Reminiscence is currently being used in

varying capacities to help individuals suffering from episodic memory problems. Reminiscence methods were introduced in dementia care and have taken a variety of forms. Reminiscence therapy (RT) involves the discussion of past activities and events with other persons, usually with the aid of tangible prompts such as photographs, daily life items, music and archived sound recordings. Most reminiscence therapy occur between several individuals using physical aids such as photos etc but there are opportunities to develop more advanced reminiscence aids with multimedia platforms. One such research, CIRCA (Computer Interactive Reminiscence and Conversation Aid), was developed by the universities of Dundee and St Andrews. CIRCA explored the possibilities for an interactive reminiscence and aided to help communication with early-stage AD. These CIRCA supporting solutions assist with the most important needs [6] for remembering, keeping social contacts, feeling safe and performing daily activities. An increasing emphasis within CIRCA is paid to designing and evaluating technologies "lifelog" [7]. The concept of lifelog, the continuous capture of personal data such as photos from one's field-of-view, location, audio, biometric signals and others, with the aim of supporting the later recall and reflection over one's life events and experiences. The reminiscence processes in the lifelog, review existing empirical evidence on for each of these types of cues of who, what, where and when. As such, recall can be improved if one is presented with cues about the people involved in an event (e.g. social context cues), the content of the event (e.g. visual cues such as SenseCam), the spatial (e.g. GIS map and the temporal (e.g. the timeline of the event) (Fig. 1).

The SenseCam captured photos and selected the most important photos as cues and repeatedly review the photos with the person with episodic memory impairment. The potentially interesting SenseCam is a continuous video log. However, this technology often captured an overwhelmingly large amount of data that can be difficult to review. These technical developments have opened the possibility for users to passively capture and store comprehensive representations of their personal experiences, leaving much to be learned about the implications of the total capture model. Work has also been done on storytelling with lifelogging technologies. Many studies focus on the technical challenges of constructing narratives from very large datasets [8]. Other studies have taken a sociological approach. For example, Gowans et al. [9] showed the unique qualities of narratives made with lifelogging technologies through an exploratory study that found the method enabled users to create stories about mundane events. Smith, K. L. Crete-Nishihata, M. Damianakis, T. and Baecker [10] demonstrated that the social context of families is an important factor in understanding how users reconstruct narratives from lifelog data.

In this research we focus on episodic memory, which is also another interpretation of the term lifelog. Furthermore the following theories and principles constitute the foundation of this work.

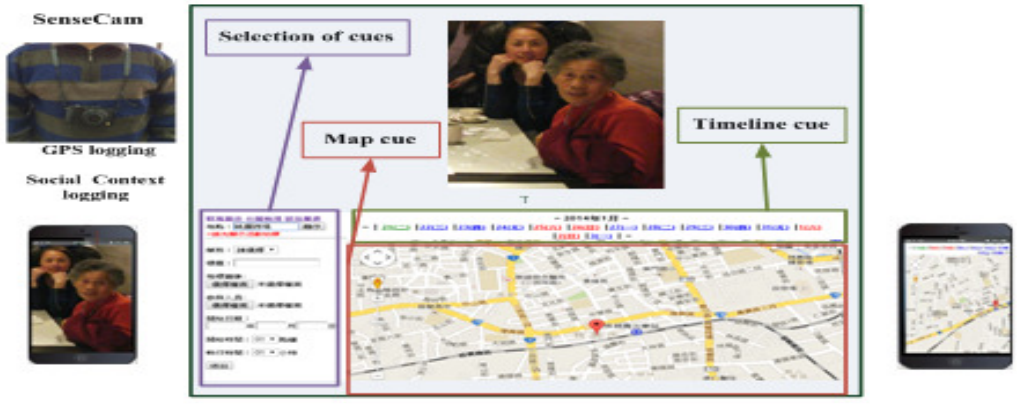

Fig. 1. Lifelog enables reviewing visual, spatial, temporal and social context cues, with the aim to recall and reflect upon daily activities and experiences in the context of reminiscence process

2.1 Spatial-temporal Aspect

We are living in a spatial-temporal world. Meanings, all of our life events except dreams happen in a specific location and at a specific date-time. Spatial and temporal data are the most important cues in contextual information. The process of reminiscence is, therefore, relying heavily on timeline and location [11]. This means that timeline is a necessary field for any lifelog record and all digital information objects should be stored with a timestamp. It leads us to conclude that, spatial-temporal data are the most important links between different information objects which came from different and heterogeneous data sources. The spatial-temporal aspect is a combination of a place and time frame.

In map-timeline, for instance in Fig. 2, a series of circles each containing a map segment is aligned along a linear timeline (→chronological order). The stay's time frame determines the circle's radius, while its place controls which map segment is shown (spatial information). Longer stays at one place result in larger circles that show more detail about the visited place.

2.2 Social Aspect

The people we encounter in face-to-face and mediated interactions have for long been assumed to be one of the most effective cues for triggering episodic and autobiographic memories. Lee and Dey [12] found people to be often associated with vivid recollections. However, while many systems have pursued this goal, there is limited empirical knowledge on whether social context does indeed play a significant role in triggering episodic memories, as well as how the different representations of it affect its impact over remembering. All these are crucial to the design of lifelogging tools that support remembering and reflection over recent events as well as ones lying further in social context past [13].

3. DESIGN APPROACH OF THE LIFELOGGING SYSTEM

3.1 Participants

AD with episodic memory impairment and their caregivers are essentially the participants of this research.

3.2 Lifelogging System Design

We designed a lifelogging system that follows a three-step process of capture, cue selection and reminiscence interaction review to support recollection of episodic memories [14] (Fig. 3). Using a combination of sensors, the system passively records experiences of the user's choosing. Then, the caregiver uses the cue selector application to construct a narrative of the experience by selecting the memory cues from the recorded lifelog data, with the help from content and context analysis, which is mashuped from the caregiver's perspective. Finally, with the reminiscence interaction, the caregiver-chosen cues are presented to the person with episodic memory impairment in a way that maximizes the opportunities for them to think deeply about the cues to remember associated details on their own without requiring repeated live help from their caregiver. In the following sections, we describe the rationale behind our design decisions.

A mashup is a composite service implemented as a composition of Web applications. Mashups may be classified by three aspects. The first aspect is the nature of the mashup, distinguishing between data mashup, logic mashup and presentation mashup. The second aspect is the type of users capable of using the framework to create a mashup application, distinguishing between developers and end-users. The third aspect is client-side mashup and server-side mashup. According to these three aspects, our approach tackles both client-side and server-side mashup (Fig. 4). The end-users who do not have any programming skills, take advantage of client-side mashup relying on lightweight Web technology such as Javascript.

In a server-side mashup design, shown in Fig. 4a, the mashup server contacts the base server and each data source when it receives a request from a client. It combines the information received from the base server and the sources and sends the combined XML to the client. Server-side mashup containers that combine base and mash-up servers are also referred to as data mash-up systems. Mashup container deployed according to workload of various data sources requested. Different data source usage e.g. processor and memory demands, can be measured at a regular interval of time for the analysis of workload characteristics. Such mashup container provides a Web-based configuration front-end that allows users to select

data sources, specify the manner in which they are combined and to create a layout for the entire mashup. In a client-side setup, shown in Fig. 4b, the base server sends only a partial website to the client, along with Javascript code that instructs the client which other sources of information to contact. When executed in the browser, this Javascript code retrieves the information from the mashup sources directly and completes the mashup (e.g. Data source D). The primary appeal of client-side mashing is that no mashup server is required and thus the URL that users visit does not change. Consequently, the mashup server is no longer a bottleneck.

Fig. 5 shows the overall structure of lifelogging system framework. The top of the diagram shows various lifelogs (e.g. Google Map (for spatial information cue); Google Plus (for social context cue) and Google App Engine (for SenseCam capture stored via Bigtable with a timestamp and filtering). These lifelogs from cue selection are imported to a database of the proposed framework according to needs of users. Once logs are imported, they composited the requested lifelogs via mashup container.

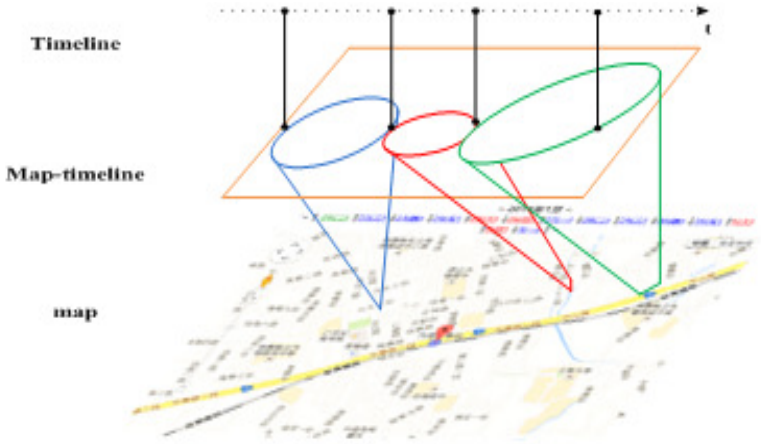

Fig. 2. Spatial-temporal aspect is combination between timelines and maps

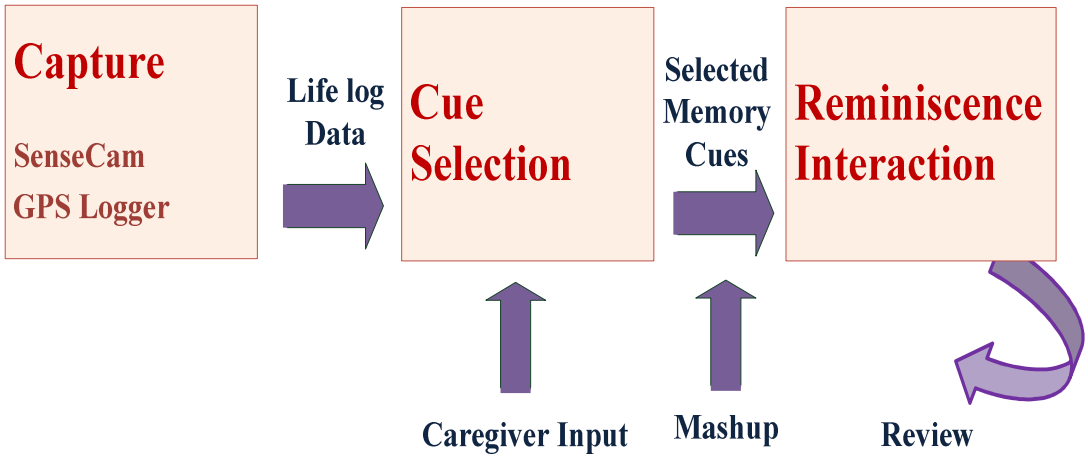

Fig. 3. The lifelogging system design process

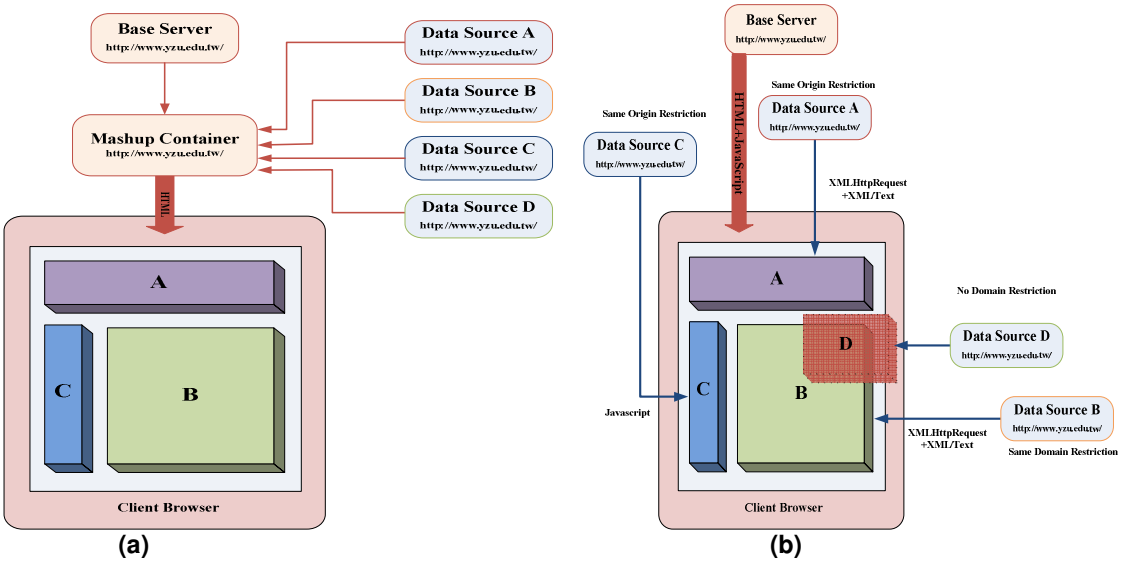

Fig. 4. (a) Server-side mashup construction (b) Client-side mashup construction

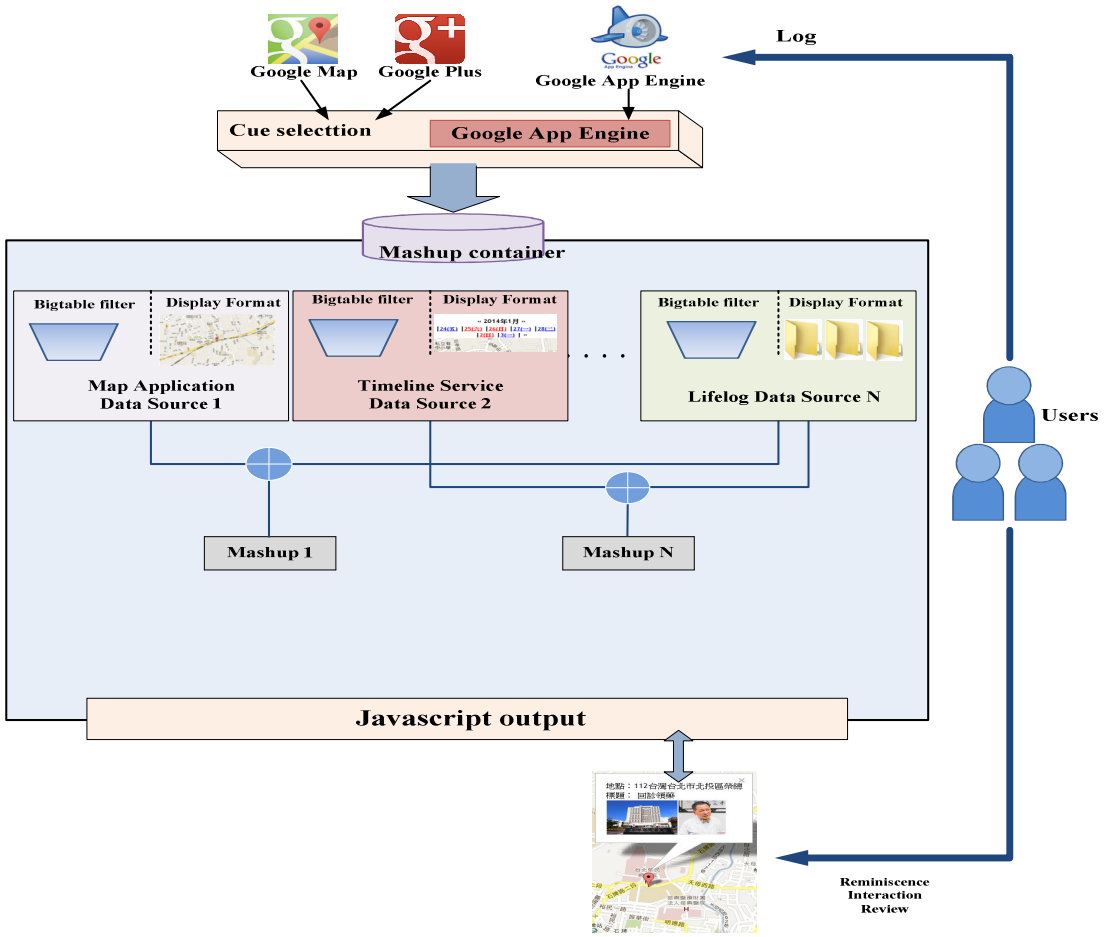

Fig. 5. Overall structure of lifelogging system framework

4. FIELD TRIAL CASE STUDY

Using the proposed lifelogging system framework, we develop a practical reminiscence interaction review applications [15,16]. This section describes a scenario featuring Maria who is a woman suffering from early-stage dementia. She has been provided with the lifelogging system to support her. The scenario describes how the lifelogging system can help her throughout the daily life and how she and her caregivers can review the images from the day, to build lasting episodic memories.

Maria is on her way to the medical center and she has the needed devices to log her day. She is wearing a small camera around her neck that captures images automatically and she has her mobile phone in her pocket. At the end of the outpatient, Maria got a phone call from her daughter Vivian, Vivian tells her that some of her colleagues whom she had lunch with last Monday want to visit her again tomorrow. The lunch place was her way home. Maria cannot recall that these colleagues in this lunch, so she uses the lifelogging system in her mobile phone to see the list of activities that happened last Monday noon. Having lunch with friends is in that list so she clicks on that activity and the system shows her details about it, the people involved, the text added by Maria about that activity and some images that have been captured automatically during the lunch. In addition, Maria takes the chance to review the latest activities that she did with each of her friends, who is visiting her tomorrow. For each person, the system shows her the activities which happened when that person was present. This shows that the digital reminiscence process helps Maria in remembering spatial-temporal events what happened last Monday. The system also helps her in recalling more details about each of her friends. This review gives Maria the opportunity to reminisce about her day and to build lasting episodic memory of what she did.

The aforementioned lifelogging system is a mobile application that supports reminiscence interaction review application at the mobile client side. The work procedure of it is shown in Fig. 6a.

(1). The participants experiences an event (e.g. remembering the venue of the lunch on the way) in journey home after medical center treatment, captures it using mobile phones and stores it as digital memories.
(2). The user can mashup the digital memory with a relevant data source by mobile tagging.
(3). The memory is indexed by the lifelog id and stored.
(4). When interested about the lifelogs again, the user can mashup the lifelogs and display and read its cue (see Fig. 6b).
(5). The timeline-map is retrieved from the lifelogs by its cue.
(6). The user can re-experience the event (recalling its details; reminiscing the pleasant moment).

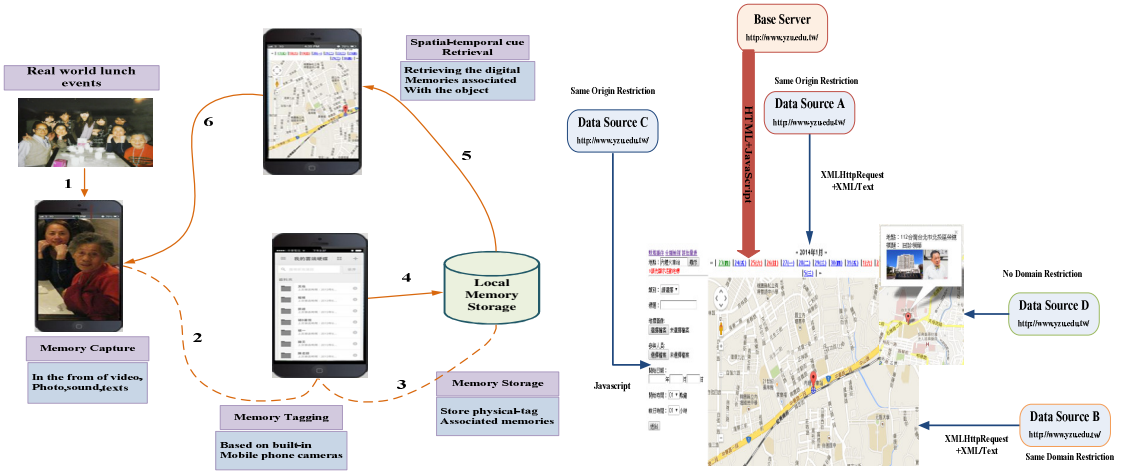

Fig. 6. (a) Lifelogging system work procedure; (b) Four data source mashup in the mobile phone display

5. CONCLUSION

In this paper, we have proposed the structure of lifelogging system framework, an application framework for visualizing lifelog with spatial-temporal onto a GIS map. The proposed framework would contribute to rapid and reliable development of the reminiscence process applications. Most importantly, future work should focus on a direct comparison of self-selected and automatically captured media/cues and the practical benefits of lifelogging in actual design and evaluation tasks [17]. We will investigate more supportive cues to understand the amount of support people with episodic memory impairment actually need to recollect their experiences. Finally, we will use our understanding of good cues to build and test a lifelogging system that assists the caregiver in providing episodic memory support.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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