Capturing Situational Context in an Augmented Memory System

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Abstract

Bookmarking a moment is a new approach being introduced to capture past experience and insert information into an augmented memory system. This idea is inspired from the concept of the bookmark in web browsers. Semi-automatic bookmarking different moments when time is limited and revisiting these moments before inserting them into an augmented memory system will help people to remember their past experience. An exploratory study was conducted to discover and shape the design requirements for a system called CatchIt. It aims to understand end-users' needs to capture their personal experience, which is an important and complex issue in the case of capture and access of personal experiences.

CatchIt is a system to bookmark the significant moments during the day before enriching them, and entering them into the augmented memory system called Digital Parrot. The conceptual design of CatchIt will be the main aim of this study. The primary requirements were derived from the scenarios and analysis of the findings of five different study stages were designed to inspect these: unobserved field visit, shadowing, using indictors, Wizard of Oz and using technology. Thirty participants were involved in field visit, survey and follows up interview. Each stage had different tasks to be performed and the findings of each stage contributed to understanding different parts of user needs and system design requirements.

The results of this study indicated the system should automatically record the context information, especially the time and location since they were typically neglected by the participants. Different information such as textual and visual information should be manually recorded based on the users' setting or situations. A single button is a promising input mechanism to bookmark a moment and it should be fast and effortless. The result showed no clear correlation between learning style and type of the information that had been captured. Also, we found that there might be a correlation between passive capture and false memories.

All these findings were used to provide a foundation for further work to implement the bookmark system and evaluate this approach. Some issues raised in this study need further research. The work will contribute to a greater understanding of human memory and selective capture.

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1. Introduction

Our life is a chain of moments, some of them sad or bad enough to the point that we wish to totally forget. On the other hand, there are important and valuable moments that we try hard to remember and maintain as long as we can. Unfortunately, most of the time, we do not know when we will meet these kind of moments; but what we can do is to be equipped to catch these moments. This is what this thesis about.

1.1 Background

Keeping memories of past events is an old desire; from the Stone Age the ancients used painting on cave walls and ceilings to record their hunting expeditions. This desire remains these days and it will be the same on the future. The difference between people from different ages is the tools which are used in each age. In a technological age, people use cameras, PDA , mobile phone, diaries or collect souvenirs to help them to recall a particular moment of their past to share it with friends, family or just to enjoy reliving the experience. Also, recording memories has become an everyday activity for many people. They carry their cameras, PDA, smart phones while they are at meetings, at the park or in cafés. They like to be ready everywhere and at any moment they need to record information which they think is valuable and they are afraid of losing.

Nevertheless, many people have had the experience of forgetting important details or having difficulty recalling salient information. Consequently, they employ different strategies to overcome this obstacle. Some of them prefer traditional ways, such as taking notes using pen and paper, while others take advantage of the revolution in the technology and digital memories.

Many investigations have been made in order to help people to use the technology to collect their memories and recall them again in need (Aizawa, 2005; Gemmell, Bell, & Lueder, 2006; Lamming & Flynn, 1994; Vemuri, Schmandt, & Bender, 2006).They assume that using the technology could make capturing information an effortless, enjoyable experience and recalling forgotten information more accurate and painless. To

test their assumptions, they tried different attempts and different perspectives such as life logging systems (Gemmell et al., 2006; Aizawa, 2005), reminder systems (Dey & Abowd, 2000) (Sohn et al., 2005) or augmented memory systems (Schweer & Hinze, 2007; Rhodes, 1997).

Some of these attempts try to make use of psychologists and cognitive scientists' ideas about how the human memory works. The Digital Parrot is one such attempt. It introduces a Context-Aware Augmented Memory system and was proposed by Andrea Schweer (2010). The idea of her system is to help the user to recall their experiences through following the connections between the information. She used the fact that memories are information and connections between this information. The Digital Parrot will be described in detail in the next chapter. Currently, the Digital Parrot does not allow the users to enter data in a convenient way. Thus the capturing of information and inserting data into the Digital Parrot forms a problem that needs to be addressed. The main aim of this project is to "feed the Digital Parrot." The approach is to investigate users' behaviour and thoughts in terms of capturing memories which they have from day to day lives which they think that they going to need in the future. By conducting five different user studies, it is expected that how to feed the Digital Parrot can be learned. Since understanding end-user needs is complicated and important issue on capture and access of personal experience search area (Truong & Hayes, 2009).

1.2 Goal of Thesis

Currently, the Digital Parrot does not allow the user to enter any data, forming a problem that needs to be solved. Data inserts are made by the researcher directly into the Digital Parrot database. Since the Digital Parrot is considered as retrieval system about past events, feeding the Digital Parrot is a recollection of every day experience system.

The goal of this thesis is to propose a new approach to collect data during the day to make it available to insert it into the Digital Parrot to make it accessible. This thesis proposes a method called *bookmarking a moment*. Bookmarking a moment enables the

user to capture data (set of cues) that are related to particular event and save it as a bookmark in time and place. By the end of the day, the user might have a collection of different bookmarks to insert into the Digital Parrot.

This thesis will explain the idea of bookmarking and design the system for bookmarking moments. Also it will explain the user studies which were used to investigate users' needs. The outcome of the studies and the recommendations for feeding the Digital Parrot will be presented in the end of this thesis.

1.3 Structure of this Thesis

This thesis contains nine chapters. The first chapter has introduced the area of research for capture and access to past experience and the goal and structure of this thesis. The rest of this thesis contains following chapters: Chapter 2 will review the augmented memory system called Digital Parrot; this includes the idea behind it and its features. The scenarios and system requirements will be discussed in Chapter 3. Chapter 4 will present some of the research literature related to capturing past experience and the comparison between the existing system and the requirements for feeding Digital Parrot. Next, the idea of bookmarking will be presented and with the explanation of the preliminary design of a system to bookmark moments and end-users' specifications. Then how end-users specifications were addressed experimentally will be explained in Chapter 6. Chapter 7 presents the outcome of the user studies. In Chapter 8, the evaluation processor and its result will be discussed. At the end, the conclusion and further work chapter will summarize the assumptions of the thesis, the contributions made by the research and indicate further work to be carried out.

2. Human Memory and Digital Parrot

2.1 Human Memory

Helping people to remember their past experience has been one of the interesting topics for scientists, such as psychologists and cognitive scientists, for long time. They have tried to understand the memory, how it works and how to improve its performance or how to overcome its weakness.

Memory can be defined as the mental and cognitive ability of processing information which includes encoding, storing and retrieving information. There are three different forms of memory system: sensory memory, short-term memory (STM), and long-term memory (LTM). The memory receives environmental information (stimulus) and then processes it by using different sensors. After the sensory stimulus ends, the sensory memory holds the sensory information until it is processed and sent to short-term memory (Pastorino & Doyle-Portillo, 2008). The information remains in short-term memory only for short time and it could be forgotten within one minute. In contrast, the information may stay in long-term memory for days, months or years (Atkinson & Shiffrin, 1971)(see Figure 2.1).

Reviewing the existing attempts to construct devices or systems to support the memory (Aizawa, 2005; Gemmell, et al., 2006; Helmes, Hummels, & Sellen, 2009; Vemuri, et al., 2006) shows that researchers have tried to benefit from simulation the work of human memory; they used artificial sensors such as camera, audio recorder and also various physical sensors, to record or capture the environment information. Also, they stored the captured information locally in a wearable/portable device for a short period before they transferred it to a long term storage system.

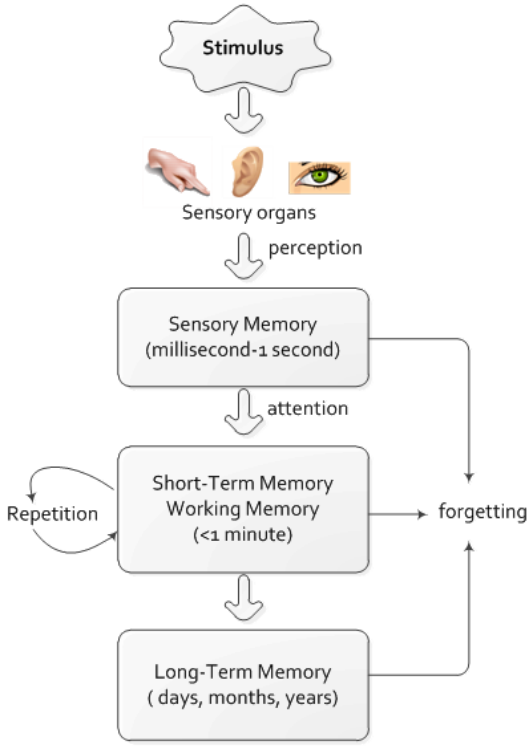

Figure 2.1: Memory structure and processes. Adapted from The Brain from Top to Bottom, by Institute of Neurosciences, Mental Health and Addiction, Retrieved August 9, 2010, from http://thebrain.mcgill.ca/flash/i/i_07/i_07_p/i_07_p_tra/i_07_p_tra.html.

To help the user to recall the stored information accurately, they proposed different retrieval techniques such as retrieving information based on similarity to the user's current context (Rhodes & Starner, 1996) or based on location and time(Gemmell, et al., 2006). Figure 2.2 shows the similarity between the human memory and memory aid systems.

Most augmented memory systems work according to the following structure. They offer a technique to deal with capturing the environmental information and then store this information and finally support the user to retrieve the stored memories.

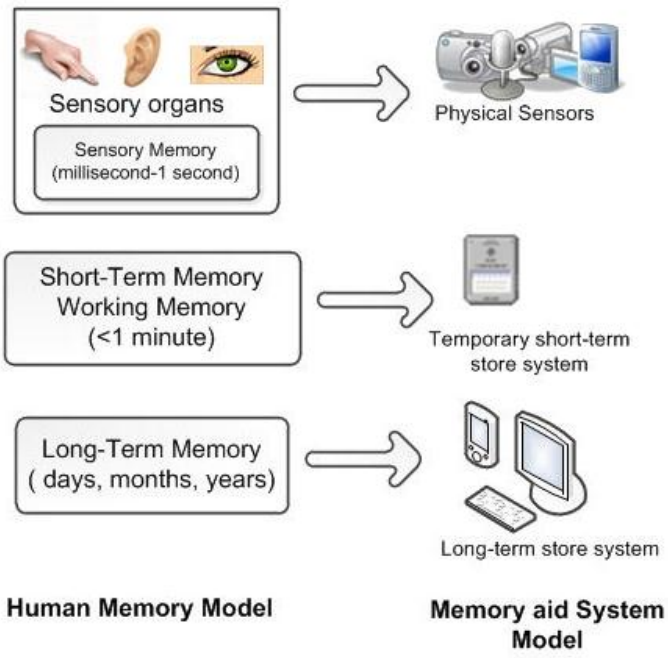

Figure 2.2: Technical model for human memory.

These three stages became essential for most of memory systems. Figure 2.3 shows the three stages to make recoding and recalling the past experience possible, the capturing stage, the storage stage and finally the retrieval stage.

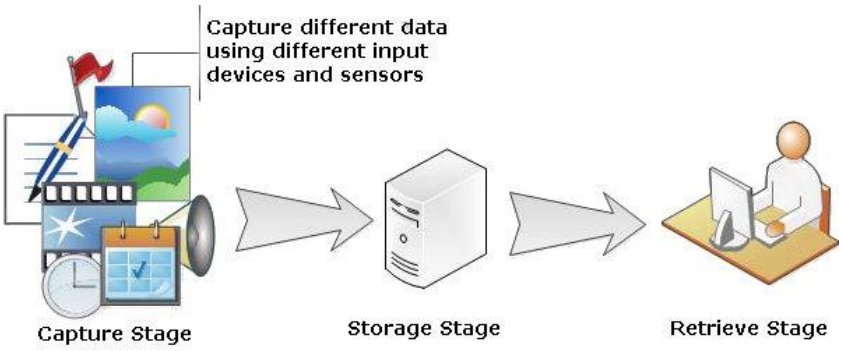

Figure 2.3: Three stages for augmented memory systems.

Capturing Stage

This refers to the stage where the user meets different forms of information such as visual, textual or/and context information and the systems start recording it. The recording can be performed manually or automatically. Also, the systems vary between focusing on a particular type of data (audio or photos) or recording as much information as possible based on what may help users to remember. These different approaches are called *situation-specific capture systems* or *total captured systems, respectively* (Sellen & Whittaker, 2010). In terms of the capturing devices, each device was designed according to the data supported by the system. For example, the systems which capture images have a device with a camera such as SenseCam (Hodges et al., 2006) while the devices to capture audio, such as iRemember, have a microphone (Vemuri, et al., 2006). These wearable or portable tools were integrated with sensors and input devices to record a range of information starting with simple data such as temperature to the information about the user's current activity. This thesis focuses in this stage more than the two other stages and will discuss these two different capturing techniques and devices in more detail in Chapter 4.

Storage Stage

Briefly, storing the data, after capturing it, is a very important stage in any memory aid system. In this stage, the captured data is stored either directly in the server, especially when the system captures information from PC such as emails or web pages, or in a portable device. When a portable or wearable device is used, the data is stored locally and temporarily in the device before attaching the device to the laptop or desktop to start transferring the data from the device's memory into the PC and storing it in a database to make it accessible in need. This project will focus on the first stage. This stage and the next stage will not be discussed in detail in this thesis.

Retrieval Stages

Captured data will not be useful without an effective retrieval system. In other words, even using advanced technology to capture information and storing data in PC with huge capacity, the technique which is used to find/ retrieve the stored data is the key element

in the success of the memory aids systems. This stage has received more attention from researchers. They have discussed the requirements for the interfaces and search techniques and the best ways to view the search results, while some of them tried to apply the psychologists' suggestions to make the process of retrieving data is similar to process of the human mind such as the Digital Parrot which will be explained in Section 2.3.

2.2 Human Memory Functions

Most Capture, Archival and Retrieval of Personal Experience (CARPE) systems follow the same approach in terms of the three different stages for recording and accessing the data, yet differ in the way of performing each stage to different memory functions. The human memory functions are categorized, in terms of remembering, into the prospective memory (PM) and retrospective memory (RM). Prospective memory refers to the kind of memory that helps people to perform future actions such as remembering an appointment, a meeting for next week or to call someone at night, while retrospective memory involves the remembering of words, people or events that have occurred in the past (Burgess & Shallice, 1997).

The Digital Parrot (Schweer, 2010), which will be described in next section, supports retrospective memory, and particularly in supporting autobiographical memory, but does not help users to remember things to do in the future (prospective memory). The autobiographical memory (AM) is defined as the memory for the events in one's life(Conway & Rubin, 1993). The research suggests that this kind of memory has three levels of specificity: lifetime periods, general events and event-specific knowledge (ESK) (Conway & Pleydell-Pearce, 2000).

Lifetime periods are, for example, the memories which are related to the whole period at university. The general events are more specific than lifetime periods. They contain single or repeated events such as the first time of going to a swimming pool. Finally, the event specific knowledge (ESK) consists of detailed information about particular events, for example "the name of the book which Sally told me about it when we were at her

house." However, in regard to remembering, the ESKs are more likely to fade faster than the lifetime periods and general events (Conway & Pleydell-Pearce, 2000). The Digital Parrot, which we try to find a way to insert the data in it, is an augmented memory system that attempted to support the event specific knowledge (ESK).

2.3 Digital Parrot

Idea of the Digital Parrot

The digital Parrot is a system focuses on the retrieval process by "combining context information with semantic concepts and associations between information items" (Schweer, 2010, p. 225). It supports the users to build their own network of memories related to particular events in order to view and retrieve these memories. For example, the network in Figure 2.4 below shows a presentation of one past experience of one of the system's users. The user had two conversations with Aroha. One conversation was about "supervising research students" and it took place in "the university campus". The other conversation was in the same place but this time was about "salary negotiation tips for women".

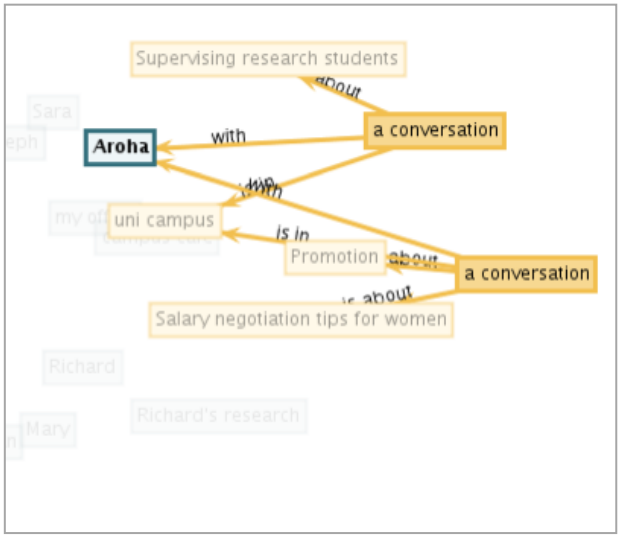

Figure 2.4: Connected information in the Digital Parrot. Reprinted from *Augmenting Autobiographical Memory: An Approach Based on Cognitive Psychology* (p. 97),by Schweer, A. Copyright 2010 by Andrea Schweer. Reprinted with permission.

This project focuses on helping users to remember their own past experiences through providing a suitable data model, storage mechanism, visualization and access paradigms. It aims to help users to remember information by following the characteristics of human long term memory as learned from psychology studies. Often people can remember the context but they forget the detail they need. They try to remember the information by recalling the context or following connections between information. In the Digital Parrot, the users are able to follow the associations from something they remember well to the item they forgot or use the context such as time, location, other people or weather conditions as a cue to help them remember (Schweer & Hinze, 2007). In the last example, the conversation with Aroha, the user can find the topic of the all conversations or the place where he/she met Aroha if he/she uses one of the pieces of information that he/she remembers very well.

The idea of using associations between information items is similar to data model that the Semantic Web infrastructure uses. The research suggested that using a typed, semi-structured data model is a promising approach to augmenting memory (Schweer & Hinze, 2007).The Digital Parrot relies on combining context-awareness with a semantic information system to support remembering.

The information and associations between the information are stored in the Digital Parrot similarly to the data model which showed in Figure 2.5. In real life, each person has information associated with him/her like for example, phone number which contains on prefix, area code and number. Then this phone number is a serial of numbers which forms a unique number which is belong to the only one person “Anna”.

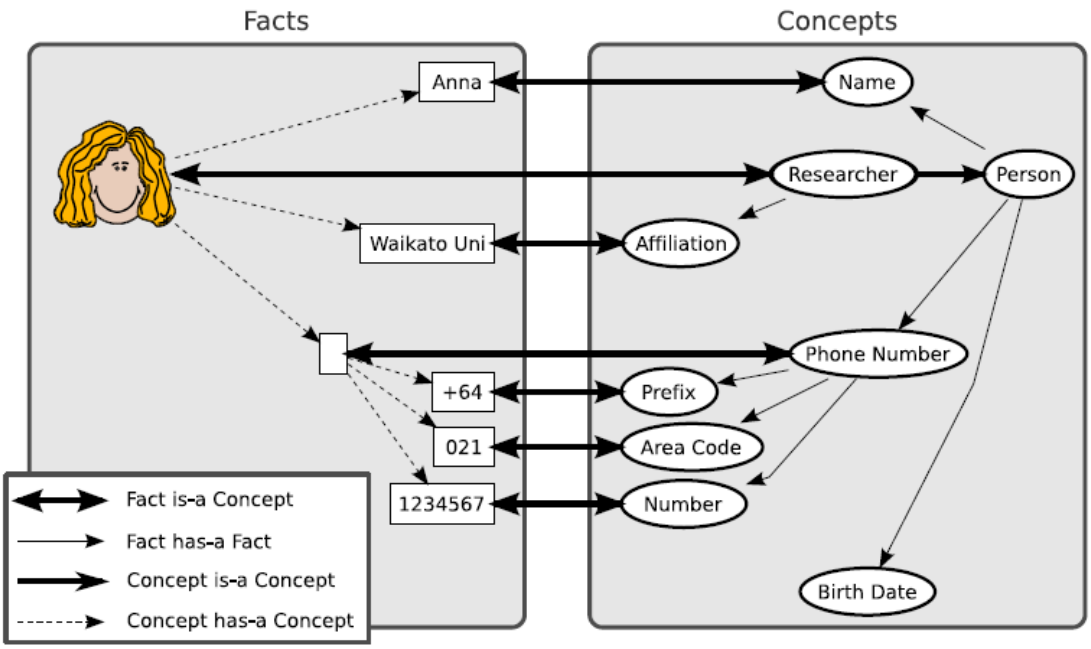

Figure 2.5: Data model on the Digital Parrot. Reprinted from "The Digital Parrot: Combining Context-Awareness and Semantics to Augment Memory.," by Schweer, A., & Hinze, A., 2007, *Proceedings of the Workshop on Supporting Human Memory with Interactive Systems (MeMos 2007) at the 2007 British HCI International Conference*, p.47. Copyright 2010 by Andrea Schweer. Reprinted with permission.

Recalling information

For retrieving the stored data, the system's interface helps users to recall stored information by using different types of views, navigators and searches. The main view visualizes the stored memories in the system; while the navigation can be done by using a timeline, typed and textual search (see Figure 2.6).

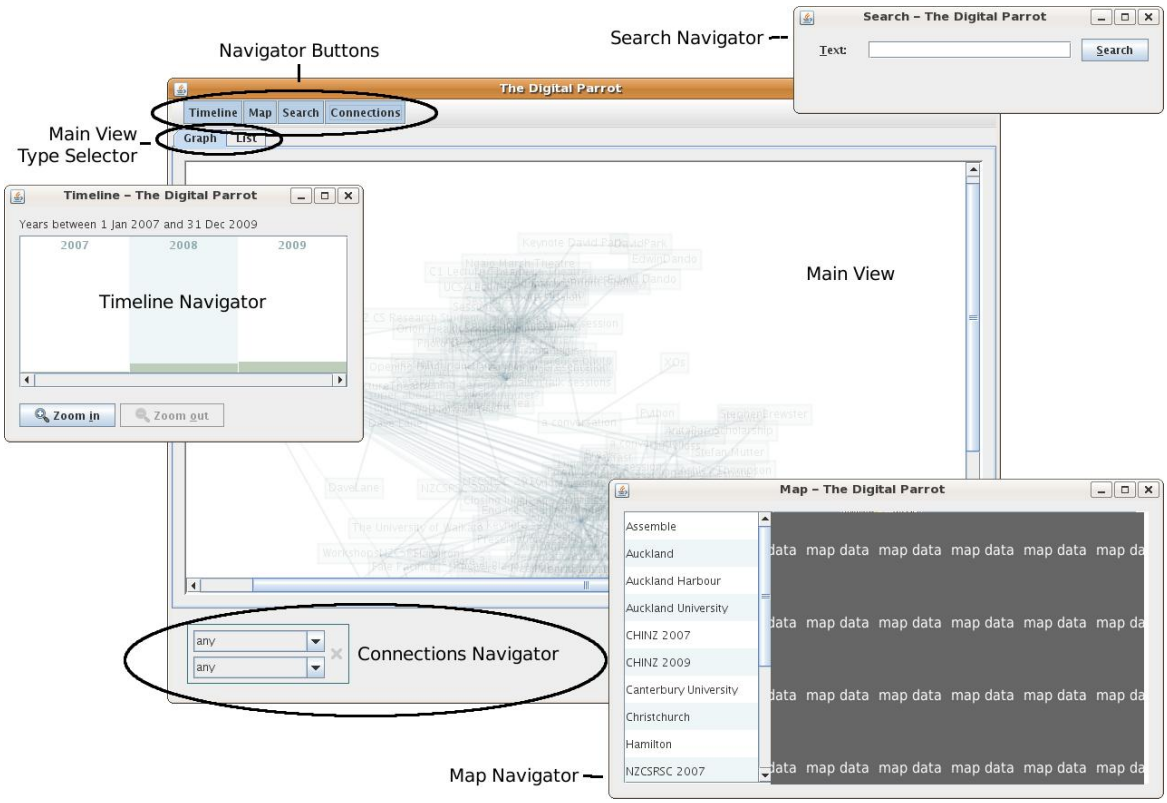

Figure 2.6: The Digital Parrot: Main view and all navigators. Reprinted from *Augmenting Autobiographical Memory: An Approach Based on Cognitive Psychology* (p. 84),by Schweer, A. Copyright 2010 by Andrea Schweer. Reprinted with permission. [1]

In the graph view, the labelled nodes represent the memory items while the edges represent connections or links between these items. Selecting a node leads to highlighting the selected node, all nodes adjacent to it, and all connecting edges see Figure 2.7.

The main view can also be shown as a statement view. The user is able to view memories as a list of statements, where each statement consists of a subject, a predicate and an object. When the user selects a memory item, all its incidences, such as subject or objects, are highlighted.

[1] The gray part in the image is added to cover a map which copyright is held by a third party.

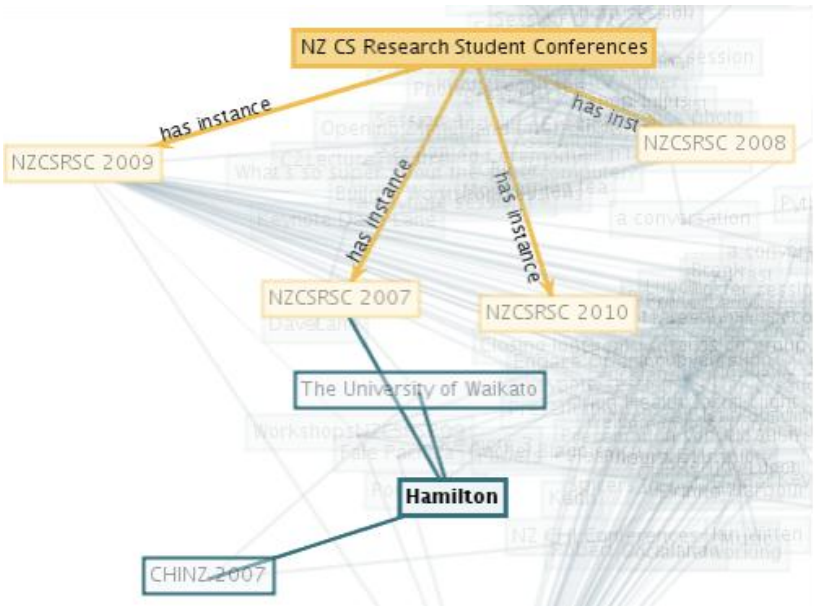

Figure 2.7: Detail of the graph view. Reprinted from *Augmenting Autobiographical Memory: An Approach Based on Cognitive Psychology* (p. 85),by Schweer, A. Copyright 2010 by Andrea Schweer. Reprinted with permission.

In terms of contextual navigation, the Digital Parrot offers the user a way to navigate their memory through a) map navigation, or b) timeline navigation. The map navigation helps the user to use the geospatial information to find memory data. The timeline navigator enables the user to search their memory, based on temporal information.

The type navigator allows the user to search the information based on the information type. To do that the user is allowed to build a connected chain of information items and types(Schweer & Hinze, 2007). As it has been shown in previous examples, the Digital Parrot is about help users to remember by following chains of associations. This chain is helps the user to focus on a narrow portion of their information item. The benefit of this chain is illustrated in this example, "To answer a question such as 'Which book was recommended to me when I spoke to someone about hypertext at a conference in Auckland?' the user could start a chain with the information item 'Auckland'. The user could then add to the chain the type Conference and then the type Conversation to restrict the main view to conversations that are connected to conferences that are connected to 'Auckland'" (Schweer, 2010, p90). In fact, the Digital Parrot is considered as a system

concerned about collecting a collection of cues in text-based format and using them to create a chain which describes a past experience. This is the main requirement to take into consideration during design a system to insert the data into the Digital Parrot.

Finally, the system supports the user by textual search method. Any information that will match the query will be highlighted. Figure 2.8 shows a screenshot of the textual search method in the Digital Parrot. For example, the user can search for all information that related to "university" by searching using the name of the person in textual search.

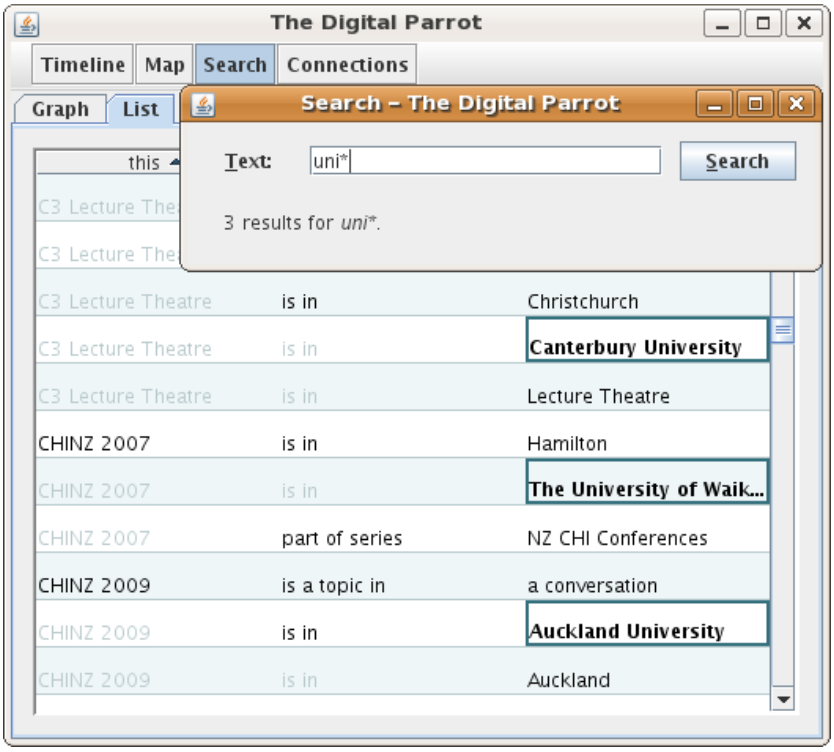

Figure 2.8: Textual search on the Digital Parrot. Reprinted from *Augmenting Autobiographical Memory: An Approach Based on Cognitive Psychology* (p. 91),by Schweer, A. Copyright 2010 by Andrea Schweer. Reprinted with permission

Regarding to the essential three phases capturing, storing and retrieving stages mentioned earlier in this chapter, the Digital Parrot implemented the storage stage and retrieval, while the research study is to investigate the first phase, capturing information.

2.4 **Feeding the Digital Parrot**

Feeding the Digital Parrot means capturing the desired information, which is supported by the Digital Parrot, and inserting this information into it. The information/memories in the Digital Parrot are a combination of content and context data. Yet, in the Digital Parrot the context data can be used as content items which might cause confusion between content and context items. Another feature in the Digital Parrot is the necessity of modifying information. Capturing information, it is not enough to insert data in the Digital Parrot, the user needs to edit and organize it.

Capturing information and preparing the data to be inserted into the Digital Parrot with consideration of its requirements/features form the issue which this research trying to address. The remainder of this thesis will focus on studying designing a system called CatchIt to feed the Digital Parrot, starting from describing the problem using scenario-based requirements then investigating the existing work, explaining the suggested system, conducting user study and presenting the result of the study.

3. Scenarios and System Requirements

This section will describe user scenarios, which are used to identify the requirements for capturing situational context system. The scenarios are an extension of the one that were used for the Digital Parrot (Schweer, 2010). An example situation of how these scenarios can be used is given below, with Sarah as the potential user.

3.1 Scenarios

Who is Sarah?

Sarah is a researcher in Earth Sciences at the university who she is working with a group of students. As researcher, usually she goes on field trips and travels to academic conferences as part of her job. As she is an Earth Scientist, the places are important for her. She is good at remembering where she met someone or heard something, but not so good at remembering who she met or what the conversation was about. That is because she is very geographically minded.

1- Capturing Ideas

It is Friday morning and Sarah is on her way to her office. A new idea for her project comes to her mind suddenly and she needs to somehow capture this idea. But she is busy driving at this moment and she wishes that could be something she can rely on to remember this idea later.

2- Attending Conferences

Sarah is already in the habit of talking to specialists at conferences, keeping track of who she speaks to and staying in touch with them. She likes her students to be part of the research community, so she keeps track of all presentations she attends and tells her students whenever she feels one of these presentation might be interesting to one of them.

Sarah usually tries to speak to as many people at conferences as possible, which is a challenge for her to remember their names or their information. She is attending a talk

she thinks is a new and interesting. Returning from her conference, she meets her PhD student and she thought that the paper that was mentioned would be a good resource for her student. However, she only remembers the place where the conference took place, but she did not have a time to write down the speaker's name or the publication.

3- Away for Field Trips

Sarah is on a field trip with her students and Martin, a visiting Earth Sciences lecturer from Germany. While they are busy collecting rock samples, Sarah and Martin chat about their research and academic life in general. Martin points out one particular rock formation and tells Sarah that Christine, a student of one of his German colleagues, is doing research about these formations. Sarah thinks it would be good for one of her students, who did not come along to this field trip, to get in touch with Christine. She is too busy to write down all the information. She thinks that she can tell her student about Christine if she could remember the name, the name of Christine and the type of rock formation.

3.2 Requirements

This section will discuss using the scenario in Section 3.1 to describe the foundation functionality of the capturing system. It will then present the non-functional requirements which are regarded as important for any capturing system and, in particular, the system proposed to feed the Digital Parrot.

3.2.1 Functional Requirements

From the previous scenarios, the system which users like Sarah needs should have the following characteristics: portability, semi-autonomy, support capturing multimedia; context and content information, synchronization, moment selection, and annotation.

Portability

Sarah needs a system that is available for her whenever and wherever she wants to capture information. She needs to capture information while she is away from her office, for example, at field trips or at conferences.

Semi-autonomy

She needs to capture the information without long interruptions while she is engaged in an activity such as conversation, on the bus or collection rock samples. But she needs to have minimum interaction with the system. Some data should be captured automatically to minimize the effort which is needed by the user to capture the moment, while some data should be captured manually by the user when he/she feels the need to add additional information.

The system should support these two capture methods: automatic and manual. Some context cues should be added automatically on behalf of the user such as time/date, location (global positioning system (GPS), and People/digital device names (printer, laptop) around the user at the moment of collecting data and the weather (the current condition). The system should also allow the user to make some explicit record by allowing them to take a photograph, add text-based annotation, record multimedia and take a note/ sketch.

Support Capturing Multimedia

Recording audio, taking a photograph and writing notes are needed for Sarah, so she can record the conversation with Martin and capture a photo for the rock.

Context and Content Information

The time, the location, calendar information and the name of people who are nearby need to be captured so Sarah will be able to retrieve the missing information based on what she can remember.

Synchronization

Most of the information which Sarah needs to capture may need further review to add more information, such as an index or comments. Also, the information which she captured needs to be linked to pre-existing information which is stored in the Digital Parrot. This part is non-portable. The user should be able to transfer the information captured by the portable device to the PC or laptop which has the Digital Parrot system.

In fact, the PC or laptop can be considered as a complementary device to wearable devices. That is, the portable devices can be used to capture information in situations where it is difficult to carry a PC or laptop. However, this portable device has many limitations such as a small screen, limited storage capacity, and limited speed and efficient input/output methods and so on. In such situations, is may be good to support the user to use a large screen for good browsing and help the user to modify marked moments in convenient way and create manual enrichment of the data captured on portable device into the desktop/laptop computer to feed the Digital Parrot as discussed in Section 2.3.

Moment Selection

In each situation, Sarah knows what kind of data she wants and she knows what moment she needs to record data. She does not like to record everything and all the time. She prefers to record information when she feels she will need it to use later and she selects the information suitable for each situation.

Annotation

One of the main issues in memory systems is to retrieve the information. Although the information is stored, it is difficult to retrieve it without finding the right retrieval mechanism. Every marked moment should be annotated automatically by location, time and date of marking the moment to help the user to access these moments and browse the moments through different ways, for instance, timeline. Also, the user can add text annotations or retrieval keys to the marked moment at the time of marking the moment on her or his wearable device. The user might want to add her/his activities as retrieval keys.

The previous requirements are the minimum requirements for the system which can help to inset the data into the Digital Parrot. The next section will analyze existing work to investigate what if there is any system which can be used to feed the Digital Parrot and examine the existing works in CARPE.

3.2.2 Non-Functional Requirements

There are other many non-functional requirements for a system which aims to capture past experiences. This section will discuss some of the most important non-functional requirements and focus more on the capture device. The device which should be used in capturing information should have the following features: comfort, appropriate size, local wireless/ wireless network, storage (longevity of the system), location device, digital camera, ease of use, privacy, portable device-based interface, and a computer-based interface.

Comfort: Regarding the everyday applications, the users should feel comfortable carrying the wearable device for long durations and being seen wearing. Fortunately, people are accustomed to integrate using PDA, MP3 and mobile phone in their daily lives activities.

Appropriate Size: The device should be small and lightweight to help the users to carry it in their pockets or bags and take it with them almost everywhere.

Local Wireless/ Wireless Network: The device should have a modem to make the access to information possible and keep the user up-to-date.

Storage (longevity of the system): The device should include a large capacity storage disk. The capacity should be large enough to hold all captured data for several days.

Location Device: The device should support the Global Positioning System (GPS) to obtain a user location. Recently, most cell phone companies have integrated GPS into some of their products.

Digital Camera: The device should have a digital camera and support taking photos and video recordings.

Ease of use: Concerning the different number and types of sensor, the user should not need to pay attention to how to deal with sensors and should be able to use it without needing exceptional training.

Privacy: The system should provide the user a level of the privacy that they are accustomed to feel with ordinary notebooks or dairies. The system should support personal control through showing the user which data is recorded and the user should be able to select the data which he/she wants to be recorded.

Portable device-based interface: The interface of the Digital Parrot's agent, which should be installed on the portable device, should help the user to interact with the system effectively and little effort.

Computer-based interface: This should support search and browse collections and assist the user to insert the data into the Digital Parrot.

The remainder of this thesis will focus on the functional requirements while most of non-function requirements should be considered during implementation phase. The functional requirements will be used as criteria to assess the existing work.

4. Related Work

4.1 Introduction

This chapter will use the requirements that were identified in Chapter 3 to review pre-existing knowledge and work in the area of capturing and accessing data. Although the interest in capturing people's entire lives started from the early 1980s (Mann, 1997), the research in capture, archiving and retrieving the personal experiences (CARPE) has been an active research area for the past years, particularly during the last ten years, when some sequential workshops were held (CARPE'04, 2004; CARPE'05, 2005; CARPE'06, 2006). The growing interest in this area might be due to the revaluation in ubiquitous computing technology which has contributed in making the memory aid systems reach out beyond reminder purposes to create personal archives. This archive contains every-thing people can see, hear or/and do in their daily lives. It may also include all web pages visited, phone calls, emails, locations, etc.

Regardless of the reminder systems, there is similarity with the augmented memory systems which consider archiving past experience even though each system is designed to support the user in a particular task. In other words, these systems have the same three main stages, capturing the information, indexing and retrieving it, while some systems support the users to capture their entire lives or large portions it (Aizawa, 2005; Gemmell, et al., 2006; Hodges, et al., 2006). Other systems are engaged in supporting sharing the past experiences with others (Helmes, et al., 2009; Yeh et al., 2006) or recording specific moments for later recall (Blum, Pentland, & Troster, 2006; Vemuri, et al., 2006).

This study focuses on related systems that address the capturing of information i.e. the capturing in the existing systems will be inspected. The type of technologies, sensors or devices they used and what data the participants were interested in will be illustrated.

According to Sellen and Whittaker, (2010) the experience capture systems can be divided into two main categorizes, a) the total capture; and b) the situation-specific

capture, and any lifelong systems must belong to one of them. The total capture refers to continuously and complete capture of personal experience (everyday life) and includes images, video or locations, while the situation-specific capture refers to capture of specific information or activities in specific circumstances and in certain places such as meetings, lectures or field research (Sellen & Whittaker, 2010).

In the rest of the chapter, selected systems will be analyzed for the data they captured, and their illustration of the requirements of this research. A summary will be given in Tables 4.1 and 4.2.

4.2 Recording Personal Experiences (Total Capture)

Digitally recording everything people do, see or hear is called Lifelog systems or total capture, where the complete and continuous record of everyday life is required; the systems depend on passive capture i.e. the capturing processing operates without any effort from the user. Passive capture is desirable because more information will be captured and the user is more able to be fully engaged in the event (Gemmell, Williams, Wood, Lueder, & Bell, 2004; Truong & Abowd, 2004). Nevertheless, some researchers argue that, in terms of helping people to remember, involving the user in capturing the information instead of passive capture would help them to remember better, even if they never return to their captured information. This argument was based on a study by (Kalnikaitė & Whittaker, 2008) who said that the act of capturing information such as taking notes, helped the users to remember better even if they never returned to their notes. They also argued that one of the disadvantages of this technique is the social and cultural barriers which would far outweigh its cost (Lamming & Flynn, 1994; Truong & Abowd, 2004). Passive capture techniques have been investigated only on few areas such as the classroom, meeting and generalized experiences (Truong & Abowd, 2004).

MyLifeBits (Gemmell, et al., 2006) The interest in continuous archival personal experience has been growing since 1945 when Vannevar Bush introduced his vision "Memex". Memex is "a device in which an individual stores all his books, records, and communica-

tions" (Bush, 1996). His vision formed an incentive for many researchers to fulfil it, for example in the MyLifeBits project (Gemmell et al., 2006) which is one of the total capture systems. It is considered as a lifetime store of everything through storing all personal information found in PCs such as articles, books, music, email, digital photos in addition to external materials such as phone calls, and documents (see Table 4.1). To obtain all these kinds of data, diverse capture tools were used. Its digital database depended on the output of SenseCam (Hodges, et al., 2006) and other passive capture devices range from GPS to special digital cameras.

In terms of linking the data, this system works like a database. It supports linking two items to each other (the source to the target); for example, it links the photo (the source) to the place where it was taken (target) and the contact with an event. And it has a type for each link. Each source has limited target which can be linked to based on link type; for example, the person can be linked only to image, video, audio or phone-call if the link from "Capture Of" type is used. All captured information or items were stored on one server and the user is allowed to add either text or voice annotation. The user of the system is not allowed to enter any information or item such as writing notes to the system directly i.e. the user have to write the note on a software like Microsoft outlook or on piece of paper and then scan this paper.

Lifelog System (Aizawa, 2005) is another project belonging to a total capture category. It is interested in a context-based video retrieval system. As in many Lifelogs systems, this system captured data from a wearable camera, a microphone, and a variety of sensors such as brain wave analyzer, a GPS receiver, an acceleration sensor (motion), and a gyro sensor. Moreover, in addition to the various devices, the system captured documents, web pages and emails then it used these data to retrieve the stored information. Even though this system support captures the information regardless of the user's location, some information is captured while using the computer such as web pages and emails the user had to use the desktop/laptop to access. Capturing context information, multimedia files and other information as it shown in Table 4.1, were automatic. During capturing the information, however, the input the user can manually

start or stop the recoding using his mobile phone. He can also enter annotations to a particular scene while the life log agent recodes the video to use this annotation later to recall this clip. The system allowed the user to synchronize the captured data and store it in one server to be prepared for retrieval. The notation in this system can be done both automatically and manually by the user. But the user can not add notes immediately to the system. Context and other information were associated to the movie clip, but the system did not link the different video clips together.

SenseCam (Hodges, et al., 2006). Another well known project which belongs to the wearable and multimedia computing area is SenseCam. Microsoft SenseCam, the memory aid system for patients with memory loss, is a portable system. The system client used a wearable digital camera to automatically photograph, capturing the user's day. The system agent does not capture any other multimedia. The photos are captured automatically every 30 seconds or when any significant change in the environment surrounds the wearer such as light level or body heat. Much of context information was captured. Table 4.1 shows the different data which were captured by the system. The system's user can attach the camera to a PC to browse the captured photos and data from the sensors. The system did not support any manual input during the capturing phase. However, the user can delete or bookmark some photos while browsing the photos on the desktop. Also, the user can browse the photos in sequence based on what time of the day the current image was captured. Each photo was associated to sensor data, also the system helps the user to create links between similar photos. The SenseCam has a feature which is similar to the work of this study, quick replay of a day's events. Most of these systems focused on automatic and continuous archival personal experience, especially the visual information. However, other study showed that the ability of the user to use the images to recall their past experience decreased rapidly after only three months. This leads to doubts of the effectiveness of such a device in supporting the long term recollection (Sellen et al., 2007).

A summary of the data which is captured by the three systems is presented in Table 4.1. MyLif Bits captured varied information; textual, visual, audio and context information.

Lifelog captured less information than MyLif Bits and also included textual, visual, audio and location information. The third system, SenseCam, concentrates on recording images with context information.

Table 4.1 Data type which was captured by the total capture systems.

Categorize	MyLif Bits	Life log	SenseCam
Files	NTFS file, Legacy applications	Documents	-
Images	Images	Images	Images
Audio	Audio	Audio	-
Web pages	Web pages	Web pages	-
Outlook includes calendar, contact, message task and note. Links	Emails, calendar, contact, message task and note. Links	Emails	-
Video	Video	Video	-
Phone call	Phone call	-	-
Media (TV/ Radio)	TV & Radio	-	-
environmental infor-mation	environmental information	-	environmental information
GPS " location"	GPS	GPS	GPS
Others	MSN iM / Personal Vibe	-	-

Total capture systems are characterized by randomly recoding (Sellen & Whittaker, 2010). That is because this kind of system does not distinguish between the different data but it assumes that all the data is equally valuable to the user, so all the data should be captured. The system should support the user to capture and retrieve valuable data

instead of capturing everything, and then they have to use it to solve their memory problems (Sellen & Whittaker, 2010).

4.3 Recording Selected Data

Research studies relating to CARPE systems are introduced to help the user to capture selected moments during everyday life or in particular environments. In these selected moments, the user is sure that he/she will need it later. For instance, the other Brother project (Helmes, et al., 2009) , where the researchers tried to create a semi-autonomous agent, captures images and short movie clips autonomously from social life to help people to re-experience their moments later. The main aim of this system is automatically encountering visual information from domestic life. They use a digital camera controlled by external sensors and actuators. The system is portable and supports automatic capture. It captures photos and short video movies only (see Table 4.2). The photo is annotated by using context information. Each photo is linked to the associated context information but each photo or data capture was not linked to any other data. The user can not add any information manually, especially during the recording session. All captured photos were transferred to a desktop in order to be browsed and retrieved. Interestingly, this study showed that a single picture can help people re-experience the ambience of the moment which means capturing limited but valuable data may be sufficient to help the user to remember, instead of unselective capturing.

ButterflyNet (Yeh, et al., 2006) is a mobile capture and access system for biologists. They take it with them to the field to help them to combine paper notes and digital photographs captured with other information during field research. Then they transfer captured content to spreadsheets to share it. The system relied on many capture components: Anoto digital pens/notebooks, digital cameras, GPS devices, sensor networks, audio/video recorders to collect the data from the field (see Table 4.2). When the user decides to capture information, the data automatically linked with associated data such as time, location, or other metadata. Also it supports manual annotation. However, it does not use a semantic relationship between the different captured data. Adding notes by the user is allowed in this system.

Table 4.2 Data type which was captured by the situation-specific capture systems.

Categorize	Other Brother	ButterflyNet	iRemember	InSense
Files	-	Notes	-	-
Images	Images	Images	-	Images
Audio	-	Audio	Audio	Audio
Web pages	-	-	-	-
Outlook includes email, calendar, contact, message task and note. Links	-	-	calendar events, email	-
Video	Video	Video	-	-
Phone call	-	-	-	-
Media (TV/ Radio)	-	-	-	-
environmental information (EI)	-	EI	EI	EI
GPS		GPS	GPS	GPS
Others	-	-	Local weather	-

iRemember (Vemuri, et al., 2006). The visual information was not the only area to be investigated. The audio information was investigated as well since the conversations are another important source of information. In 2004, the audio memory prosthesis device was proposed. This wearable device attempted to create a personal audio archive with contextual information and support the user with a retrieval tool. The conversations were recorded via microphone, then the conversation and associated data such as location, calendar events, email, and local weather at the time are linked to it and immediately transmitted via a high-speed wireless network to a large-capacity server. The system does not support taking photos or recording videos. Beside the conversations, it captured

different information such as the calendar and email (see Table 4.2). The system is under user control i.e. the user has to decide which situation should be recorded. Even the conversations are linked to context information but there is no link between different conversations. To retrieve the information, the system provided a user with speech-recognizer generated transcript to help him/her to search within the data. Also, the user can search for the information by using keywords. Since this system supports audio capture, other multimedia, such as video, are not supported, also adding notes to the system is not available.

InSense (Blum, et al., 2006). A new approach in capturing and accessing past experience are has been introduced by InSense's team who used real-time context recognition to predict important moments to be captured. InSense is a wearable system to automatically capture photo/audio when the system recognizes the current situation as an interesting moment. According to the system, the interesting moment should belong to one of these categories: location, speech, posture and activities. When the system detects an interesting moment, it automatic takes a picture and a short audio clip. To detect an interesting moment, the system relies on a rule-based system. The manual input is not provided in this stage. The main goal of this study is to investigate assessing the real time analysis of situational context to detect the interesting moment to be recorded. The system is portable. While the system support using several pieces of context information (see Table 4.2), it does not support recording video stream. Later on, the user is allowed to select a label from pre-existing set of labels for a particular interesting moment. Each image is associated with the time and the sound clip which were captured with this image. The captured data is downloaded to desktop for browsing. Each image and audio clips are sorted individually.

All the situation-specific capture systems examined were interesting in collecting user location at the time of data capture. Also, most of them, three out of four, were interested in photo capture. A study which was conducted suggests that images are helpful to trigger true, re-living style remembering. It also suggests that location data supports

inferential reconstruction processes through helping the users in reconstructing their past experience (Kalnikaite, Sellen, Whittaker, & Kirk, 2010).

Most of situation-specific capture systems tend to avoid passive capture. The only system which was interested in it was the other Brother. This is because one of the system goals was to capture photos without any effort from the user in specific situations like parties. The other systems allow the user to decide which situation or moment they consider as important information. Not all information was captured manually; manual capture means the user has to interact with the system somehow to capture the information. Location, weather information and other information were captured automatically when the capture ordered was performed by the user (see Table 4.2).

4.4 Comparisons

This section compares these systems in terms of the requirements of the CatchIt system, used in this study, which are addressed in the previous chapter.

- The portability forms an essential requirement in order to support the user while he/she is away from her/his desk. Most of the systems support this feature and only MyLifeBit and Life log extend their system to make working on desk top/ laptop required to capture more information such as webpages, emails and phone calls. Life log focuses on retrieving information by analyzing the video stream, while in CatchIt, first it does not support video stream capture. Second, it does not support retrieval of the information from these movies. Lifelog records much of the context information which is not needed in CatchIt and it does not offer the user the option to record text notes during the capture.

- In terms of supporting capturing information without requiring interrupting, the other Brother, InSense and SenseCam maintain capturing information without interrupting the user by analyzing the context for automatic capturing . In contrast, systems, such as ButterflyNet, iRemember and Life log, need a promotion from the user to start recording. The MyLifeBits uses both techniques; it captures

some information automatically like capturing photos while the user is outdoors but also the user needs to scan the paper-based information to be stored in the system.

- Comparing MyLifeBits project with the CatchIt system, firstly, the MyLifeBits project captures heterogeneous digital data. Table 4.1 shows the different data types which are captured by MyLifeBits which are not supported by the Digital Parrot such as phone calls or the email messages. In addition, the system captures the information automatically while the user works in his office or while he walks in the street. The system supports capturing context information and many different multimedia files such as photograph, video and audio (see Table 4.1). the main difference between this system and CatchIt is the total capture; it focuses on selected data in selected moments, while this system attempts to collect all the different data during the day.

- For InSense, the capturing was preformed automatically after automatic analysis of situational context. The current study requires the capture processing to be without interpreting, but a small effort from the user is required to tell the system to capture the moment. Also, the system does not allow the user to insert any other data such as text during capture stage.

- The approach in this study differs from most systems in terms of multimedia capture; MyLifeBits, InSense, Lifelog, SenseCam and the other Brother support capturing video streams or sequences of photos while in CatchIt, taking photos and recording video is optional to help the user to remember while transferring the data into the Digital Parrot, but is not fundamental. ButterflyNet does not support audio or video recording, while iRemember supports only audio recording.

- In terms of context, CatchIt is considered as one of the systems which takes a small or limited portion of situational context information, unlike SenseCam or

MyLifeBits which collected plenty of context data including wearer information such as body heat or brain waves.

- The CatchIt is similar to most of the systems, it supports the synchronization between the workable and the server to browse and edit the captured data. Also, the captured information is annotated automatically.

- The CatchIt is different from other systems in allowing the user to add text in the capture moment. Most of the systems do not support this feature, except for ButterflyNet, which allows the user to write a note during the capture stage. But this system is design for biologists.

- The major difference between the CatchIt system and the other systems is how the captured information is stored. The data is stored as a network of related information .i.e. the new captured information can be linked to the new and/or to existing information. Also, the multimedia files stored are attached to the context information. The information is stored in the system as text which is related to other text in a semantic relationship.

- Some previous systems encountered large amounts of information such as calendar events, emails which this system does not support, while other systems focus on particular information and ignore other information which is assumed, in this study, as being potentially useful, such as photos like iRemember.

- In CatchIt, the targets know exactly when they need help and exactly what kind of data they want to record for later perusal. So they do not need total capture. This study focuses on helping the users to capture the first situation information then adding more information later when they have time, if they want to. Of course, this information such as images or location, is not enough to help the user to remember, especially after long time (Hodges, et al., 2006). The target users are supported to use what they captured to help them to enter more information

into the augmented memory system instead of depending only on what they have been capturing.

- Our approach is not continuous capture of past experiences in order to help people to remember, as most of the systems have argued (Gemmell et al., 2006;(Aizawa, 2005) But the study investigates capturing data that may act as cues to trigger user memory to build a structured personal experience archive by using the Digital Parrot (Schweer, 2010).

4.5 **Summary**

The existing work can summarized with regards to capturing the data, the total capture and the situation-specific capture, into two main types of the past experience systems (see Figure 4.1). The total capture is very popular to be used for recording everything people see, hear or do and they focus on finding an appropriate retrieval system, mostly desktop applications. Also, there is an interest to investigate a wearable device for total capture. Similarly, the situation-specific capture systems are more involved with the wearable devices for capturing the specific events in workplace such as capturing meetings or lectures, or outside the workplace such as capturing an experience and sharing it with friends.

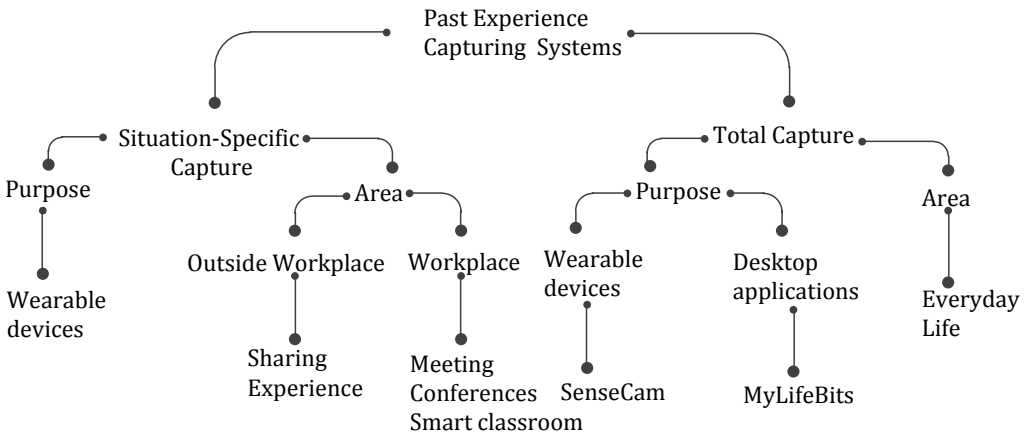

Figure 4.1: Categorize the past experience systems.

By reviewing the existing systems, it has been shown that the total capture systems captured much information that Digital Parrot does not support, and also, they do not support the idea of bookmarking moments. The situation-specific capture systems focus on either inventing a new device or developing a system to help the user to achieve a particular task such as sharing information with others or to helping them to capture information in a specific context Although, some systems have some similar aspects of the Catchit, none of them can fulfil all the Catchit requirements to feed the Digital Parrot.

5. CatchIt Design

This chapter will discuss the design of CatchIt to feed the Digital Parrot. First we will explain “Bookmark a moment”. Before revisiting the scenarios in Section3.1 and show how the system would fulfill the user’s needs to capturing information. Second we will explain the conceptual design of the system.

5.1 Bookmarking Moment

Every day people like Sarah face situation where it is so important to them and their career. In most of these situations they do not have time to record information but they have time or they like to make time for going through all valuable information for reflection, editing or archiving. So they need to be able to mark the important situations that they find themselves on front of important information while no time to record it similarly to what most of the people do while they surfing the web. One of our routine is bookmarking a web page that we like most and we think that we will back to it later one.

Bookmarking important moments in our life is the new approach that this thesis tries to propose. We try applying the same technique which most of the web browsers provide to the user to help them to keep the interesting web page for reuse or revisit. In fact, our life is collection of serial moments some of them are more important than others. Let’s imagining these moment as web pages and as we move from one moment to another is like move from one page to another page. Whenever we come across an important situation we act like what we do when we found interesting web page. In web context, we bookmark the page and the browser usually save the name of the page with the URL but in real world context, we suggest that the user bookmark the moment but this time more than the name of the moment is needed to be recorded. For a system such Digital Parrot, the context and content should be recorded.

Wide range of sources e.g., audio/video recordings, user's location, people names, as well as manual information input like text should be recorded every time the user bookmark a moment. And by the end of the day, the user will have a set of moments or bookmarks waiting for him to be edited or archived.

Since it never possible to capture absolutely everything (Sellen & Whittaker, 2010) ; we focus the effort on selected data (cues) to be captured. The main aim of our system is to enhance short term memory to assist the users to recall their recently experience during the day by collecting cues that might help them to trigger their memories (autobiographical memory). The most important information which the system should capture are what, who, when and where. These cues are useful for retrieval memories (Lamming et al., 1994). Surely to tag a moment we should capture time, data, location, image, audio, text, annotations and short movie clips. All these different kinds of data involve using various sensors or captured device. The collected data are stored locally on the portable device before transmitted later on to PC or laptop. Where the data can be accessed, modified and transmitted to the Digital Parrot.

To design the system we will first revisit the scenarios in Section3.1 and show how the system would fulfill the user's needs to capturing information. Second we will explain the conceptual design of the system.

5.2 **Revisiting the Scenario**

We will use the same scenario in Section3.1 to reveal the conceptual design form the user's point of view. People like Sarah are supported by the system to keep track with the important information they might come across in their everyday live to recall it in needs. Figures 10 shows that the idea of bookmarking different moments during the day and review them later on for editing and archive them.

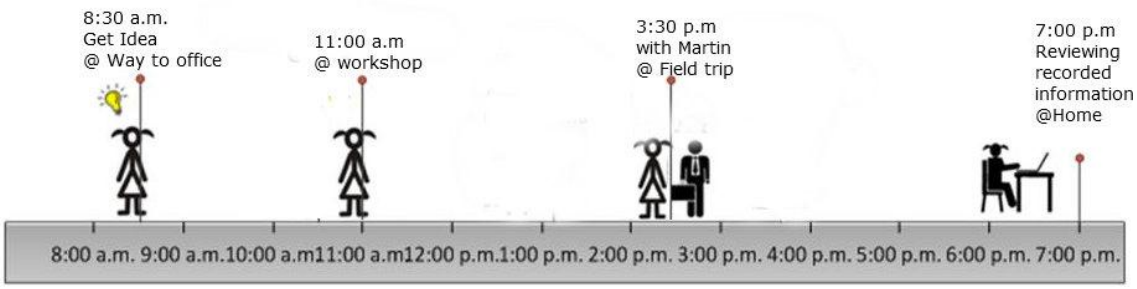

Figure 5.1: Scenario Illustration: Sarah's day using CatchIt.

5.2.1 Bookmark a Moment during the Day

- When Sarah has the conversation with Martin and he tells her about Christine and his research on rock formation, she is in the situation where she does not have time to write down many details about the rook formation or the name of the student and his supervisor who do this research on this rook formation. She knows that she wants to remember this moment so she asks the system to mark this moment. She continues her conversation, while the system starts collecting the context information specifically the time, location and people around. Obviously, the context information might not be alone sufficient in all situations. Sarah thinks it might be a good idea to record the conversation and take a picture of the rock formation as well. Both conversation and a picture of the rock are arranged in the system to the marked moment. Now, Sarah has the context information of her situation and additional multimedia files. The automatically system realizes that the picture, the audio recording and context information belong to one a cohesive package of data. Each time Sarah asks the system to record information at any moment during the day, the capture information is saved as a moment.

- While Sarah is driving and she needs to capture her idea about her project, she asks the system to record her idea, the time. Her location is changing constantly so the system suggests that she is traveling. She tells the system briefly about what is on her mind. However, in some cases, like when Sarah uses the bus to travel, she quickly writes or sketches her idea. She has no appropriate time to add more details but she marked this moment to back to it when she has free later.

- When Sarah was at the talk, the application used her calendar and shows each talk in the session she's attending. She just selects the talk and she just typed the publication which she was thinks that this will be enough to locate an electronic version of the publication later when she has more time.

5.2.2 Revision in the Evening

By the end of the day, there is sequence of moments which are sorted by the time stamp. Sarah goes through them chronologically. She trust her memory and she knows that there are lots of information she wants to add later on but she wants to be sure that the system riches her that she has been in an important moment during her day. Whenever Sarah comes back from a conference, filed trip and so on, she is going through her memories to follow up on his new information such as new contacts, new publications and idea. Every time Sarah backs home, the system shows her about how many moments she recorded during her day. After while, Sarah has many moments that she wants to brows, edit and stored in a server. She goes through all the moment on her portable device but she likes to browse these moments on her desktop or laptop as the screen is larger and the input and output mechanisms are more comfortable and available.

She synchronizes her portable device and desktop/ laptop. She needs all her information to be organized and linked to her pre-existed events and data and she needs to add more information since she has a time. Consequently, she starts browsing, editing and then transform/enrich them into an augmented memory system or the Digital Parrot which we explained it in Chapter 2. She uses the Digital Parrot to combine her new information with others related information and make it retrievable.

When Sarah brows the moments and she reach to the moment at filed trip, she view the information which was captured. She had a conversation with Martin about the rock formation. The system tells her that this moment was a conversation and Martin was nearby and there is a picture already associated with this conversation and suggests to Sarah to indicate Martin as a partner in the conversation. She adds the text “rock formation” and scientific term as tags to this moment, in case she will use text search to find this information in the future. The system has given her a transcription of the conversation. So she easily finds Christine name and then she uses this name as tag for the conversation with Martin. Since she has the information of all people she met in the past she finds Christine’s supervisor data and she connects it with Christine.

Thursday afternoon, she meets her student and she tell him about Christine but she cannot remember the name but she can remember the scientific term of the rock formation. She opens the Digital Parrot and she searches for the rock formation then she finds the Christine's name as a student of Christine's supervisor. She gives all Christine's supervisor contact information and she suggests to her student to contact him.

Sarah's captured information will be connected in semantic way in the digital parrot. When she meets her PhD student she just search for the places and then she remembers the session was in the afternoon so she goes through all afternoon sessions that she attended then she finds the session and she follows the connection which is called " mentioned in" to find the publication.

Sarah has 3 days off from her work and she thinks it good to her to use this time in working in her project. She remembers that she has an idea about solving one of her project problem. She search for her project then she look for the ideas related to this project then she finds there is many ideas related to her project then she remember that write her idea in a text file. She fined the attachment then she opens it and start reading her idea to apply it.

5.3 **Conceptual System Design**

In this section we will describe the design considerations and assumptions of the system which is supposed to be used to capture information for the digital parrot. Firstly, we will converse about the type of data which we interesting in recording and the situational context then we will discuss the tools which will use and finally and most importantly identify the interesting moments.

We can define the bookmark a moment as the action of storing different cues for one event at particular moment in a portable device and these cues with semantic information and associations will be used to create a digital copy of person's memories in the Digital Parrot.

As we said before the Digital Parrot is a system deal with context and content data. Consequently, we will focus on recoding this kind of data. The context of user's current situation in our approach refers to the context variables which surrounds the user in particular time include the time, location, weather, people and other aspects. Surely we cannot capture all of context attributes but we try to capture a collection of these attributes in order to provide the user sufficient information to be able to recall the past experience with limited effort. The situational context can be captured automatically through different sensors while extra information or the content data can be added manually by the user. When we said context, we mean the time, location, time and people nearby. While when we talk about content we mean the multimedia which includes audio, video and photo.

For identify the interesting moments, the user must make a decision. Whenever the user feels the situation where there is important event or moment, he/she need to bookmarking this moment using the device see Figure 11.

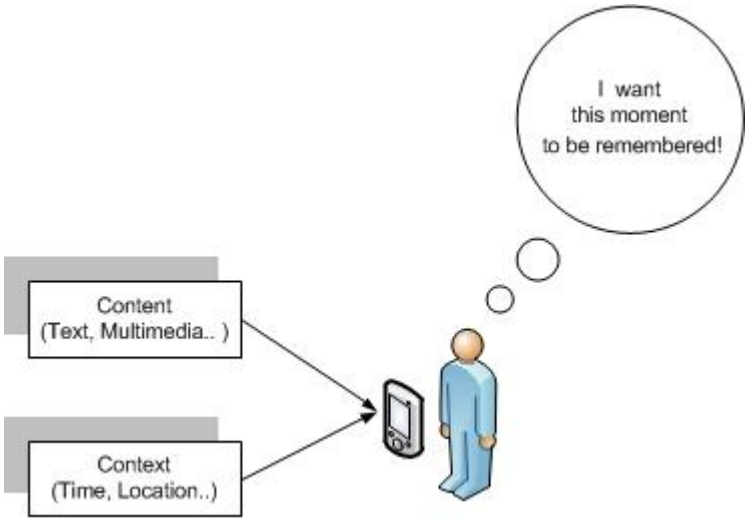

Figure 5.2: Recoding context and content data for each moment.

In this early design we assume that a smart phone like the iPhone will be ideal for our Digital Parrot's agent CatchIt. This is because we aim to help the user to capture information easily and fast and we assume one button should be enough. Device like iPhone has all of our minimum hardware requirements such as the GPS, camera, and voice

recorder, portable wide screen for retrieval and most important “One Big Button”. The user should be able to user one-tap to record the information.

Figure 5.3: Suggested Portable Device.

The captured data goes through three different stages see Figure12. The first stage is acquiring the situational context such as the time, location and people nearby. In this stage a portable device is required to help the user to record this information while the user is away from his/ her office/home. The environmental information which surrounds the user will be registered by various sensors and input devices which are integrated with the portable device .The information will remain temporally in the portable memory until the user decides to transfer it to the Digital Parrot to edit it and archive it.

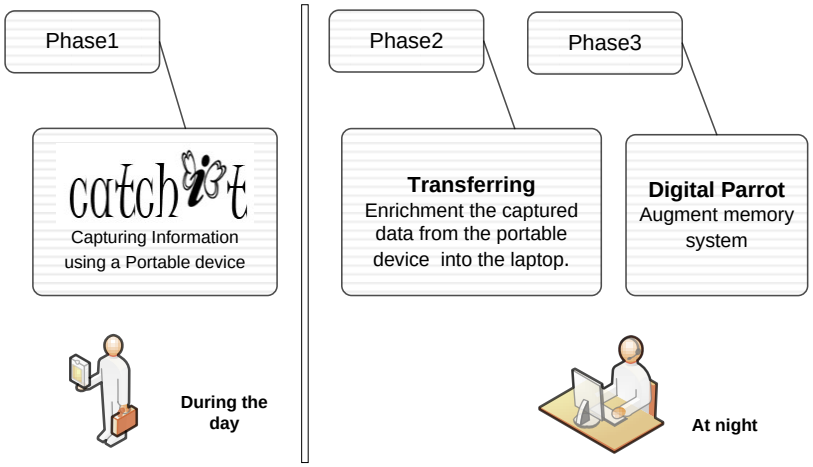

Figure 5.4: Three Stages for Processing Memory Trigger

Gathering of data or capturing phase is the first phase for any memory system. This stage is collecting data from different sources around the user when the user knows that this information is important and he/she needs to remember it later on. The user uses the portable device to storage information which surrounds his/her situation and permits the user to enter extra information such as photo, video and text. Figure 14 shows the data flow form it is captured until it stored in the Digital Parrot to be ready for retrieval in need.

To help the user to capture this important moment the system agent uses the available GPS modem to record the location. Also the time and the date are recoding automatically to help in marking a moment fast. While some context information is record automatically, the user able to captured or inserts data manually such as writing a note.

In this stage the system, the user will have collections of moments in the portable device. After pulinging the portable device to the PC, the captured data is transferred from the portable device to the server or to the desktop. The transferring of the information is completed through synchronizing the portable device with PC/laptop. The user will be able to brows the information before entering it into the Digital Parrot. In this stage, the user can browe all the mareked moments. And by selecting one of these

moment, he /she can view it , deleted it or transfer it to the Digital Parrot to be processed to become more useful for future use in the Digital Parrot.

The captured information is stored locally in the portable device in form of different moments. Each moments is automatically annotate based on the time, date and location to make it easy to access. Captured information is stored in specific structure with multimedia data of the event. The user can build her/his organized archive by capturing situational context then later one while he/she still can remember and has a time to organize and add more information to the captured data and prepared her/his data to be connected with the pre-existing data and store it in remembered way.

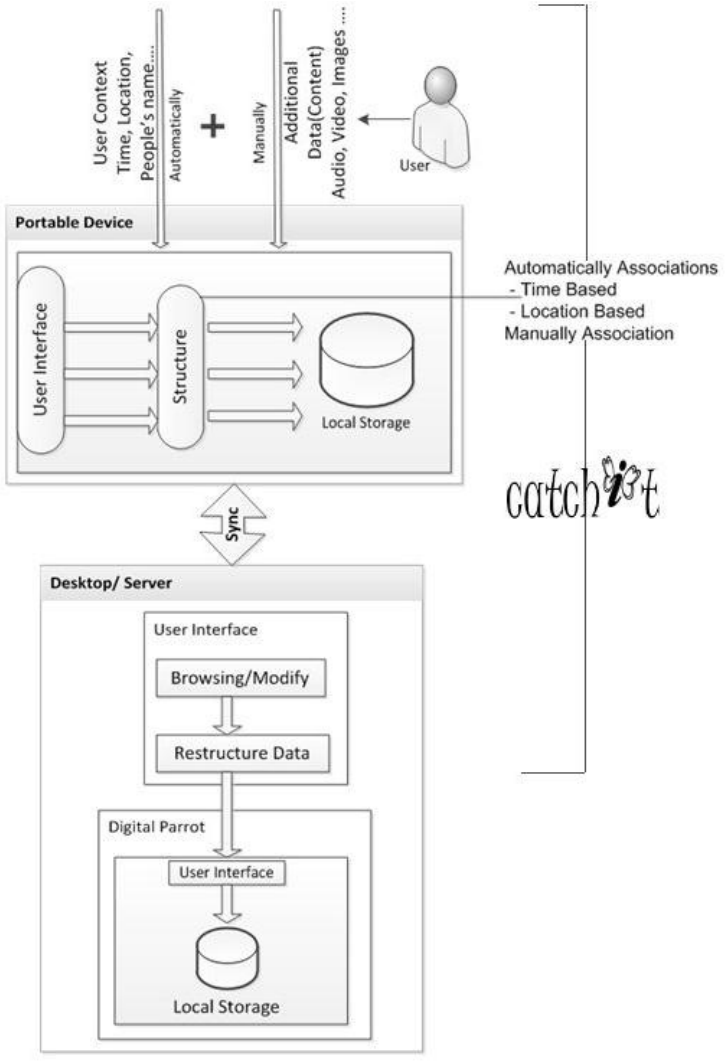

Figure 5.5: CatchIt Architecture

The information about the user location is recoded through a built in GPS unit. The GPS receives the location on longitude and latitude format. This form of the location needs to be converted to locations or addresses to be readably to the user and help the user to use location information as a key to retrieve the associated data. The location is associated with the moment automatically. Whit Bluetooth technology, as most of cellular phones have it, the user able record people nearby (Bluetooth name) who a) leave the Bluetooth function switched on his/her mobile phone or laptop and b) located within transmission range which is around 10 meters for mobiles or up to 100 meters in some laptops.

In terms of synchronization, the system should support two-ways synchronization to support the user to keep a copy of information on to directions or to prepare for capturing information in the future. For example the user can create a label for all events which will be related with a specific filed study.

6. Bookmark a Moment: User Studies

6.1 Introduction

The previous chapters have focussed on the idea of booking moments, existing works and the conceptual design. Instead of focussing on implementation it was decided to conduct a study to collect data which examine closely and understand end-user specifications in terms of capturing data for later use. This included the study of the users' point of view and behaviours, using devices, visiting places and open interviews with the users. To collect these data multiple research methods such as interview, observation and wizard of Oz (see section 7.2) were used. This section will describes how the research was designed and conducted. The subjects are described in section 7.3 and section 7.4 will explain the physical location for the research. Section 7.5 will discuss the ethical considerations. The two last sections, 7.6 and 7.7 will describe the procedure of each study conditions and sum up this chapter.

6.2 Experimental Design

The main aim of this study is to build a better understanding of the user needs and situations in terms of capturing data. It is assumed that semi-automatic bookmarking or labelling the important moments during the day would help the user to effectively create a personal archive for his/her past experience using an augmented memory system like the Digital Parrot. In order to discover how bookmarking can be developed, many questions need to be answered such as when, where and how capture data.

A flexible approach was adopted by using a combination of different methods to provide the data necessary to provide evidence to better understand the real situation.
In this study, qualitative and quantitative research methods were used in combination. The big picture was examined, then the more specific areas. Capturing data is data gathering task and recording data of the environment is very complex and context dependent and different data collecting techniques are required to understand the capture processing. There were five different stages/conditions to data collection and each stage has different aims. The findings were drawn from the result from all stages . The first

stage, began with investigating the user's point of view and their experience in recording past experience. Then how users record their past experience in the real world was observed, followed by a closer examination using a prototype to assessment the user interaction with a device to bookmark a moment. The final stages focused on the kind of digital memories which are recorded using smart phones. Different study conditions were designed to cover some aspects of experiences recording behaviour, the type of information desirable for capture and how the users might use and benefit from such a system. Because one study conditions would not cover all these aspects different study conditions to clarify these issues. The next subsections discuss each stage in more detail.

6.3 **Procedure**

In each of the five different methods, the participants had to go through same two main stages. Generally, first user's actions were studied in a real context then and after the user behavior was observed, they were asked t to explain some of their behaviours/ actions and their point of view about their experiences in capturing data (See Figure 6.1.).

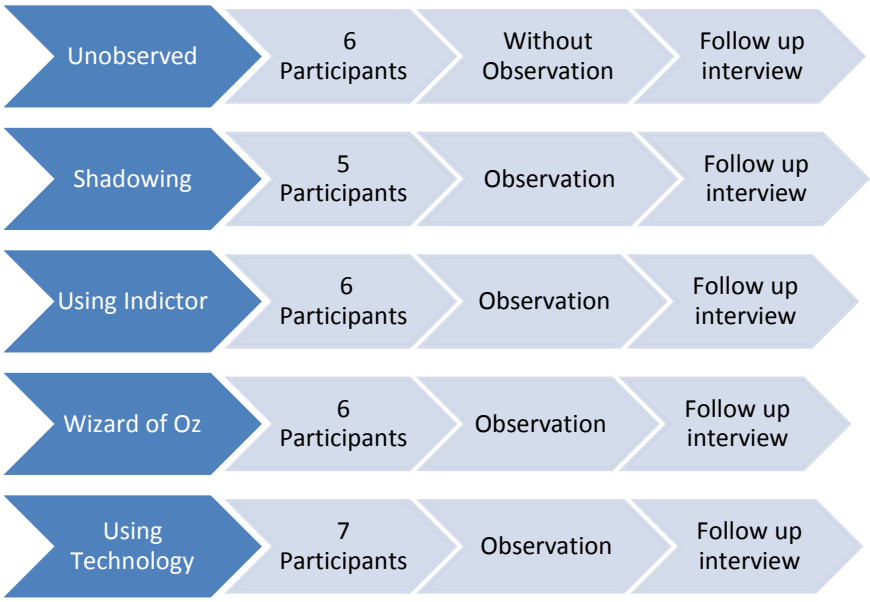

Figure 6.1 Study Execution: Number of the participants, based on study conditions and their stages.

Field study

The first stage for all five methods is visiting a tourist sight such as zoo, garden or museum up to an hour to accomplish some tasks depending on the methods (see section 7.3.) The same place was used for all methods to make the context similar for all participants and for all methods because how different contexts may affect capturing data was not of interest in this study. The fieldwork will be described in more detail in each method in Section 7.3 and Section 7.5.

Interview

In the second stage, the participants have to return to the usability laboratory[2] in the evening around 6:00 P.M. Then they were interviewed immediately after they answered the paper-pencil surveys (see Appendix C) for demographic and background information. The observations were used as the basis of the interview questions. Every participant was interviewed alone. Audiotapes and notes were taken throughout the interview. Then the entire interviews were transcribed for analysis. The interview for each study condition will be explained in methods Sections.

6.4 Research Site

Choosing the place where the research should be conducted was a challenging task in this study. It needed to be a place where people usually face situations where there is plenty of information to be recorded while they are under time pressure. It also needed to be a place where subjects' behaviour could be closely observed in different situations in a short period of time. Hamilton Zoo[3] was chosen. The Zoo is located in the Waikato region in New Zealand. The participants were close to the animals and animals' information, met zookeepers, and talked to other participants. These situations form potential value information which subjects might need to record.

[2] The University of Waikato Usability Laboratory
[3] http://www.hamiltonzoo.co.nz/

Since the Zoo does not offer a free entry to the visitors, the Zoo's official were contacted to arrange an acceptable offer (see Appendix B). Also the location of the Zoo bothered many of the participants because it is located around 9 Km away from the city centre or approximately 14.8 Km from the university campus. To overcome this issue, transportation to and from the Zoo was offered. A few subjects offered to use their own vehicles to go to the Zoo, so they had to meet the researcher at the Zoo entrance. The participants have to go with the researcher, while in some study conditions they have to go alone (see Sections 6.4.1 and 6.4.5). All the participants who went go alone were provided with a confirmation later (see Appendix F) and the fee before going to the Zoo.

6.5 Methods

This section describes the five techniques used to collect the data in this study.

6.5.1 Unobserved Visit

The first technique used in our study is the interview. The interview is one of most important and well known qualitative research techniques for collecting data and evidence. The participants were interviewed to explore their experience of capturing data and their understanding about what was going on. The potential benefit from this study condition is to understand more about what participants think about recording information, what kind of information they usually record and what they are doing now. Face-to-face discussion was used to interview the participants.

The interview questions varied from direct, indirect interpreting and follow-up questions. The first part was structured and the second was free-flowing. how they defined the important/ interesting moment and what kind of techniques they used and what context they used to remember the moment. They were also asked about the motivations and the discouragements for capturing information? The participants had to go through two main stages. Before interview the participants they were asked to visit the zoo in the morning of the interview day around 10 a.m. and spend a period of time, not less than one hour, at the Zoo. They had to go on their own to the Zoo without any hints about

what would be required from them and what they will be asked in the interview (see Figure 6.2)

Figure 6.2: First condition: P3 and P4 at the Zoo without observation[4]

They were sent to the Zoo to ensure that they had a recent experience of meeting a quantity of interesting data which includes animals, new or interesting facts about them, new people and so on. When the participants returned from the zoo, they were free until the evening, the time for interview. Each participant had to return to the usability lab in the evening but at a different time. For example, the participants had to come to the interview at 6:00 pm while the second participants had to come at 7:00 pm and so on. For approximately 30 minutes, participants were interviewed to discover what they thought, their stories, shown how to transfer data.

6.5.2 Shadowing

After listening to the participants in the previous method, their behaviour in real life was investigated. Shadowing is defined as a research technique which involves a researcher closely following a member of an organization over an extended period of time (Truong & Hayes, 2009). The aim of this technique is to study the actions in a real-time context.

[4] Adapted with permission.

In this method, the researcher or expert acts like a participant shadow; the shadower has to follow the participant to everywhere he/she goes and sit wherever the participant sits over an extended period of time.

The goal was to clarify the challenges or the difficulties which people might face. Part of the goal was to understand how different people can follow similar/different patterns in capturing information and what are the personality differences which could affect the way of capturing information. Understanding the different behaviour of different subjects can do in order to capture the information contributed to clarification. The kinds of information important for the user to be recorded, and some of the user's personality traits were also observed.

Figure 6.3: Shadowing a participant at the Zoo[5].

The participants of this study to go to the zoo again, but this time with an expert to observe how they encountered information in the situation. The expert shadowed the participant from when he/she entered the zoo to when she/he left it for approximately one hour and recorded participant's behaviour, particularly in terms of capturing infor-

[5] Adapted with permission.

mation, without interrupting the participant and by the end of the hour the shadower, had several field notes to be analyzed (see Figure 6.3). In this study condition, for each time the user encountered information the situation and how they recorded the information was observed. The antecedent and following actions of the capturing process were captured. The situations or the behaviours of interest were noted.

6.5.3 Using Indicator

In the web world context, many people bookmark a webpage by clicking on the mouse or using their keyboard. To apply the idea of bookmarking a moment to life, possibility of bookmarking an interesting moment using the same techniques was investigated. The participant was provided with a small device with only one button to press whenever he/she wanted to mark a moment. The device is small and can be carried by one hand all the time. Besides capturing all the required information, bookmarking moments should be easy to use, involve little physical interaction and flexible to carry around. The users should also feel comfortable in the environment in which they are.

In this user study, the participants were provided with a small device (Energizer Key ring LED) to use to indicate any interesting moments. Figure 6.4 shows the prototype which was used during the study condition. The device is small and can be carried in one hand all the time.

Figure 6.4: Prototype used as the indictor.

Figure 6.5: Using indictor to bookmark a moment.[6]

Figure 6.6 : Using the indictor at the Zoo and the observer is recording information from observation.[7]

This device was used because it has only one button to press whenever the participant wanted to mark a moment (see Figure 6.5). The participants were asked to use the device to record data. For the observer, using the device meant that the participant needed to record some data, including the current situation context. Consequently, the observer started observing and recording how the participants interacted with the device

[6] Adapted with permission.
[7] Adapted with permission.

(see Figure 6.6). Then the recorded data and observation result were used in the interview.

This user study involves six participants, recruited from the general population. In the beginning of the study condition, the observer will introduce herself and describe the purpose of the observation to each participant. Finally, the participant will be provided the Participant Information Sheet to sign and know that he/she is able to quit at any time. Each participant has to spend no more than one hour walk around the Zoo with the observer then she/he is able to leave or spend more time at the Zoo. During this time the participant should use the device to record an important event, a conversation or just information about the animals or the places in the Zoo.

The participants have to come later on in the same day to the University of Waikato particularly to the usability lab where the interview will take place. The interview will start around 5 pm and it will not take more than half hour. The participants will be interviewed separately and the interview time will be arranged in advance.

6.5.4 Wizard of Oz

After investigating using one button to bookmark different moments, we conducted the fourth study condition which called Wizard of Oz. the key point in our study is to understand what kind of data those users believe it is an important to be captured, observe the situations when the users tend to capture data. And examine the kind of captured data. How the user deal with such a system.

In this user study we used Wizard of Oz (WOz) or Oz Paradigm methodology. Wizard of Oz technique is a popular experimental evaluation mechanism in computer human interaction. Generally, this technique is used to study the usage of natural languages interface for retrieval information systems(Salber & Coutaz, 1993). The Wizard of Oz-study condition usually involves at least two people: the participant who supposed to use the system and the wizard who sites in different room to observe the user's screen and

respond to the users input like a real system. The user does not know about the wizard till the end of the study condition.

Figure 6.7: Wizard Oz records textual information. an iPhone's GPS and the Zoo map was used to record location.[8]

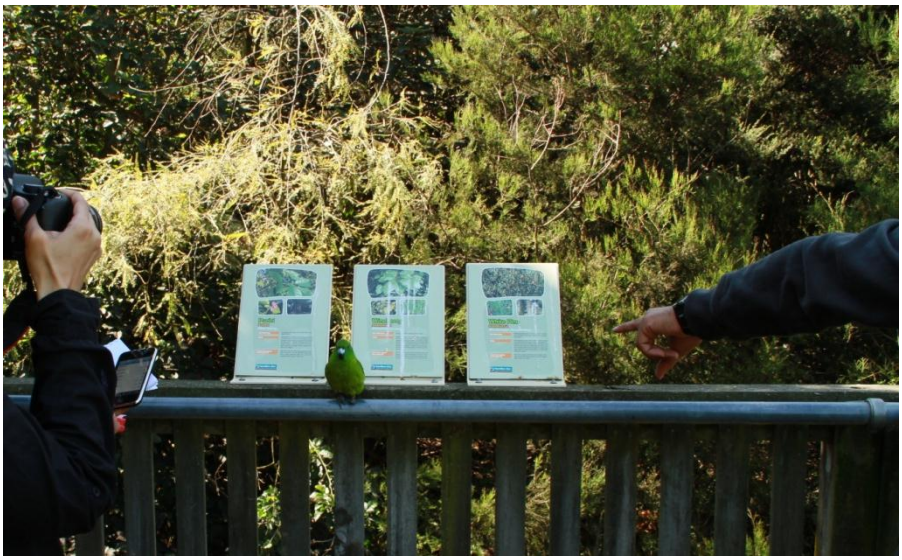

Figure 6.8: Wizard Oz records visual information based on participant's request[9].

[8] Adapted with permission.
[9] Adapted with permission.

In this project the WOz technique was used but with some differences such as the participant interacted directly with the Wizard from the beginning of the study condition. In this study condition there was only one Wizard. The main role for the Wizard is walking along with the participant to a) observe the user's actions, b) simulate the system's responses in real-time in terms of recording the data. The user had to tell the Wizard exactly what kind of the data they want the system to record. The Wizard will be equipped with digital devices to record images, voice, location, people's names and context and any other information that subjects might think of it (see Figure 6.7 and Figure 6.8). The problem in this study condition is the performance is not "optimized" yet. The wizard needs to record the data which might cost time, unlike the system which supposed to be fast and effortless. Also, the Wizard used words as if were feedback when she finished recording the data.

In this condition, each participant was followed by the Wizard (the researcher), who acted like the system. During approximately one hour in the Zoo, the participant asked the Wizard to record any data of any situation he/she likes to use later to recall the situation. This recorded data was to be used in the interview. The participant had to tell the Wizard what exactly kind of data they wanted the system to record for them. Immediately, the wizard recorded the data using an advanced digital camera which includes video, and voice recording. Also the Wizard has a GPS to record the location if the participant asks, and carried a map for the zoo in case any participants wanted to capture a specific location within the zoo. To record user comments, the Wizard used paper and pen. During the study condition, the participant was able to talk to people around him/her, talk to zookeepers and act as normal, there were not any rules or regulations.

All the data was analyzed in order to clarify in such a situation what information the users want the system to capture, then to test whether this information could help the user to recall recent experience accurately. Additionally, the potential limitations in deal with the system and the digital data were examined.

After spending one hour at the zoo, the participants were asked to return to the usability laboratory in the evening to answer some questions related to the zoo trip. The participants were interviewed. In the interview, the focus was on asking the participants some questions related to their behaviour, such as one of the participants liked to take notes most of the time so the participant was asked how he would like to enter the text. For more information about the interviews see Chapter 8.

6.5.5 Using Technology

The last study condition was using technology because the users were asked to use an electronic device, such as smart phones, to capture digital information. They were able to take photos, record the locations, record video and audio, also they could write a text memo. In this situation, the observer was not needed. This study condition was set up to investigate the physical aspect of the devices which the user prefered to use for capturing information and investigate recording, organizing, sorting and retrieving the information using portable devices (Figure 6.9).

Figure 6.9: Recording information using mobile phones[10].

[10] Adapted with permission.

The participants were asked to spend some time in the zoo and record any information that they feel worth to be recorded for later use. Also, before going to the zoo, the participants were provided with the entrance fee and a confirmation letter to confirm that he/she was a participant in our study. Also, they were asked to return to describe their experience in capturing information and what kind of information they recorded.

6.6 Recruiting Participants

To recruit participants, people were approached in the University of Waikato university campus[11] and asked to be volunteers, and their contact information was collected. Also emails were sent to friends and friends' friends. The number of the subjects depended on the study conditions. The Table below shows the number of the participants, based on the study conditions.

6.7 Ethical Considerations

This study involves real people in real environment which means Ethical Approval is required before we were able to carry out this study. We obtained the ethical approval from Human Research Ethics Committee at Department of Computer Science at University of Waikato (see Appendix A). Before any study conditions, we first asked the participants to sign the Information Sheet and Consent Form to be sure that the interviewees are aware about the aims of the research and informed the participants about their rights and their possible involvement.

6.8 Challenges

The major challenge in this study was the schedule; since all of the methods used included observation for no less than three hours per a day and followed by interview for the same period, which is time consuming. First the participants had to be observed, than

[11] The University of Waikato University in Hamilton, New Zealand

the observation results analysed. This was followed by a taped interview which had to be transcribed and analysed.

The place was another challenge; transportation had to arrange for most of participants and this consumed time. Another problem quite frequently faced was finding the participants, because the study was conducted during the end of the study year and public holidays, also the study required long periods of free time. Another challenge was keeping the commitment, some of the participants showed excitement to participate in the study, but they sent their apologies as they could not be there, especially as they considered their participation as a full day's activity!

The other challenge is the situations. Even though the zoo was full of different types and interesting information about animals, plants, places, etc. which formed an incentive to record, most of the participants did not record things. Although, the enthusiasm and happiness on the faces of the participants was clearly seen, but this did not mean they recorded these moments. This could support the assumption that recording information is a goal-oriented task (Brown, Sellen & O'Hara, 2000)

Finally, the last challenge was lack of punctuality among the participants. We had to contact the Participants had to be contacted several times and sometimes collected from their place to bring them to the interview. That they were conducted in the evening seemed to make the participants reluctant to come to the interviews.

7. Findings

The previous chapter discussed the design of the approach and the methods which were used to collect data about participants' behaviors and thoughts about recording personal experience. In this chapter, the findings obtained from the study are presented. Firstly, Section 7.1 presents the demographic information of the participants. At the beginning of each interview, participants were asked to complete open-ended and closed-ended survey questions. The results from this survey are presented in Section 7.2. Since the interview and observation generate enormous amounts of data, selected results are presented from each stage/condition individually. The next chapter will discuss these findings and discuss what has been learned from this study.

7.1 Demographic Information of the Participants

In total, 30 international students from Waikato University (15 male and 15 female), ranging in age from 18 to 30 years took part in this study (see Figure 7.1). The number of the participants differed based on the study conditions (see Figure7.2). In this study, five different techniques were combined to broaden the understanding of end-user needs to capture information to help them to remember. In each technique or condition, the participants had to perform different tasks. The gender representation is unbalanced in most of the study conditions. For the first condition, we interview six participants (5 male and 1 female), 90 percent of them university postgraduates from the technology sector. Only one male participant was a university undergraduate. In the second condition or Shadowing, all the participants (1 male and 4 female) were postgraduate university students. In the study conditions called 'Using indicator,' half of the participants, (2 male and 4 female), were postgraduates (technology field), while the rest were undergraduates.

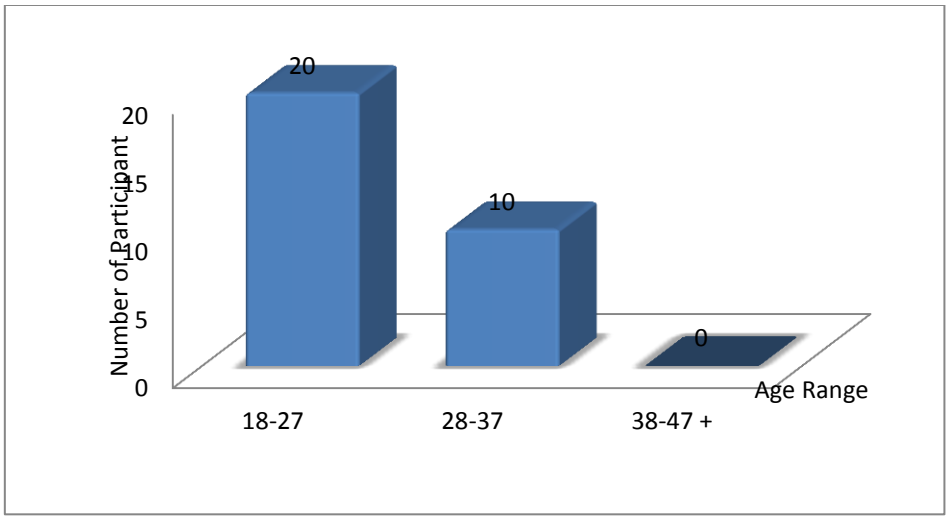

Figure 7.1: Age distribution of the participants

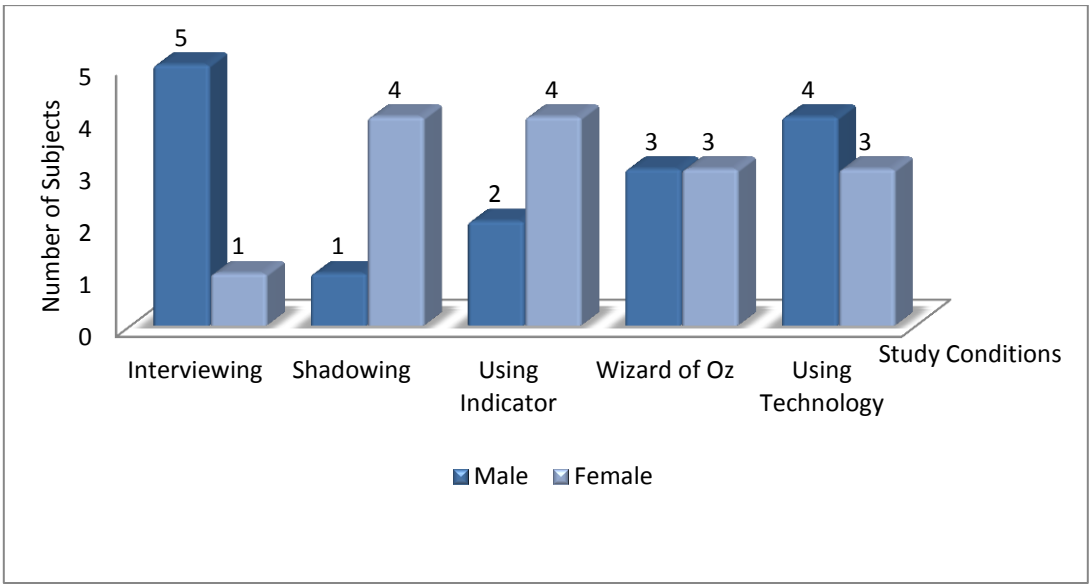

Figure 7.2: Distribution of the participants according to study conditions.

In the fourth study condition, there were six participants (3 male and 3 female); one of the males was postgraduate university student while the other two were undergraduate students. The two female participants were a postgraduate student and an undergraduate student. Finally, the participants in the last study condition were four males and three female; two of them were postgraduate students while the rest were undergraduate students. In this study condition, it was required that the participants be familiar with

smart phones as they were asked to use their mobiles to record their experience at the Zoo.

7.2 General Analysis: Survey Questions

In the beginning of each in the interview, all the participants were asked to complete a collection of open-ended and closed-ended questions which are related to their everyday recording behavior and their preferences. Before presenting the results of each study conditions, the result from analysis of the survey are presented.

Recording Technique

First, the participants were asked what kind of the tools/ techniques they use when they come across important information and they want to record it for later use.

Two of the participants acknowledged that they do not record any information because they believe in their ability to remember. The rest of the participants said that they recorded using different ways. Some of them use only one technique, such as taking notes using pen and paper or just taking photos, while others said that they use more than one technique. One of the participants said he used five different techniques. The different techniques used by participants to record their past experiences are shown in Figure 7.3.

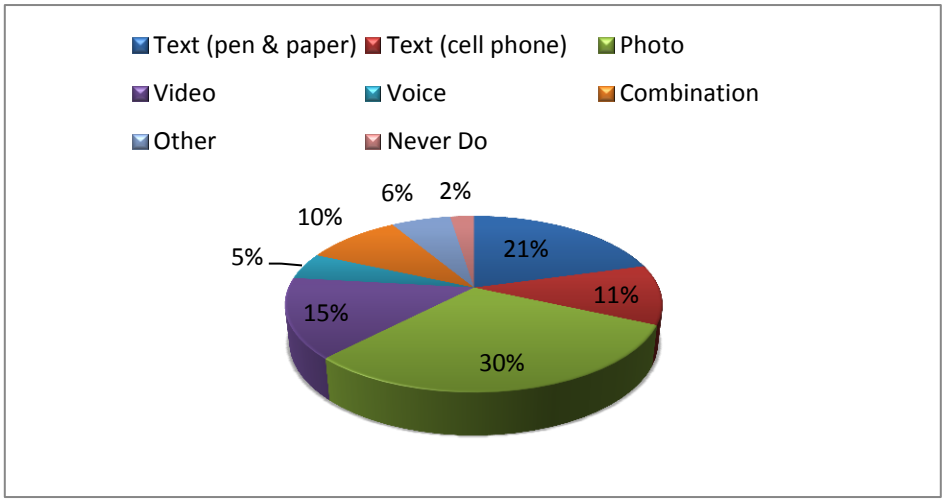

Figure 7.3: Recoding techniques are used to record Past Experience

Taking notes became the first place; 32 percent of the participants like to write down their important information: 21 percent use pen and paper, while 12 percent use their cell phone to record information. Taking photos was in the second place, 30 percent of the participants like to use a camera to record their past experience. Recording video is ranked third (15%), while the voice recording was not desirable for many participants only 5 percent said they do use it. Some participants (10%) said they used combinations of text, photos, voice and video. Six percent of the participants said they use other techniques such as a physical object, asking other people to remember/record the event or the information, using smart pens or desktop applications.

Ten females and nine males said they take notes. Six female take notes using pen and paper, while four males use pen and paper. While no female recorded using cell phone as a tool for taking notes, two males record note in their cell phone. In contrast, four females said that they use pen and paper, as well as the cell phone to record information and three males said the same. See Table 7.1. Figure 7.4 and Figure 7.5 show an example of notes that were taken by mobile phone and by pen and paper.

Table 7.1 Using pen and paper and cell phone to take notes among participants.

Gender	Participants	Pen and Paper		Cell Phone		Pen and paper & Cell phone	
		No.	%	No.	%	No.	%
Female	10	4	60.0	0	0	4	40.0
Male	9	4	44.4	2	22.2	3	3.33
Total	19	10	52.6	2	10.5	7	36.8

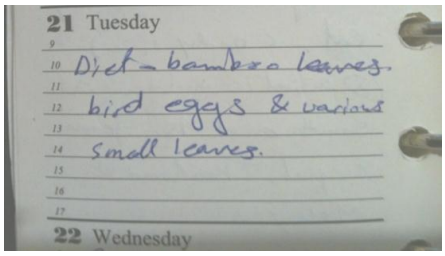

Figure 7.4 Pen and paper note: taken by Participant P9

Figure 7.5 Digital note recorded by P27 at the zoo using a mobile phone

In terms of recording visual information, in the zoo context, the camera was the main tool used by the participants to record information. They took many pictures and some short videos and notes. Figure 7.6 shows some pictures taken by participants and the pictures were not about the animal only but different objects were included such as people, cages and others. Also, most of the participants who took pictures, took more than one picture of the same animal. They usually changed the zoom, the angle or recorded different animal's movements (see Figure 7.7).

Figure 7.6: Collection of the pictures of different subjects taken at the Zoo.[12]

Figure 7.7: Many images of the same animal[13]

[12] Adapted with permission.
[13] Adapted with permission.

Retrieval

Also, the participants were asked about the kind of information which helps them to remember their past situations or events or information that they have recorded. Their answers were divided into five categories: time, location, names, actions and other (see Figure 7.8).

The location was the most popular cue for 36 percent of the participants while 21 percent thought that names help them to remember. Eighteen percent said that the time helped them to remember, while 11 percent of the participants supposed that they would be able to remember if they could remember what was going in the event or situations. Fourteen percent of the participants replied that other cues help them to remember, such as sounds, color and smells (see Figure 7.9).

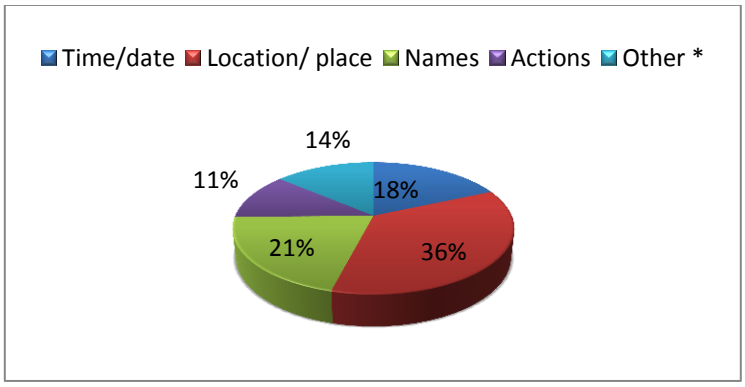

Figure 7.8: Standard cues help participants to remember.

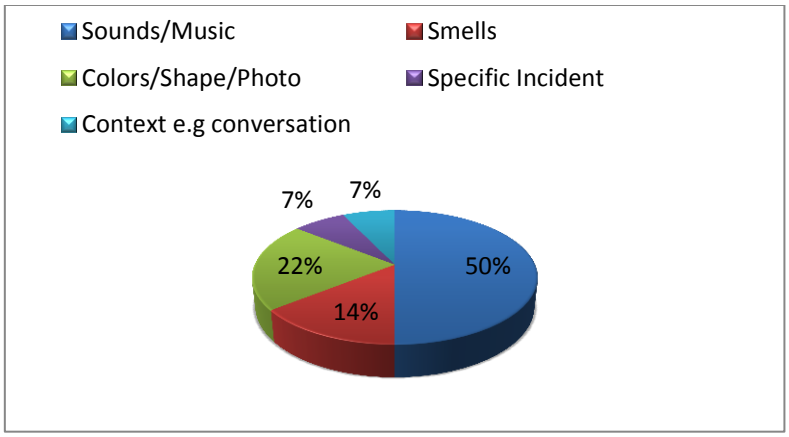

Figure 7.9: Other cues for remembering.

Data Transfer

The participants were then asked what they did with captured information. Twenty-six out of 30 participants said that they transfer their data to their PC/laptop and organize them in ways that helped them to access it later, based on data, locations or the occasions. Only four participants who said they do not use their PC/laptop to store and archive their data; two of them said because they do not record information in the first place, while the other two participants said that they prefer using paper (see Figure 7.10).

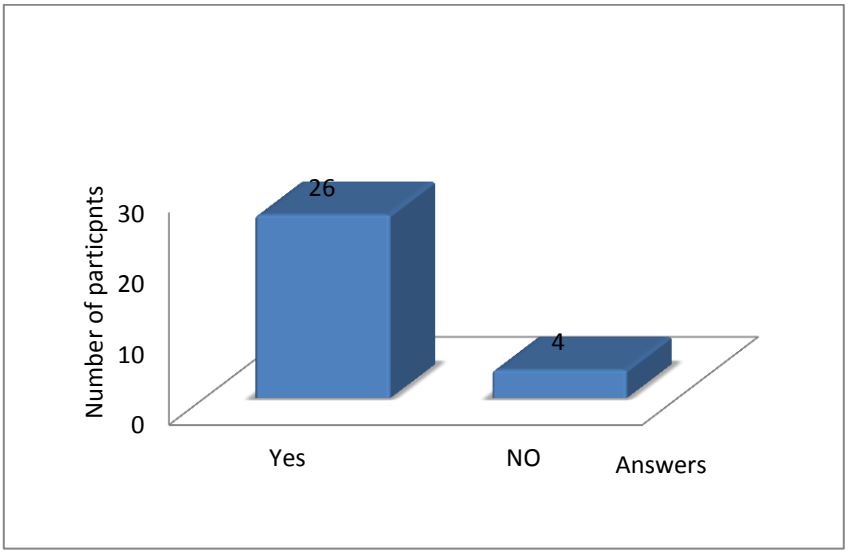

Figure 7.10: Transfer recorded data to the PC

Obstacles to Recording Information

Sixteen participants said they had an experience of having problems while they recorded information, while 14 participants said no. The problems which the participants described could be divided into four categories: technical problems, time, situation and personal issues. The technical problem is any problem that is related to the device which is used to record information. Time problem refers to the situation where the participant did not have time for recording information. Problems which are related to the situation were classified within the situation problems. The personal problems included any problem that is related the person. Table 7.2 shows the number of the participants who recorded each problem, including some examples of each problem.

Table 7.2 Problems preventing the participants from recording information.

Problems	Participant	Examples
Technical problem	9	Battery Memory full Suddenly stop recording Run out of the ink in pen Bad camera. Recoding breaking down
Time	3	Time limitations Busy with the event.
Situation	3	Distracted by someone People are not comfortable with me recording. Can't find pen & paper
Personal	4	Feeling embracing. Forget recording. Forget to take camera.

Using technology is necessary for feeding the Digital Parrot. Consequently, Liker-scale to rank participants' interest in using the technology in their everyday life was used from 5 to 1 (5 means they are very interested: 1 means they are not interested at all). Around 47 percent chose 5 and 33 percent said 4; while 20 percent ranked their interest in using technology as 3 (see Figure 7.11).

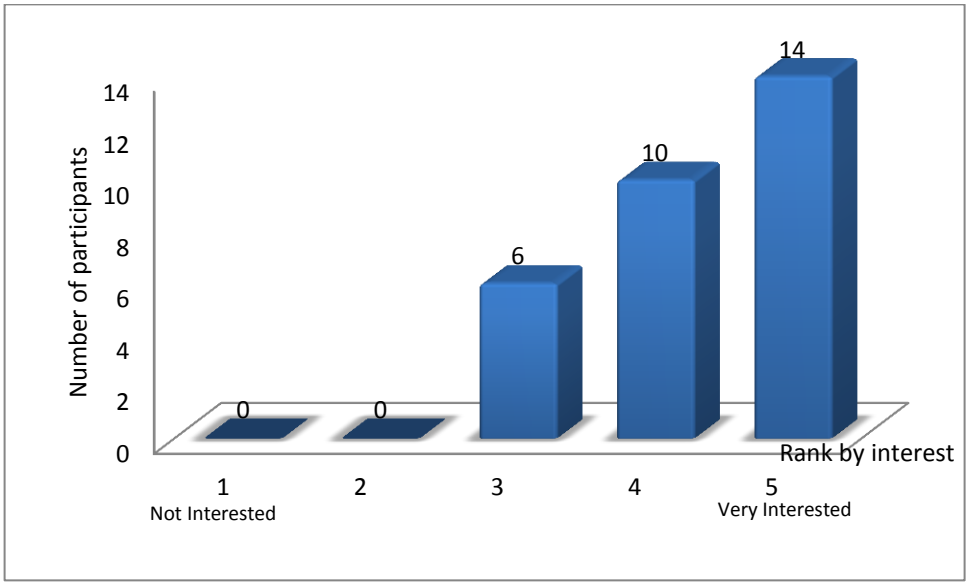

Figure 7.11: Interesting in using technology.

Five out of the nine participants who used cell phone to write down note of important information said there are very interesting in using technology. Three of the nine chose 4 while one participant chose 3(see Figure 7.12).

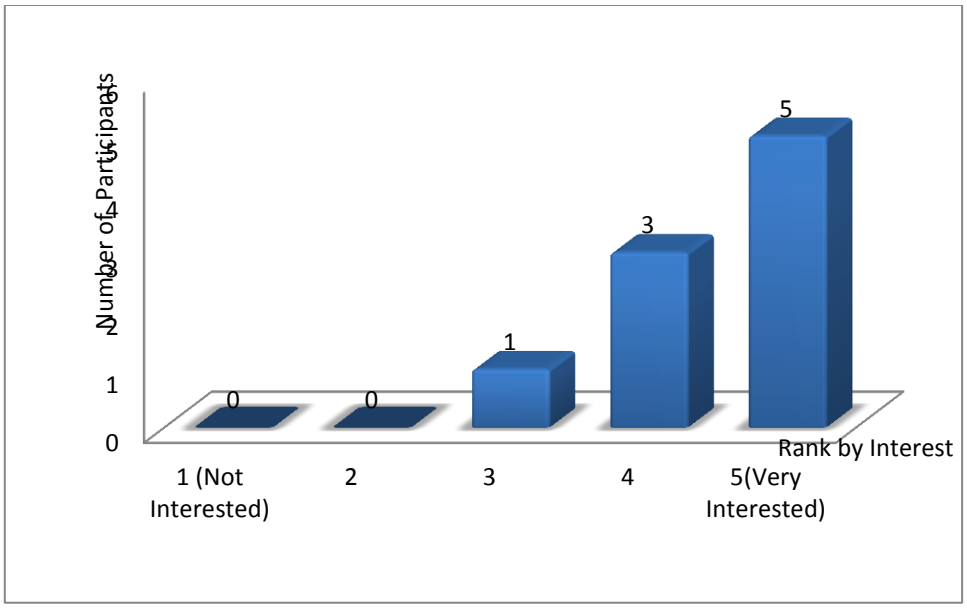

Figure 7.12: Distribution of participants, who take notes by cell phone, based on their interest in the technology.

Memory assessment

To assess their remembering, the participants selected a score from Liker-scale to assess their memory in terms of remembering their last experience (1 means their memory is very weak; 5 means very strong). Figure 7.13 shows that the majority of the participants were between 3 or 4, while two describe their memory as very weak. One participant describes her memory as very strong, while one participant supposed that his memory was weak.

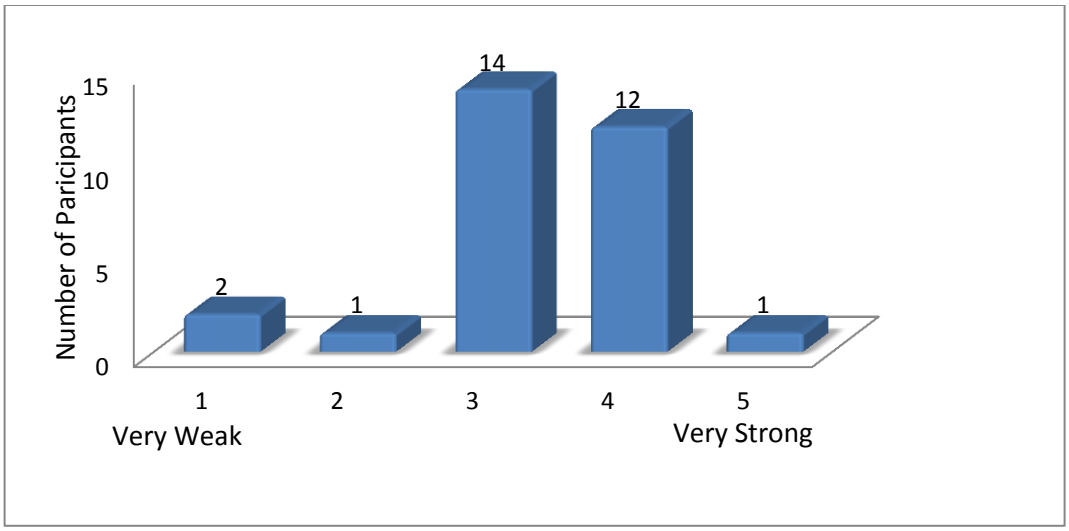

Figure 7.13: Memory self assessment

Learning Style

The learning style means that the participants were asked to choose between the four learning styles, which they identified as their own style: visual (recall information better when using photo, color, maps or any visual materials), auditory (learn best by hearing conversations or lectures), reading/writing-preference (learn best by reading and writing down information) or kinesthetic or tactile (learn through experiencing/doing things). This question was asked to identify whether their learning style can affect the way that people record information.

Visual Learner and Taking Photos

There were 21 participants (70%) who said that they take photos to record information are visual learners, while only one participant who is a visual learner does not take photos. Only four participants who are not visual learners said that they take photos, while four participants do not take photos to record information or their past experience describe themselves as not a visual learner (see Figure 7.14).

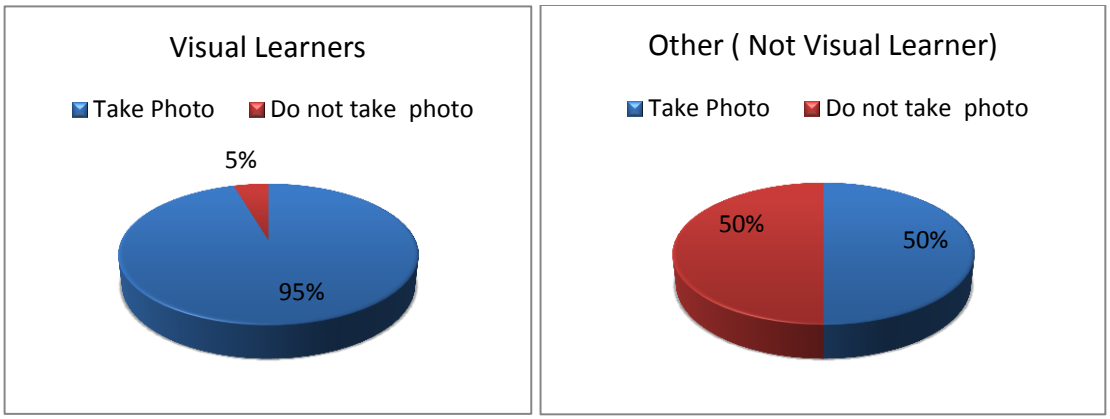

Figure 7.14: Visual and other learner styles and taking photos

Auditory Learner and Recording Voice

In terms of recording audio data, eight participants out of 30 said that they record voices. Three participants said that they are auditory learners, but only one participant said that he uses voice recording to record information. However, other learning styles acknowledge that they use voice recording. Table 7.3 shows that participants with different learning styles record important information as audio.

Table 7.3 Number of the participants who record voice showing their learning style.

Learning Style	Participants
Visual/Reading/writing	1
Visual/Auditory/Kinesthetic	1
Visual/Kinesthetic	3
Reading/writing	1
Visual	2

Taking Notes

Nineteen out of 30 participants said they take notes to record information for later use. Nine write notes on their mobile phones and eight out of those nine participants use pen and paper as well. As shown in Figure 7.15., the participants who like to take notes were

classified based on their learning style. Fifty-three percent of the participants who said that they take notes said they are visual learners: 37.5 percent said they are reading and writing learners as well.

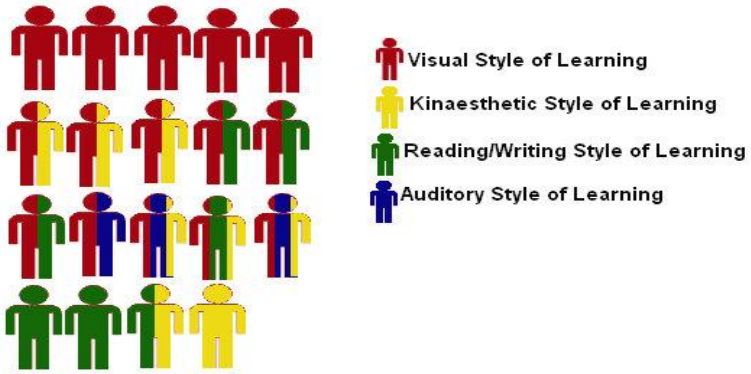

Figure 7.15: Taking notes and learning style

Twenty-seven percent of the participants who take notes are kinesthetic; 75% of them are visual learner as well, while 12.5% are reading and writing learners. Only 12.5% are exclusively kinesthetic. The auditory participants who take notes are visual learners. Seventy-eight percent of the reading and writing learners are visual learners as well.

Table 7.4 shows types of captured information and the percentage of the participants from different learning style based on who records what. It shows a strong correlation between photo capture and visual learning style. However, it shows the opposite with taking notes and recording audio.

Table 7.4 Information type and learning style

Type of information	Learning style	
Photos	95% visual learner	15% not visual learner
Text	23.3% Reading and Writing leaner	63% Not Reading and Writing leaner
Audio	12.5 % Auditory learner	87 .5% Not Auditory learner

Summary

The result from the survey shows that regardless of the situations, participants tend to record text information then visual information more than any other information. The context information was the information most used to retrieve recorded information. The information is transferred to desktop computers to be organized according to the context information and sometimes based on what was going on, including events or actions.There are technical problems, time, situation and personal issues which prevent the participants from recording information. Finally, the results show that learning style does not affect the kind of the information that participants record.

7.3 Unobserved visit

After participants returned from the Zoo, they were interviewed to hear their stories and what they thought about recording their experience, especially after they had visited the Zoo. It was hoped that the participants will have had the experience of meeting plenty of information which might they record. In the interview, they were asked about their experience, if they recorded any information, and their reasons for recording or not recording the information.

Information to Remember

After returning from the Zoo, participants were first asked what kind of the information they like to remember and acquire and why they recorded particular information. Table 7.5 shows the kind of the information that each participant likes to remember, categorized into three main categories textual, visual and other (which includes video, context and speech). The graph in Figure 7.16 shows that more than half of the information that the people like to remember is visual information.

Table 7.5 Kinds of information the participants like to remember.

Participant	What	Category	Participants' Answers
P1	Names	Textual/ Visual	Names of the animals. Name of the lady he had conversation with. Which animals he missed so he can see it next time.
	Funny scenes	Visual	A tiny bird stranded behind dangerous animal signs
	Video	Other	Funny scene for friend with bird
P2	Names	Textual	Names of the animals
	Photo	Visual	Photo for new animals she hasn't seen them before. the animals cages such as bird cage
P3	Photo	Visual	Colors of birds
	Video	Other	Birds' behavior
P4	Photo	Visual	Information about the design of the Zoo weather
	Note	Textual	What is special about this area? animals information location
P5	Photo	Visual	The animals. How to go to the Zoo (map)
	Names	Textual/ Visual	Which animals he missed
	Note	Textual	Interesting fact about monkeys
P6	Photo	Visual	How to go to the Zoo (map) What I saw
	Names	Textual/ Visual	Which animals he missed

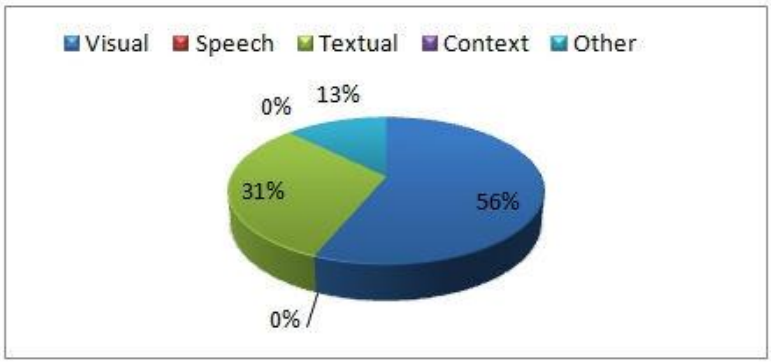

Figure 7.16: Type of information which the people like to remember.

This was followed by textual information. Two participants like to remember data captured by video, like birds' behavior. Also 87 percent of the data was directly related to being on the Zoo i.e. most of the information which the user liked to remember included animals, while, for some, there is some information can be desired regardless of the situation, such as people's names and the weather. Some of the information were are related to the Zoo context.

The participants said there are many things they like to remember. However, only two of the participants recorded information, while the rest said that they did not record any information. They were asked for the reasons behind not recording information. Table 7.6 shows this information. Two of the participants said they forgot to bring their camera. One of them said he relied on his memory, while the other said she does not have a camera.

Table 7.6 Reasons for not recording information.

Participants	Answer	Reasons
P2	No	Does not have camera
P3	No	Forget take the camera
P5	No	Forget take the camera
P6	No	Relies on his memory

Having the Tools and Recording the Information

The participants who record information were asked what kind of information they record t discover whether or not they recorded all information that they wanted to remember. Table 7.7 shows that most of the data that participants said that they like to remember it they did not record. And the most repeated answer is they can remember.

Table 7.7 Reasons for not recording the desired information

Partici-pant	Information wished to be remembered	Recorded or not	Reasons behind not recording
P1	Names of the animals	NO	I think I can remember
	Name of the lady he had conversation with.	NO	It will take long time to write it. I assume that I can remember it so I can write it down in the bus. Not nice to try to record while she talk to me.
	Which animals he missed so he can see it next time.	NO	
	A tiny bird stranded behind dangerous animal signs (Take photo of the sign)	Yes	
	Funny scene for friend with bird	NO	
P4	Information about the design of the Zoo. What is special about this area?	NO	
	Weather and location	NO	I depend on my memory
	Animals' information (After taking a photo of the animal I took photo for the sign which has information about this animal)	Yes	

Look back to the past again

The participants were asked if they came across information while they were at the Zoo they did not record, and now they had changed their mind and they think they should have recorded it. Where relevant, they were asked for reasons for that change. Five out of six participants said there is information that they did not record and two out the five said because they did not think it is important when they were at the Zoo (see Table7.8).

Table 7.8 Importance of the information changes over the time.

Participants	Answer	What	Why
P1	Yes	Zoo map Lady name	Busy talking to other people He thought that he could remember
P2	No	-	-
P3	Yes	Animal behavior	I don't have the equipment
P4	Yes	Take photo of an animal	I thought it is not interesting then I changed my mind after reading about it.
P5	Yes	Animals' name	I thought it is not that important
P6	Yes	Animals' information	-

Additional information needed to be recorded

All the participants were asked whether there was any additional information they thought it was important to record. Their responses are given in Table 7.9. The additional information includes video, voice, name of people and other information which might help to remember.

Table 7.9 Additional information useful to record.

Participants	Additional Information
P1	What people are were with me, social contacts, Sound
P2	Actions (the photos not enough)
P3	Nothing
P4	Video (animal behavior and environment)
P5	Voice/video, visual information, names of people who I was with
P6	Mix of information which serve different purposes, such as people met for the first time

Keeping and Retrieving Memories

The main ways the participants recorded information at the Zoo and any similar situations was asked for. For recording, five participants out of six said they use a camera to record their trips and events, while three of them said they use notes as well. The sixth participant did not say that he used the camera, but that he likes to use a recorder and notes to record meetings with his supervisor.

For keeping the captured information, all participants said that they save the information on their desktop computers. One participant said he uses the calendar to save his important information as well. Figure 7.17 shows how participants organize their recorded information to make it accessible. Two participants say that they used the location to classify their memories, while two said they used time with location. Similarly, two participants like to label their images or their recorded information by what was going or what is in the image. One participant prefers to save his recorded information under the name of the people who are related to this information.

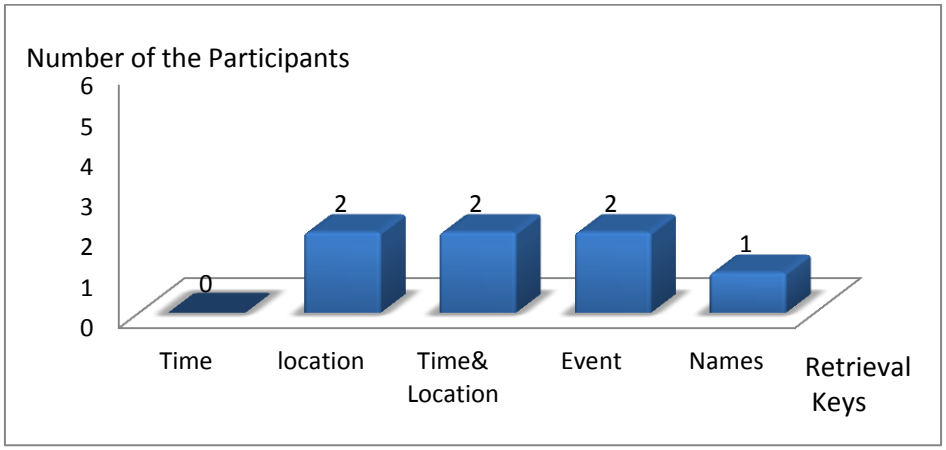

Figure 7.17: How the participants prefer to sort captured data

Comparing the cues which help the user to remember with the way that participants sort their captured information, they were asked to identify the trigger that helped them to remember. The location came first, while the visual information came second. The name

of the people and the event came third, similar to other which includes the time and using their memory (see Figure 7.18).

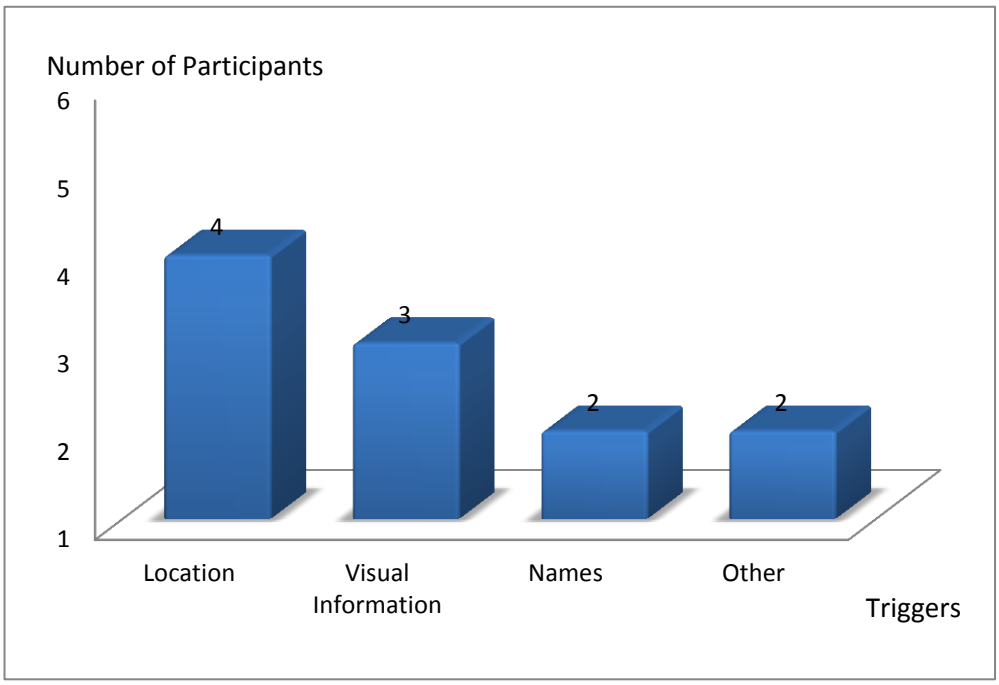

Figure 7.18: Triggers to remember past experiences

Incentives and Facilitators of the Processes of Recording Information

In this section, we investigate what might help a participant's record information. As we can see in the Table 7.10 we can be divided the factors into three groups.Group1: factors are related to the situation, group 2 which include factors are related to the information itself, group3 factors which are related to the tools which are used to capture information.

Table 7.10 Facilitators of the processes of recording information

Participants	Facilitate to Record Information	Group
P1	Enough time	1
	Able to take notes	3
	Worth to be remembered	2
	I need to have a prove [proof]	2
	Keep Memories	1
	Intersecting/ accidently event	1
P2	Have fun	1
	New place	2
P3	Important event	2
	Valuable information	2
P4	Valuable memories	2
P5	The context help me to record	1
P6	The context help me to record	1
	Have a device	3
	Tools (software)	3
	Group of people who I'm with	1

Obstacles in Recording Information

We asked the participants for any obstacles that prevent them from record information while they were at the Zoo or any situation similar to the Zoo and we present their answers in Table 7.11.

Table 7.11 Difficulties that prevent recording information in the zoo or similar situations

Participants	Obstacles
P1	Distraction Weather issue such as so cold and wearing gloves Environmental issue such as dark No time
P2	Absence of equipment
P3	Lots of information and I'll look for it online. Take lots of photos
P4	Take lots of photo Memory is full
P5	The size of the camera big can destroy the situation The context does not help Impolite
P6	Need permissions to record Listen to the recording is hard so why I record it Interrupting the conversation.

As can be seen from the table, most of the obstacles are related to the situation: the weather, too much information, needing permission and interrupting the conversation.

Requirements for Bookmarking a Moment

For the hardware features, all participants agreed that the device should be small while they disagreed on the way that the users should interact with the system to record the information. The participants in this matter divided into two main groups with three participants in each group. The first group believes that the recording should work by detecting the user sound. The participants think that the device should start recoding when the user asks it to record using the voice command. The other groups think that the recording should be manually and the device should have an input tool like a button to control recording. The participants added more hardware's requirements like connectable to a computer, light and has camera, voice recorder.

The suggestions from the participants for a record past experience system can be classified to three stages; before recording requirements, during recording and after recording.

Table 7.12 Participants' requirements for systems for recording past experience

Stages	Participants' Requirements
Before	Classify the information to be captured in advance.
During	Recording every thing Using color coding to distinguished between different situations and information. Record faces and associate them with names. Context-awareness
After	Privacy Viewing related information for the captured data Showing feedback

Table7.12 shows the requirements each participants believed to be critical to the capturing system. One participant thought that the user should be able to control and set the kind or the type of information which the system must capture in advance. Another user needed to know what kind of the information she/he will need in the next event. Similarly, another participant thought that the system should use different colors to illustrate different situations and information and these classification techniques should be used for recording and after recording i.e. for example the user should be able to use red to record photo only or could classify the red memory as most important information. One participant thought that the system must record everything as he would not know which information that he would need in the future.

Some of the participants believed that the system should have context-awareness since the importance of the information is dependent on to the situations. For example, according to the P3, the names are not important at the Zoo but they are at conferences.

Also, one participant thought that it could be useful if the system were able to associate faces with names during or after the recording. While another thought that that associating the captured information with related information which did not exist during the recording would be a very good feature for the system.

Finally, one participant believed that the most important requirement is privacy, especially as this kind of system records sensitive information and personal information. Another one said that having feedback is an important requirement.

Summary

In this study condition, the participants we asked to visit the Zoo without being observed by the researcher. The results of the follow up interview show that not all the participants recorded information neither did they record the same information. However, the participants show that they changed their judgment about the importance of the information over the time. Most of the time, the importance of the information and the situation forms an incentive to record past experience. The technical problems, such as the camera memory being full, or problems related to the situations such as distraction or environmental conditions, are the main problems which can prevent the user from recording information. The participants suggested using either voice commands to capture information or use an input method, such as buttons, to record information.

7.4 **Shadowing**

Another techniques used in the study was to follow the participants and notice how they recorded the data. Then during the interview they were asked to explain why they behaved in this way. This section will describe the different behaviors which were noticed for each participant separately, and then the participants' explanations their behaviors will be given. There will be a summary at the end of this chapter of some of the similarities and differences between the participants in terms of recording information.

The first participant was very selective and confident about the information that she needed to record, she read and watched, then she took more than one picture for either the animal or the information board and watched for some time. She said that is because when she thinks the first one was not good, she takes another one, or when she thinks the situation has changed.

She read most of the information boards very carefully; she took picture for some of them while she just only read the others. And she said to take picture of the information board, the information should be new or interesting to somebody. If she did not record, that means the information either not interesting or she already knew it.

The second participant seemed not interested in the animals and was looking for his favorite animals. When he met interesting information he took photo himself, then he asked his friend to take more photos for him because as he said, “She’s better. Really, she’s better at taking pictures. That’s the whole reason. I wanted good pictures. It’s her camera and she’s really good at taking pictures and most of my pictures are fuzzy and shaky because I don’t have a steady hand.”

Each time he recorded information, he first recorded the information of the animal, then a photo of the animal. This he said was because:

> “I try to keep that up because later on when the pictures are sorted and I always, you know, when I go to a slide shows I say, 'Okay, now those animals come, cause first comes the sign, and then comes the animals. Because usually that’s what I do in the Zoo in reality too.' I first look at the sign, look at what we are expecting in the cage around the area, and then I search for the animal.”

The third participant depended on taking notes all the time and she rarely used her digital camera to take photos of the animals. She recorded more than picture for one animal, saying that she needs to capture different actions. In terms of recording textual information, she went very close to the information board and spent a long time writing down the information in her note book and she read and commented on the information while

she was writing. She tried to understand and select the data to write down. Figure 7.19 shows one of her notes.

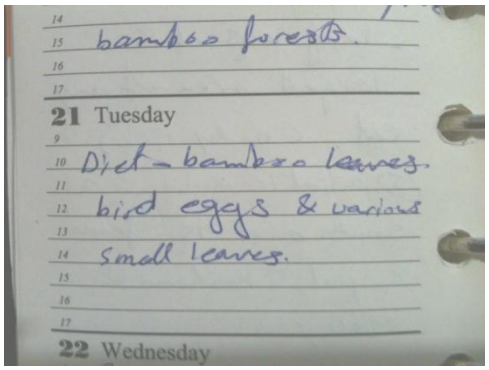

Figure 7.19: P9's note: (keywords and short sentences were used and the participant used her calendar).[14]

For each animal that seems to interest her she recorded the name and diet. She said she does not like the technology so she prefers to use her pen and paper.

She captured a photo of bird and saying the photo was for her brother and she did not record any other information like the name of the bird or any other information about. When she was asked why she did not record at least the name, she said, "My brother does not care and he already knows lots of information about the birds."

The fourth participant spent more time to read and pick the information that she liked and then she watched the animal. She tried to write very fast and watch and talk to friends about the information. At some points, she used her own language to record information and during the interview she said because it is fast for her. Figure 7.20 shows one of her notes where she use her mother language to record information.

[14] Adapted with permission.

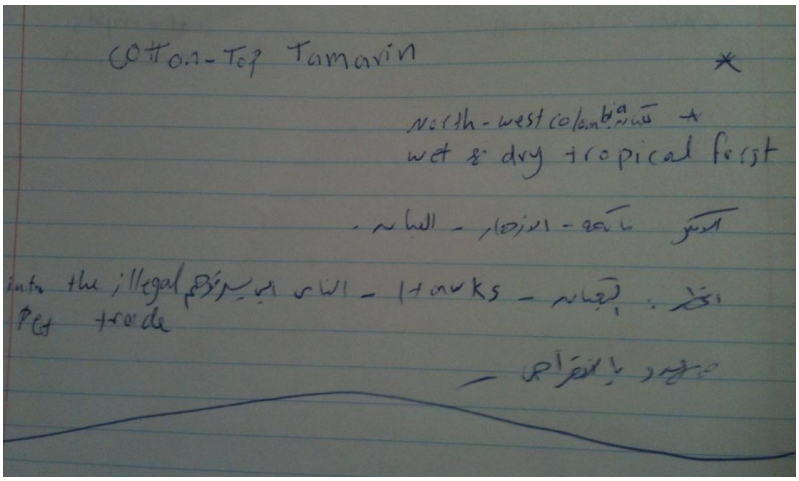

Figure 7.20: Note was taken by P11, using her mother tongue[15].

After more than half an hour, she changed her mind and started recording short notes and asked her partner to use her digital camera to record information. Sometimes she asked her friends to record information for her. In one situation, she was interacting with a bird and she asked her friend to take a photo for her. Both participants who used notes to record information used short sentences and keywords.

During the interview, she was asked why she used the pen and paper instead of using her mobile phone which she said she uses frequently to record information. She said because it is not easy to get the information to the device.

The fifth participant wrote notes and sometimes she used her mother tongue as well for a while then she stopped and kept taking photos for both the information and animal she was interested in. She tried to find a good position and discussed the information with her friend before she used her digital camera to record information, such in the Figure 7.21.

[15] Adapted with permission.

Figure 7.21: P10 Recording information about the cheetah[16]

She seemed to think that one photo was not enough, so most of the time she took more than one picture for both the animals and the information board. When she was asked why she said, "Sometime the picture was not very clear or unfocussed, the focus was not good or something like this, and I delete it also the light [flash] reflects on the board." Also she took many photos for one animal, then she passed by again after long time she took more photos and she explained that because first she felt uncomfortable because of the dirt and then, the second time she changed her mind and she needed more information about it.

Sometimes she took photos of the information board without reading it. When asked why she did that, she said, "Because the time and I'm with groups, sometimes you cannot take your time to do all this information." Sometimes she read the information board then she decided to take a picture of it, even when, in the beginning, it seemed she was not interested. She took a photo of the whole information board even though she said that she was interested in only one or two facts about this animal.

[16] Adapted with permission.

Capturing tools

Even where the participants have something in common; there are some differences between them. The similarities and differences between the participants were divided into three categories. The first category is the tools which were used, the second is recording behavior and third is the kind of the information which has been captured. Firstly, two main tools which the participants used: the digital camera and notes. All the participants used the camera to record information in different ways: some to record both visual and textual information, while participant used it only for visual information. Some participants did not use notes at all, others made notes in English while others used their mother language. Participants who took notes used short notes, using key-words of the most important information. Some of participants recorded the information by themselves while some of them ask the others to do it for them.

Capturing Behavior

Participants showed some similarities when they recorded information such as all the participants took more than one picture, they looked for interesting information and they did not record random information, so they took their time to read the information. Finally, some of the participants asked friends to record information for them. The differences between them were that one participant recorded information with considera-tion of how to browse it later. While other participants did the same, they did not care about it. While some participants think each photo of animal should be combined with its information, other participants think it depends, sometimes the photo of the animal is enough. While some participants spend time to read and decide, one participant thought she can record the information and she would read it later.

Captured Information

The information which was recorded differs from participant to participant. Some of participants like information to be written, while others like it to have it in digital format. Some of them like it to be in short sentences or view words, other like have all the information. However, taking more than one picture was noticeable behavior for all the

participants. All the participants tried hard to have good pictures. Information was selective. The participants decided what information should be recorded.

Summary

This section reported the different behaviors of the participants during recording information at the Zoo. Some differences and some similarities were seen between the participants in terms of recording information, the tools which were used and the type of information recorded. All the participants used cameras to record information, while others wrote notes and took photos. There are some difference and similarities in the participants' notes. All the notes were short, but some notes were in English while others were was in participants' mother tongues. No information was recorded randomly. The textual information was recorded by notes or by photos.

7.5 Using Indicator

In the web world context, many people bookmark a webpage by clicking on the mouse device or using their keyboard. To apply the idea of bookmarking a moment in our life, the possible of bookmarking an interesting moment using the same techniques was investigated.

Besides capturing all required information, bookmarking moments should be easy to use, involve little physical interaction and be flexible enough to be carried around. Also, the users should feel comfortable in the environment. In this study condition, how the participants interacted with such a device was observed, holding the device during the study condition, using the device to record the information and after using the device.

In the next part in the study condition, the participants were interviewed to examine what they thought of the device and the whole study condition. To record the observation input in the field, an observation form for each participant was used to record the situations, how they record the information and what happened before and after they used the indictor and in the comment column any signification behavior in terms of using the device was recorded (see Appendix D).

Table 7.13 shows the input from the observation which includes how each participant held the device, using it, choose the information and point to the information using the device. Briefly, the participants held the indicator either in their hands until they used it then they hold it by their fingers or they keep it all the time between index finger and thumb. The participants were confused the first time they used the device, then they looked more confident.

The participants did not record all the information that they were shown. They spent time to filter the information they saw, and read, then they decided. Participants pointed to different directions when they used the indictor. Some of them pointed directly to the data that they wanted to record, while others did not care where the indicator pointed.

Table 7.13 Results from observation of the participants while they used the indicator.

Participants	Holding the Device	Using the device	Choosing the information	Pointing to the information
P1	He hold the device in this hand all the time and most of the time he held it between his index finger and thumb as a standby for recording	First time he pressed the button several time and waiting for a feedback. The second time he pressed only once. From the third situations he became more confident, sure and fast in terms of pressing the button and he pressed the button once	Before he pressed the button, he first stopped and noticed the information that seemed interesting to him; then he pressed the button and walked away immediately.	He pointed the device directly toward the information that he wanted to record.
P2	He covered it in his hand all the time until he needed to use it.	In the first and second situations he pressed the button, then he was looking for feedback. In the third situation, he was unsure if the information was recorded or not. In the fourth and fifth situation he was more confident and pressed the button very fast.	He first looked for interesting information then he decided to record information He stood up in front of the information	He pointed to the way where the interesting information was without focusing exactly on the piece of the information that he needed to record o
P3	She used her finger to hold the device	Pressed the button for short period without looking for any feedback or looking to the device or the information again	She suddenly decided what kind of information she needed to record and she pressed the button directly without taking a position	She focused on pressing the button regardless of where the front of the device was pointed; some time she pointed to the sky

P4	Sometimes she held like she is used to it; and sometimes she covered it in her hand	First she pressed the device twice and then she pressed the button once; sometimes she checked on the device	Sometimes she spent time to find interesting information to be recorded; while sometimes she decided to record information randomly	She put the device as close distance as possible to the information as she could to record the information then she pressed the button
P5	She covered it in her hand all the time until she needed to use it.	She just pressed the button softly and very fast	She pressed the button very fast and walked away	She was careless about the way where the device pointed as long as the device in the same way
P6	She held it all the time with her finger on the button and she held it in longitudinal direction	She pressed the button for a long time around 5 seconds Pressed the button more than more than once Pressed the button in different angles	She spent a long time to pick interesting information; then after she pressed the button, she spent some time to continue reading or watching	She pointed exactly toward the information or animal that she wanted to record and she tried to be very close
Participants	Holding the Device	Using the device	Choosing the information	Pointing to the information
P1	He hold the device in this hand all the time and most of the time he hold it between his Index finger and thumb as standby for recording	First time he pressed the button several time and waiting for a feedback. The second time he press only one time Form the third situations he became more confident, sure and fast in term of press	Before he press the button he first stop and notice the information that seems interesting to him then he press the button and walk away immediately	He pointed directly by the device toward the information that he wants to record.

		the button and he pressed the button once		
P2	He covered it in his hand all the time until his need to use it.	In the first and second situations he pressed the button then he was looking for feedback. In the third situation he was unsure if the information was recorded or not In the fourth and fifth situation he was more confident and press the button very fast	He first looked for interesting information then he decided to record information He sanded up in front of the information	He pointed to the way where the interesting information was exist without focus exactly on the piece of the information that he needs to record o
P3	She used her figure to hold the device	Pressed the button for short period without looking for any feed back or looking to the device or the information again	She suddenly decided what kind of information she needs to record and she pressed the button directly without take a position	She focused on press the button regard list to the way where the front of the device was pointed some time she point to the sky
P4	Some time she hold like she is use it and sometimes she covered it in her hand	First she press the device twice and then she pressed the button one sometime she checked on the device	Sometime she spent time to find interesting information to be recorded while some time she decided to record information randomly	She put the device as close distance as possible to the information that she can to record the information then she pressed the button

P5	She covered it in her hand all the time until her needs to use it.	She just press the button softly and very fast	She pressed the button very fast and walk away	She was careless about the way where the device point as long as the device in the same way
P6	She hold it all the time with her finger on the button and she hold it in longitudinal direction	She press the button form long time around 5 seconds Pressed the button more than more than one Pressed the button in different angles	She spend long time to pick the interesting information than after she pressed the button she spent some time to continue reading or watching	She pointed exactly to word the information or animal that she like to record and she tried to be very close

Pressing the Button

In terms of using the button to help the participants about how situations they have been in and they use the button to bookmark it, they were asked if they could remember how many times they pressed the button. Their answers were very close to the observations but only one participant gave a fixed and correct answer. (See Table 7.14.)

Table 7.14 How many times participants bookmarked a moment

Participants	How often they bookmarked a moment
P1	Five to six
P2	Five to four
P3	Five to four
P4	Five to six or more
P5	More than five times
P6	Five times

Only One Button

The participants were asked whether they thought one button was enough to record information. Five out of six said that one button was convenient for them. One participant did not think so, and suggested that if one button recorded different data then each data should have separate button because the importance of the information differed based on the situation.

Also the participants who said one button was okay with them suggested that having more than one button; one for very important information and the other for interesting information. Another participant said, he thinks one button is enough if the device records the same information all the time, like only video or images.

Feedback

Since the prototype used is not designed to give a feedback the participants were ask what kind of the feedback they would like to have. While at the Zoo, it was noticed that some of the participants were very confident. The device produces light when the button

is pressed, but because the study was during the day the participants did not notice this. The participants' answers were divided into two main categories; visual feedback or audio feedback. Fifty percent of the participants said they liked to have audio feedback while 50 percent said they liked visual feedback. The participants liked visual feedback mean that they liked to see what they had recorded, while one of them said light color.

How this device work?

During the interview the participants were asked to describe how the device works. They were not told that the device is a normal Key Ring lighter and they are not able to access the captured data.

Table 7.15 shows participant's answers. The participants disagreed on how the device worked but they agreed on the kind of the data which was recorded, with some differences. All the participants think this device records images and sound. Some of them think that the device records also record video, text information and people they meet. Some participants think the device is so advanced that it is able to record "a 360 degree angle of what's happening around" or "record interesting information by itself." Other participants thought of it as simple device to record images and voice or video recording.

Table 7.15 Participant's descriptions of how the device works.

Participants	How the device works
P1	It should record a 360 degree angle of what's happening around me, in terms of voice and also the image for thirty seconds
P2	Device looks something like a USB a little bit or like a laser. I would think that to me it would look like a video recording or a picture taker. Or if it's still in your pocket and you just press it, then it's like probably a voice recorder.
P3	one press it record voice while twice record the image
P4	Recode image and sound.
P5	Record picture and information like an interesting fact about the animals. It can record it by itself.
P6	Works as in you press it and it memorizes the stuff you want to memorize. It takes pictures and voice and the people you meet

Summary

Using the indicator to bookmark a moment was the third study condition in the study. The participants showed the ability to be adaptive with the device even though it did not have any clear feedback about what kind of information it recorded or how it worked. They used their imagination to predict how it works. All the participants thought the device should record the images and voice. Some of the participants pointed the indictor directly toward the information that they wanted to be recorded, while others did not care where the indictor was pointed. Even when the information includes visual information, half of the participants prefer having an audio feedback, while the rest like the visual feedback.

7.6 Wizard of Oz

This study focused on the captured information. The participants were asked to tell the wizard whenever they wanted to record information they needed and whatever they wanted to be recorded.

Kind of the data

Figure 7.22 shows the different types of data that were captured by the wizard. As clear from the figure, photo was the data type which all the participants asked to have recorded. Thirty percent of the data was textual information; 10 percent was video.

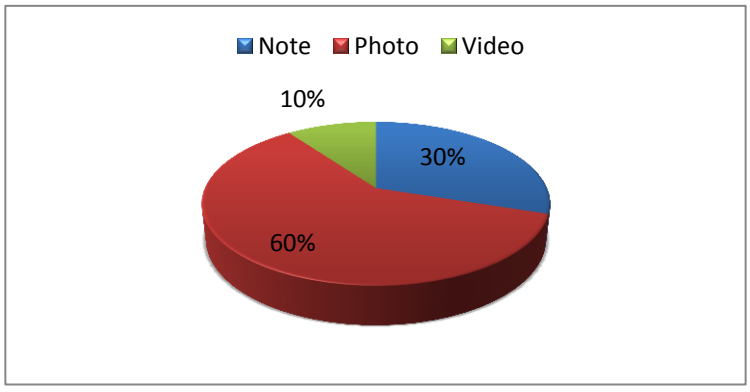

Figure 7.22: Different kinds of data recorded by the Wizard

The Triggers

The participants were asked which of the flowing triggers they thought would help to remember the trip to the Zoo (see Figure 7.23). The location and names were each chosen by five participants, and the exact day by only one, while the weather was no help to the any of the participants.

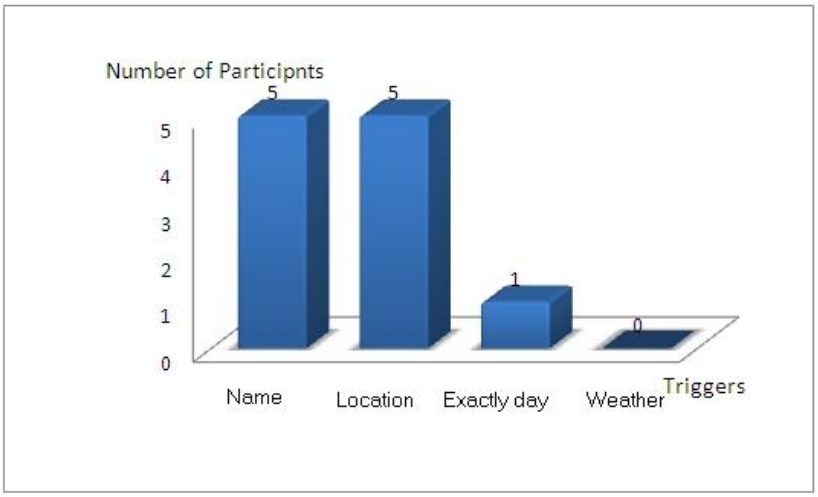

Figure 7.23: Triggers which help the participants to remember their trip to the Zoo

For the weather, one participant said that he think the weather in general could be helpful, like only summer. Another participant commented that the names of all people will not help but some names might.

Location

The participants were asked whether the location of the Zoo was important to help them to remember. All the participants said "Yes." Then they were asked whether they asked the Wizard to record the location for them since it is important. All the participants said "No." They were asked to explain why they did not.

Table 7.16 shows that the participants gave different reasons. One participant could tell from the photo, and another thought they could remember and add it later during archiv-

ing the data later. Another participant said it is automatic to know the location since we can find the animals in the Zoo. Two of participants were not sure, one because he might I forget, the other said she wasn't thinking of it.

Table 7.16 Importance of the location and potential reasons behind not recording it.

Participants	Is Location Important To Remember	Did You Record It?	Why
P1	Yes	No	I don't know, maybe I forget
P2	Yes	No	There's no place to keep animals.
P3	Yes	No	Can tell from the photo
P4	Yes	No	When I go back and I'm referring to it I will know it was in the Zoo because if the animals are there; we know the place where we were recording the information you know
P5	Yes	No	I know the place and I'm going to put it in a folder that is named after the location.
P6	Yes	No	I'm not sure, I wasn't thinking of it.

Remembering During Browsing Captured Data

The participants were shown some of the captured information and asked if they able to remember why they asked the Wizard to record and what was going on. In general, the female participants were able to remember better than the male participants. This is may be because the female gave more attention to recording the information than the male. All the male participants needed hints in some stages. Only one had difficulty to remember very well. Both females and male showed confusion in some stages but in different levels, especially when the picture was not clear (see Table 7.17).

Table 7.17 Ability of participants to remember during browsing captured information

Participants	Gender	Ability to Remember
P1	M	Needs help to remember
P2	M	He almost able to remember but Needs some help
P3	M	He almost able to remember but Needs some help
P4	F	Very well
P5	F	Almost able to remember well
P6	F	Almost able to remember well

Additional information

The participants were asked if they liked to record information like the exact location for each animal, sounds and smells of the animal, having 3D image for the animals and their places or environmental information like the temperature, light and humidity. All the participants believe this information is not important at all.

False Memories

While showing the participants the pictures which they had been asked to record, a picture was added which the participants did not ask the Wizard to record. They were asked: "Do you remember this picture? Did you ask the Wizard to record it for you?" Five participants out of the six participants said they remembered the picture and they are sure that they had asked the Wizard to record it for them. The only participant who said that he did not remember the picture had difficulty to remembering other pictures which he asked the Wizard to record for him.

Interestingly, one of the participants argued that he did not ask the Wizard to take a picture of one animal, which he had. That was because, when he asked the Wizard to take photo, he was busy with other people and he asked the Wizard to take picture of the

information board which included the animals' face. The participant did not look at the board but he asked the Wizard to record it.

Summary

The result for the Wizard of Oz experiment shows that the participants focus on recording visual information more than textual or context information. They believed the context information is helpful to recall past experience but they did not record it. The photos which were captured at the Zoo helped people to remember to some extent but more information was needed. The participants had experience of false memory when they saw a photo of a situation they were familiar with.

7.7 Using Technology

In this study condition, the participants were not observed at the Zoo. They were asked them to go by themselves and record information as they usually do. In the interview, the participants we asked some general and some of them specific questions. After answering the general question (see results in Section 7.2) the participants were asked questions about:

- Their frequency of using mobile phone for recording information, and the reasons for this;
- The situations when the participants used the smart phone to record memories;
- The data which they recorded at the Zoo; and what different type of data usually recorded?
- Keeping the captured information;
- The ways of transferring the data from the portable device (mobile phone) to the PC;
- Archiving and editing the captured information;
- Browsing the data on both mobile and computers; and
- What did they think about their mobile phone as a device to record memories and what kind of improvement was needed?

Table 7.18 Types of portable devices used

Portable device	# participants
iPhone	4
BlackBerry	1
Nokia	1
Sony Ericsson K770	1

Table7.8 shows the types of the portable devices which are used by the participants to record information at the Zoo.

The frequency

The first question the participants were asked was how often they use their cell phone to record information. Figure7.24 shows that all the participants admit that they use their mobile to record information: 43 percent said always, while 28 percent, said most of the time or 29 percent sometimes.

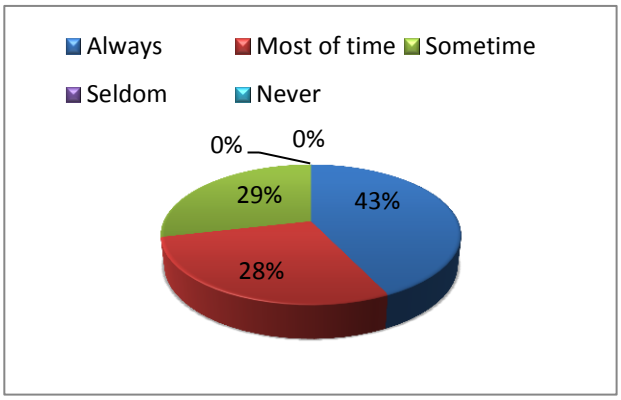

Figure 7.24: Frequency of using mobile phone for recording information

The situations

Then the participants were asked about the situation where they use the smart phone to record memories. Each of the participants said more than one situation and these were classified into four main situations. The first category is for study, any information that is related to study including recording notes in the class or recording lectures. The second category is remembering which includes appointments, shopping lists or birth-

days. The third group, memories, which includes any situation that is related to the social life and travelling. The last category, later use, includes any ideas or notes which are recorded to use later, like a funny saying.

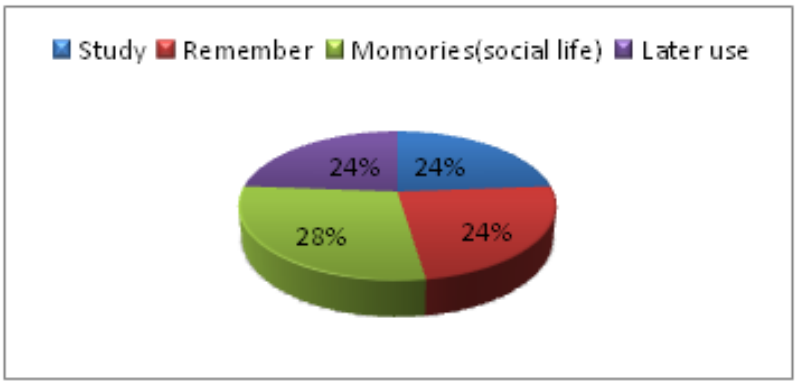

Figure 7.25: Situation when the participants use their cell phone to record information.

Twenty-four percent of the participants use their mobile phone to record information related to their study and the same participants use their mobile phone to remember lists and other tasks. The same percentage uses it to remember unique information like poetry (see Figure 7.25). The heavy use of the cell phone (28%) to recording memories and social events.

Data Type

The participants were asked about the kind of the data which they like to record at the Zoo and this data was classified as visual, text, video or audio.

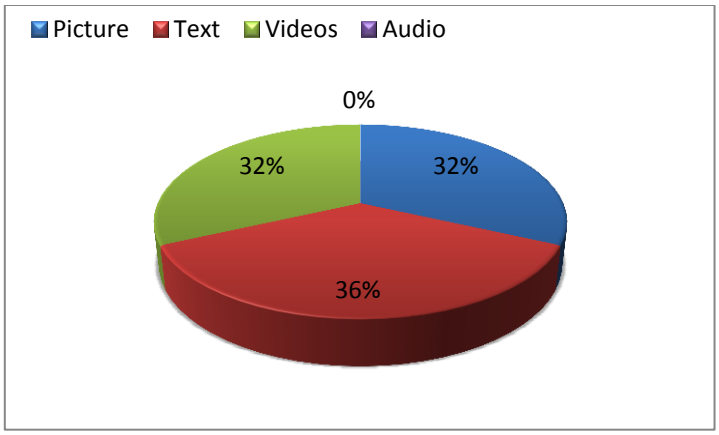

Figure 7.26: Kind of data which participants recorded at the Zoo.

The data was 36 percent text, 32 percent visual (pictures) and 32 percent video. There was no audio data. Most of the text was animals' names, while the pictures ranged from animals, signs and people (see Figure 7.26). Most of the videos were short video clips of the animals.

Location

Also the participants were asked if they recorded the location and no participants had done so. Some of them took photos of the information board and they also wrote down a note instead of taking photos of for the information in same stage.

Keeping the Captured Information

The participants were asked what they do with the data they captured using their mobile phones. Did they keep it on their mobile or move it to computer and keep a copy on mobile phone or move it to a computer and delete it from their mobile?

All of the participants chose the second option. And all of them agreed on moving some of the recorded information to their computer/laptops and keeping a copy of the most important or significant information in their cell phone.

Editing the Captured Information

All of the participants said that they edited the captured information and 100 percent organize the editing in folders, while 57 percent of them said they also rename it. Twenty-nine percent of participants said that they also send it or do research or delete unwanted data.

Transferring the Captured Information

Since all the participants said they edit their captured information, they were asked what they used to transfer the recorded information from their cell phone to their PC/laptop.

Six participants out of seven use a cable to connect their mobile phones to their PC/Laptop in order to transfer the data. One participant said that he did not use the cable but he used Bluetooth to transfer data from his mobile to his computer. More than half of the participants said that they use the email to transfer the data to their laptops (see Figure 7.27). "I send it to my email, actually, and then I go and load it from my email. If I have time I'll plug-in it into the computer," one of the participants said.

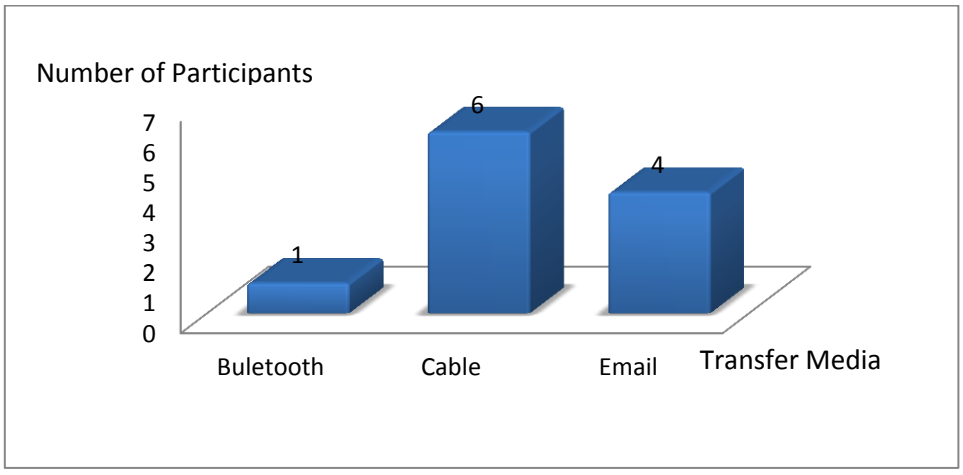

Figure 7.27: Transferring the captured information

Browsing Data on the Portable Device (Cell Phone)

All of the participants said that they like to edit the photos or information on the PC as the screen is bigger than the portable and also because of the functions and the internet

connection since they like to email the photos. On the other hand, all of the participants said that they like to keep some information on their cell phone, especially the notes, to use it when they want to retrieve the data anywhere. "I tried to do some research in it and sometimes I keep it in the iPhone because it's easy to access it anytime," One participant said.

What is There and What is Missing?

The participants were asked what made the cell phone an ideal device for recording information and what was required to be added to make the ideal device to record past experience. Six participants said the availability and portability. Also the equipment which their mobile phones have form a good supportive feature for six participants.

In terms of the missing features, some of the participants asked for internet access, while the other needs are varied between improving the quality of the video recording, supporting the zooming, increasing the capacity of the memory to adding the time on the photos. (see Table 7.19)

Table 7.19 Participants suggestions for their cell phones to be ideal for recording

Participants	Suggestions
P1	More memory Improve video quality
P2	Sensor, scanning, internet access and some mechanism to retrieve data via internet.
P3	Zooming
P4	Internet access all the time.
P5	internet access
P6	Timestamp on the photo itself
P7	Nothing

Summary

This study condition shows that the mobile phone is already used as a tool to capture information. This information can be text, audio, video and photos. In the Zoo context, no one of the participants recorded audio information. Also, the captured data was usually moved to the desktop computers, generally via cable, and sometimes remotely through the email or Bluetooth. Similar to the results from other study conditions, recording the location was ignored. The captured information was usually modified, organized and archived. There is a need to keep a copy of the data in the portable device to reuse it in need. Mobile phones seem, to some extent, to be the fulfillment of participants' needs to capture information.

7.8 Summary

In this chapter, the findings of participants' behavior at the Zoo have been described. First the result of the survey completed by the participants before their interview was presented. Then the result of each study conditions was presented individually. These study conditions were an unobserved visit to the Zoo, shadowing the participants at the Zoo, using prototype, Wizard Oz and finally using technology. Some of the findings reinforce what is already known while some of the findings were new. In the next chapter, these findings are discussed and the interesting results highlighted. Using these findings design requirements are identified and discussed.

8. Discussion

This study aimed to explore recording information to derive a preliminary design of CatchIt. A system helps people to capture their past experience. This chapter will further evaluate selected study results that were presented in the last chapter, with especial respect to the design requirements of the system. However, the study has limitations, which will be discussed later in this chapter.

8.1 Lessons Learned

Observing participants' behavior, listening to their thoughts and viewpoints has produced enormous amount of the data, which need to be evaluated and interpreted. Selected results will be used to put the general and significant issues related to research issues under spotlight. This chapter will focus on two main interlocutors; first, the type of the data which has been captured and second, capture behavior. Some issues will be emphasised which are related to the human natural and situation where the information need be captured.

8.1.1 Needs for Recording Information

The findings show that the majority of the participants think their memory in terms of remembering past experience is good or strong. Considering the memory as very strong or very weak was also noticed in this study. It is assumed that, in this study, recording past experience is not because of the weakness of the memory, at least from participants point of view, recording information can accrue from people who think that they have a very strong memory. Interestingly, people can misjudgment their ability of remembering. Participants with good or strong memory forgot information, while participants with weak or very weak memory showed a skill in recalling information about their past experience. This suggests that people can misjudge their ability to recall information. This misjudgment can be because of their psychological state, as believed by (Bolla, Lindgren, Bonaccorsy, & Bleecker, 1991). These researchers said that self-rating of memory disturbance may be because depressed mood than to poor performance on memory tests. It was concluded that CatchIt can be an assistant tool for ordinary people who think their memory is good but who forget some information. People who evaluate

their ability to recall information as weak can also benefit from the same system without needing especial requirements. Especially they show that they can remember their past experience at the zoo.

8.1.2 Type of Captured Information

We examine the type of the desired data which people recorded and we analyzed what kind of the data was so important to the participants to be recorded and what was less important. Also we investigate what kind of data is missing and why it was missed.

8.1.2.1 Recording Contents

The contents refer to any information that is recorded for later use. This information can be either textual or visual or audio information, or any combination of all these. This section will discuss the content which was captured in the zoo and the information which was not.

- ***Textual Information***

In everyday life, 63 percent of the participants used notes to record information. Approximately 53 percent used pen and paper while 36.8 percent used a cell phone as well as pen and paper. The popularity of using notes can be because the participants were students, who are used to taking notes for their study. Conducting the same study with different groups might or might not show the same popularity of using notes to record information. Even people who used a cell phone,10.5%, to take notes still used pen and paper based notes.

While in the Zoo context, most of the data was pictures then video and text, especially taking photos for the textual information from boards. Sometimes the participants took notes for information instead of taking photos of the information board. Participant 23 justified this saying that the board has lot of information and he does not need to all of it. Also, recording information does not mean copying exactly as displayed; some participants read the information in the board in English then wrote the information in their

own language, to save time, they said. From the interview, most of the information which was recorded at the Zoo was about past events.

The situation is affecting the kind of the information which is recorded. Twenty-four percent of cell phone notes were for use as a prospective memory aid. They used the cell phone to take notes to remember things they wanted to do. This is might show that using cell phone for notes is similar to the use of paper-pen notes. A study conducted to examine the lifecycle of the note shows that all the participants used paper notes to remember doing things in the future (Lin, Lutters, & Kim, 2004). However, in the zoo context, the notes taken by the participants at the Zoo was interesting information they wanted to keep. The system which is supposed to be used to feed the Digital Parrot should support taking notes and take photos of a text as well.

- ***Visual Information***

The visual information that participants used was either photos or short movies or both. The effectiveness of photos to trigger memory is an arguable topic. Some researchers showed that photos help to remember (Hodges, et al., 2006) while other researchers agree that using photos might not be good for long term (Sellen, et al., 2007). The other form of visual information was recording video. The video recorder was used to record the activities of the animals and most the movies were very short. Whether the video can help the user to remember was not examined because this study is investigating what kind of the information is recorded by the participants. The video recording at the Zoo was used to record information. From the first experiment, the visual information forms the most desired information that participants want to remember from the zoo, then the textual information. This information can be either photos or video.

- **Taking Photos**

  Thirty percent of the participants noted that they used photos to record their past experience in everyday life. Similarly in this study, some participants took their cameras with them or used their mobile phones to record photos while the others

came without bring their cameras or using their mobile phones which have a built-in camera.

The contents of the pictures which were taken at the zoo were varied. The animals were the main object in the photos taken by the participants. However, different objects, such as cages, signs, people or devices used at the zoo, were presented as well. However, most of the photos are indicating the zoo context.

Photos can help recall, to some extent. Participants showed that they were able to give information about the situation when the pictures were taken. However, on the photos cannot be totally depended on as a way to help people to remember especially when we do not get a very high rate of accuracy. Participants show that they can recall their past experience by looking at the photos which were taken at the zoo, but sometimes they needed more information to remember. However, when the photos were not focused or had a strange object they needed more information and when they received some hints they usually remembered.

Five of the six participants had the experience of false memory. The sixth participant had a problem to remember his past experience so did not recall false memories: he kept saying most of the time that he could not remember. The participants recalled that they asked the researcher to take the photo for them, while they had not. This could show that the participants mixed between knowing this information and remember asking for recording the information. Further investigations might be needed to discover whether this false memory happened only with visual information or it was the same with other forms of information such as textual information. There was not enough evidence to establish that there is a correlation between false memories and passive capture. Especially, where the participants showed false memory when they saw pictures which were taken by the researchers. Further study is needed to investigate this correlation.

- **Recording videos**

The video was one of the ways that participants used at the Zoo to record information. They used short clips to record activities of animals or people at the Zoo. In everyday life, 15 percent of the participants use video to record their past experience. This small percentage compared with taking notes or photos can be due to the inappropriateness of using the video in everyday life, usually people are less likely to use video to record short notes or to record an idea.

In the zoo context, observation showed that participants used a video recorder to record animals' behavior or different events. The clips were short (10 seconds to 2 minutes) and sometimes the participants complained about the quality of the clips because of the limitation in their devices or the animal suddenly stopping doing any action. Participants who used their cell phones to capture information agreed that the video clip should be short but they disagreed on the length of the short clip. The argument for lengths was between less than 10 seconds, to no more than 30 minutes. While using video everyday uncommon when compared with textual information and photos, it also depends on the situation; it can be more effective than textual or photos. Short movie recording should be supported in the CatchIt with restricted lengths to save battery and memory space.

- ***Audio information***

The observation and interviews show that using an audio recording was absent in the zoo context. Not one of the participants recorded any audio information, even when they were equipped. Most of them carried a mobile phone with a built-in audio recorder. Yet 26.6 percent of the participants said they recorded audio, but most of them were for study purposes or meetings. Participants who did not use audio recorder explained that either it is a time consuming task or they had never tried. Even recording every day conversation is not a very popular way to record information but it can a useful tool if the participants feel comfortable or recording a voice can help them to remember. Participant 24 said that besides using the audio recorder for recording lectures "I like to write poetry so whenever something comes into my head; I either use the notes to write

it down or either use the audio recorder" (P24). While P14 said he uses the audio recorder to record information which he wants to remember later. For example, he records himself reading a piece of a book. This shows that the effectiveness of audio recording is dependent on the conformability of the user also even with good equipment and a willing user, audio recording is unlikely to occur frequently. These findings agree with a study done with three participants who used a system called iRemember (Vemuri, et al., 2006). The result of this study shows that recording conversation does not occur constantly; since the average of the conversation recorded by the three participants during two years was 54 conversations.

The possibility of the need of recording audio information cannot be ignored, especially as it can be used in meetings, one of the situations that it is expected this system would be used. CatchIt should support audio recording but the most important is to support extracting the context and information contained from the audio recording and using it to enrich the Digital Parrot.

The content of the pictures is important as well since it is used to name the picture, folders or notes. The findings show that the contact of the information can be used to tag the captured information and be used again to retrieve captured information. This indicates that contents analysis for annotation captured information can help archiving and retrieving past experience.

8.1.2.2 Context

This section discusses the context information that was recorded and not recorded in at the zoo. Time and location are one of the most important pieces of context information that helps people to recall their past experience. Yet this kind of information did not receive noticeable consideration from the participants at the zoo. Although the zoo was place rich of context information no attempts by the participant to record this kind of the information were noted. Participants agree on the importance of context information in recalling past experience, yet they did not record what they felt was important. Also not all context information has the same significance, they commented that information like the weather, light, and smell would not help them to remember.

- ***Time***

During the field study it was noticed that the participants did not record the time or ask for the time to be recorded. Similarly, they did the same with the location and other context information. They concentrated most on the interesting information which they wanted to keep. From the interview, most participants agree that the exact time might not important to them to remember. Only 14 percent of the participants think that they would use the time and data to retrieve the information. Some participants pointed out that it might be useful if they could use the season, like summer or winter, instead of the exact time or day. So it was suggested that the time should be recorded automatically with a semantic representation. This means instead of recording only the time and the date the system should be able to automatically add the corresponding information like the seasons, last summer or birthday. Also, using the semantic representation for the time should consider the location, since the seasons and the time differ based on the region.

- ***Location***

From the questionnaire and interview, the participants were sure about the importance of recording location and using location to retrieve information; surprisingly, all of the participants did not record the location. This is quite common; a study of the use of paper in everyday students shows that among 277 situations only in 95 situations the location was recorded (Nichols & Cunningham, 2009). Participants in this study justified the reasons behind not recording information as not knowing why they did not think of or thinking that they can tell from the photos or because it is in their mind and they will remember it, especially they will go home and organize the captured information and save it after the location.

From the interview, the participants did not think recording the specific location for each animal within the zoo was important and it would not help them to remember. So the system should aware about the location in terms of in which

situation the specific location is important and when the general location should be recorded. Additionally, the system should map the physical information with semantic information. This includes converting the latitude and longitude of the field into the name of the place which would help the users of the augmented memory system to remember, according to Schweer (2010).

- ***Recording Names***

Names sometimes help people remember information as the findings show. This is a general statement which needs to be examined. It seems useful to record the names of the people who were present, but some participants indicated that if they knew the person before it would help them to remember, while if they meet them for first time it might be useless. This is might be because it was hard to remember their name in the first place and we quite often face the situation where we recognize the faces but forget the names (Burton & Bruce, 1992). In contrast, sometimes the name of the people we know very well does not help to remember, especially if we spend most of the time together. According to a P6, "I could remember right now - where did I go with my best friend in last two weeks or three weeks…. one, two months, then it would be difficult. But if I've met someone new and if I met someone different then I could easily, 'Well yeah, I went with him to that place'" Another participant commented that the importance of recording the names is related to the situation saying, "It really depends where you go. I mean people's name in the zoo, I don't think it's that important …. in conference, yes" (P3).

This suggests that recoding the name of the people should be selective not automatic and the user should be able to set up when the system should record the name automatically and when not. CatchIt should automatically record the name using the Bluetooth whenever it seems useful to the user. Also, the system should be aware about if this person is a new person or the user has added them to the Digital Parrot before.

8.1.3 Information Capture Behavior

Naturally, each person develops a system for himself which he is comfortable with to perform everyday tasks. And since recording information is one of these tasks, we tried to observe any significant behavior or whether the participant follows a similar pattern to capture information.

Collaboration

Some participants asked friends to capture information for them either because they did not have good equipment or they think there are not good enough to take a good photos. Others refrained from recording information because they believe that this information can be found online or because there are a number of people recording the same information, especially if they were expecting to get a picture of an animal or landscape. Surprisingly, the participants did not distinguish between pictures that they asked for to be captured and ones that they met and saw but did not ask to be captured.

It was also observed that when the participants took photos by themselves they tried hard to get a good quality picture and, in most cases, took more than one. But when they asked friends or the Wizard to take the photos for them, they did not show any concerns about the quality of the images. This can be an indicator of the effect of seeing the picture after capturing it or assuming that the photos will be good unless they see otherwise. It could be something related to trusting the other or could be something else which needs to be researched. This can raise the importance of supporting the users to see the photos after capture or trying to use good technology to get good photos and achieve less blurring.

Capturing Purpose

Recording information is an act which aims to make use of the recorded information not for the information itself (Brown, et al., 2000). Following the study observations, the purpose of recoding the information at the zoo was organized into three main categories. The first purpose was archiving the information and storing it for long time. The second reason was to share it with others, such as family, friends or publish it on the social

network websites. The last purpose was to re-use it and this includes using the captured information to do more research or learn new vocabulary in different language.

Also, recording past experiences should take into account retrieving the information. Participants showed some awareness of retrieval while capturing the data such as recording the animal's information board before taking photos of the animal to help to review the data in logical order, for example, the name and information of the animal then some pictures of the animal.

Passive and active capture

This study focused on the active capture, the approach of this thesis is to help the user to bookmark the moment that he/she wants to remember. Regardless to the drawbacks of both passive and active capture, active capture proves that it helps people to remember while the passive capture helps them to remember more about their past experience (Sellen, et al., 2007). This study did not show that if remembering more information is so important or not. It was noticed in the current study that participants prefer to remember and capture much information, but did not think all information had the same value. By concentrating on active capture in CatchIt, all necessary and valued information that the participants believe is important to them can be captured. However, a further evaluation of the system could help in discovering more about what extra information is missing. Also further study could explore the extend to which people do not want to remember more.

As active capture, in the follow up interview, which was at night after the participants returned from the Zoo, the participants showed encouraging evidence that they were able to remember very closely and very accurately how many moments they bookmarked different moment (pressed the button) and hopefully they would remember the information and situations if they saw the captured information. Also, this might be the reason for false memories because of the Wizard taking the photos instead of the participants themselves, and might indicate that passive capture might lead to a false memories. Also, the observation has shown that the participants spent time to browse

the information and find the information which they feel should be recorded. In some cases, there were events that happened accidently and participants felt they wanted to record them, but they did not because either they were busy with something else, were not prepared or the importance of the information changed over the time. That is, the information was important while the participant was at the zoo but later on he/she thought it might it would have been good if they had recorded the information.

Incentives to Record Information

The factors that encourage participants to record information were organized into three main categories: situation-related factors, information-related factors and tool-related factors. Most of the participants' answers belonged to the first and second groups, while a few answers corresponded to the third group i.e. three answers out of sixteen were about the tools. This suggested that the situation and the information are the reason to capture information and the devices should be design based on the situations and information in which the devices are supposed to be used.

However, inventing a new device it might raise the problem which many participants noted, that they depend on their mobile phones to record information instead of using digital camera, which offers good quality and big memory capacity compared with the mobile phones, because they do not like to carry too many devices. Even though this opinion can be argued, especially when people are seen carrying their mobile phones (sometimes two), they also carry MP3 devices or iPods, and some people carry notebooks as well.

This can form a real challenge for invented devices. If people have to carry or wear a new device then the device is needed which cannot be replaceable by the one of the devices that people already have. At this stage, the new system needs to be integrated into a device that people already carry and feel familiar using in order to evaluate the idea of bookmarking moments.

Personal References

The primary evidence does not show strong correlations between the learning style and the type of the information that has been captured by the participants. But it does indicate that a) regardless of their learning style; participants tend to record information based on the situation and information as maintained earlier. That is, non-visual participants took photos at the zoo and non-writing-reading learners style write notes if they have to. This might explain why half of non visual learner participants recorded photos at the zoo while participants pointed that they used audio recording to record lectures even though they are not auditory learners; and b) there is a relation between people's preferences and the tools that they used to record information. For example, participants who like to take notes to record information took notes at the zoo as well and participants who said that they do not record information and they rely on their memories, did not record information.

Adaptation with new technology

From the observation, it was seen that the participants showed a high ability to use new technology even if it was totally different from what they were accustomed to use in similar situations. By using the indictor given to them, some participants struggled the first or second time, and then they used it very confidently.

Even though they were not told what kind of the data this device recorded, they assumed it recorded image and voice. Only one participant out of five pointed to textual information. This might indicate that people are able to adapt to a new device regardless of how it looks since it does what they want. Also it might indicate, as well, that in the zoo context, people assume images and voice properly video recorded is the suitable type of captured data , while another study in different situation might indicate different type of information is desired.

Participants suggested integration of the audio or visual feedback in the device. In this study, it might be early to decide which feedback works better, especially when the effectiveness of the feedback depends on the application. For example, the audio feed-

back helps to improve user performance more than visual feedback does during playing games (Hanqiu, Chan, Hung, & Peter, 1998). This suggests that since the iPhone could be used to develop this system, initially the user could be allowed to choose which feedback they like, audio or visual, a study to investigate which way works better for this approach could be conducted.

Portability and Synchronization

This study reveals that the majority of the participants record information frequently even though the majority believes that their memories are not weak. They recorded information during the day and they revisited it later for organizing, editing or sharing. That means most the participants already have a routine which matched the approach used in this study.

Participants showed their need to use the laptop/desktop to browse the recorded data, especially because the big screen and the editing is easiest. However, they also showed the desire for moving the recorded data to their hard desk or email and keeping the most significant information on their mobile phones to either share it with friend while they are away from the computer, or to revisit when they need it while they are away from their PCs. They keep it until they feel that they do not need it any more or they need some space in their mobile memory.

Transfer of the captured information from mobiles to the PCs is mostly done through connecting the two devices through the cable, while in some cases they use wireless technology or the internet as media instead of the cable. So they send it to their email and they open the email on their PC to download the data.

These behaviors suggest that the synchronization between the two devices (mobile and PC) should be into two direction and the user should be able to have a copy of the data that he/she thinks that they might need to use while the away. Additionally, they suggest also supporting remote synchronization to help the user to send the information to a buffer before finally inserting it into the Digital Parrot.

Obstacles in capture

The majority of the problem which prevents participants recording information not only at the zoo but also in everyday life is technical problems. Short battery life and limited memory of the devices which they use are serious issues that people complain about it not only in this study but also in other studies (Pettit & Kukulska-Hulme, 2007). Hopefully, these problems will be solved in the near future. There were other technical problems reported such as bad cameras or break downs. These problems are not within the scope of this study which is focused on designing a system, not a device.

The limited time was one of the problems which was reported by the participants. In our system, this matter is to be overcome by offering a good user interface and semi-automatic capturing system. It expected that some of the situational and personal issues will be solved. However, it cannot be estimated to what extend these problems can be reduced until the system it has been developed and evaluated.

8.2 **Recommendations**

User behaviors and thoughts in five different study conditions have been studied to explore capturing personal experiences. The empirical evidence from the study as well as the insights from related work will be used to examine the CatchIt empirical requirements and draw suggestions to be considered for use in next stage, developing CatchIt.

- The results of the study and related work show that all the requirements which were represented in the Chapter 3 are essential requirements and should be carefully considered during implementation of CatchIt.

- All the requirements, which are portability, semi-autonomy, support capturing multimedia, context and content information, synchronization, selecting the moment to record information and annotation, were the minimum requirements that match the requirements which the results of the study revealed. These require-

ments should be fulfilled and taken into consideration with the other recommendations.

- The bookmarking moment should include different information based on users' setting or situations and the user should be involved in deciding which information should belong to which situations.

- To bookmark a moment, CatchIt should support manual capture for short audio, textual, visual information while it must capture the time and location automatically as it was discovered that, most of the time, the users forget to record the locations which this study shows most users rely on as a trigger to remember. Also, using the semantic representation is recommended to help the system user to find the stored information.

- Preliminary studies suggest that after moving the captured information into the Digital Parrot, the users should have a copy of the important and favorite data in their portable device to retrieve it whenever they need/like to.

- Also the study suggests a) not to invent a new device since the participant said they did not like carry many devices, instead using the cell phone and testing whether CatchIt can work affectively on it; but this does not mean new device will be useless; and b) supporting the user to review the captured information when the user likes to especially when a photo is taken. Also, analysis of the content of the captured information will be helpful in terms of annotation and tagging the captured information. Contact analysis will be important when the photo of the text is captured.

- Since the information is stored in the Digital Parrot as text, this information should be automatically extracted from the photo, video and audio. Also, the system should support the participants to add more information and keep this visual

or audio information attached in the Digital Parrot. Support of other languages as input information should be considered at some stage of developing the system.

- Bookmark the moment should be fast and effortless. In order to achieve that, the user should be able to set up the system to record information in the way that the user prefers to use in different situations. User preferences and the user interface should play an essential role to make recording information easy and fast, especially when the user has to use only one button to bookmark moment. Also, the bookmark can be done by initially using one button while it records the information the user needs and gives the user feedback. The kind of the feedback should regard the user preference and the user can choose between audio or visual feedback. Also, it is recommended that the possible of using voice command should be considered as an option to bookmark moments. This might need special equipment to make the devices attached to the user's body.

- Finally, a user study should be conducted to investigate the user interface for bookmark moments, especially as user interface was out of the scope of this study. It is highly recommended that the user interface of the system should consider the requirements of capturing and retrieving information.

8.3 **Study Limitations**

This study is an explorative study examining user behaviors and thoughts to drive preliminary design requirements. It used interview and observation in the field. These methods need many resources such as time, observers and financial support.

The time constraint forms the main limitation of this study and more observation and interview was needed, especially remembering past experience has physiological factors. Also, the researcher had to observe, interview and analyse the data, which is time consuming as well. These two limitations also had an effect on the sample size.

Recording past experience is an everyday practice for an enormous sector of the population and using a random sample of international students does not represent the general population. But because it was easy to access students and because it was hard to find people who were free the whole day, especially our study required visiting the zoo during the day and then back at night for the interview, students were the participants . Also the number of the participants is limited. However, the system which will be produced based on this study will be evaluated in a general and larger sample to support the primarily findings of this study.

Another limitation is the study environment. The study conducted at the Zoo, while other contexts, such as workplace or an academic field, might affect the result.

9. Conclusions and Further Work

This research set out to investigate the users' needs to capture past experiences and shape the design requirements for a system which aims to bookmark different moments in our life. The early sections of the thesis evaluated and integrated the findings from the user studies. These sections discussed the problem in the existing augmented memory system the Digital Parrot, which is entering the data into the system. The data need to be captured and enriched in the system.

In order to research this issue, the current situations were described in scenarios then these scenarios were used to shape the system requirements from technology perspectives. After reviewing the related work, and comparing it with the primary requirements derived from the scenarios, a new approach to recode information was suggested. This is to bookmark different moments, which was described in detail early in this thesis. A number of requirements were specified in Chapter 3 and the conceptual design of the CatchIt was described in Chapter 5 but instead of implementing the system different direction was used to further explore the idea of bookmarking the moments. Five different user studies were conducted to see capturing past experience through user eyes instead of the technology point of view.

The result of the study was used to develop recommendations for the system design and these recommendations should be used in the next stages of this project, implementing the system and evaluating it to gain more knowledge and information about the human memory and recording personal information and to examine the effectiveness of using CatchIt and the Digital Parrot in helping people to record and retrieve their important information.

From this study, it has become clear that in people's lives there are important moments and they are aware of recording them and recording information is goal-oriented behavior. It can be done by the person himself or a friend can be asked to do it for them, even though the time and surroundings can be some of the contraindications of recording information. The information type varies based on the situations and people's judgments.

Within the same situation, the captured information is different from person to person and this makes it tricky to automatically record the same information for everyone. Although, there are situations where people like to record same information. The textual information was the majority of the recorded information in everyday life. This was a good indication, especially when the Digital Parrot depends on text as a way to insert the captured data and store the data.

Mobile phones also were used to record information to show the different use of the mobile phones. Also, this study notes that people might dispense with using a digital camera if their mobile phone provides them with high quality photos and services.

The recent reviewing of the captured information showed highly promising help to remember and the act of bookmarking different moments also helped to remember the situation where people have met the information. This study showed that many participants are susceptible to false memory, especially with information that they know part of.

Also, it was found that automatically recording context information is essential and sometimes can be useful with mapping the captured information with semantic information. Also manual capture will not help only in recording information according to user preferences, but also help the user to remember the moments when he/she recorded the information. Also, when information is captured when the people are away from their office/ PC, it can be important that the retrieval can be done remotely.

It was noticed that learning style did not affect the type of information that participants captured but it might have an effect on the way people retrieve the information. A further study to investigate this point could be conducted.

This study also indicates that transferring, editing and archiving the data is a behavior that participants used to doing. This is an encouraging result which shows that even revisiting the bookmark moments at night to insert it into the Digital Parrot will not form

a problem. Interestingly, the study shows that using the internet as a mediator to transfer the captured data from the mobile to the PCs has, to some extent, become common.

The first further work is to develop the CatchIt system based on the suggested recommendations from study findings. Some of suggested requirements are similar to these requirements which were derived from the scenarios. The primarily development will be on mobile phone platform. The second further work should be evaluating the system, especially the user interfaces. Finally, we are determined on investigating how integrate CatchIt with the Digital Parrot. The third task will be the most challenging in regards to the number of the studies which are needed to find the suitable user interface. Then many studies and research should be done to assess the affectivity of CatchIt with the Digital Parrot and whether it can help the user to remember their past experience.

Also, this research raises many issues to be research in more detail which might contribute to improve our understanding of user behavior. Information such as the possibility of effect of passive capturing in false memories or the since there is no indication that there is a correlation between the learning style in terms of capturing information and it cannot be predicted whether the case will be similar in terms of retrieval of information. Finally, the availability of the information online might affect capture of information. Since it was found that a strong belief that information online can prevent participants from recording information, this issue needs to be further explored to improve a personal recording experience system.

This study was limited by the study environment. Studying captured personal experience with consideration of bookmarking approach in different environments like academic and everyday life with might bring different findings in terms of system design requirements and user behavior.

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Appendices

Appendix A

Ethical Approval

Computing and Mathematical Sciences
Rorohiko me ngā Pūtaiao Pāngarau
The University of Waikato
Private Bag 3105
Hamilton
New Zealand

Phone +64 7 838 4021
www.scms.waikato.ac.nz

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

27 October 2010

Jehan Alallah
C/- Department of Computer Science
THE UNIVERSITY OF WAIKATO

Dear Jehan

Request for approval to conduct a study for your Masters degree research

I have considered your request to conduct a research case study *Capturing situational context in an augmented memory system,* using human participants. The study will be in two parts, one where each subject has to spend up to one hour at a tourist site in Hamilton and the second part will be an interview and completing a questionnaire, in the Usability Lab at the Computer Science Department, University of Waikato.

The procedure described in your request is acceptable.

I note that confidentiality and participant anonymity will be strictly maintained and all information gathered will be used for statistical analysis only. No names or other identify characteristics will be stated in the final or any other report.

All notes, recordings and documents will be kept securely in the FCMS Data Archive and destroyed after five years.

The research participants' information sheet and consent forms meet the requirements of the University's human research ethics policies and procedures.

Yours sincerely,

Mike Mayo
Human Research Ethics Committee
School of Computing and Mathematical Sciences

Appendix B

Hamilton Zoo Offer

Subject: RE: doing a user study at the zoo
Date: Thu, 21 Oct 2010 09:23:29 +1300
From: Fiona Prowse <Fiona.Prowse@hcc.govt.nz>
To: annika.hinze@gmail.com <annika.hinze@gmail.com>

Hi Annika,

Thank you for your enquiry. I am pleased to offer you a discounted rate of $5 per person per visit. Once you have been given the 'green light' for your study, please let us know the dates and number of people attending. Many thanks.

Kind regards

Fiona Prowse

Education Administration Assistant

Hamilton Zoo

Brymer Road

Private Bag 3010, Hamilton 3240

DDI 07 838 6887

Fax 07 838 6960

Email fiona.prowse@hcc.govt.nz

-----Original Message-----

From: Annika Hinze [mailto:annika.hinze@gmail.com]

Sent: Wednesday, 22 September 2010 1:23 a.m.

To: Ken Millwood; Annika Hinze

Subject: doing a user study at the zoo

Hi Ken,

as talked about on the phone yesterday, we are planning to perform a user study at the Hamilton Zoo about how people remember events and how to best help them remembering using an augmented memory system. Attached is part of the ethical approval application for the study.

We would anonymize the user observations but mention the Hamilton Zoo in scientific publications and also in publications for the wider public (e.g., in the Waikato times).

We plan to visit the Zoo with a number of study participants, mostly accompanied by a student researcher. Each participant would come alone or in groups of two. We explore five different ways of support for remembering what people encounter, in each of these we plan to have up to eight study participants. That is, we may want to visit the Zoo up to forty times with typically two people each time. It would be great if we could find a way to have a reduced entrance fee for research/education for this project so that we can afford visiting that often.

If you are interested in hearing more about the project, or in participating or reading about the results just let me know. It would be great to have the support of the Hamilton Zoo for our research.

Cheers

Annika

Annika Hinze

Head of the Information and Databases Research Group Computer Science Department University of Waikato.

Appendix C

Survey

Demographic Data Questionnaire

[IT IS IMPORTANT THAT YOU ANSWER ALL QUESTIONS]

1. Are you Male or Female?

☐ Male ☐ Female

2. What is your age?

☐ 18-27

☐ 28 -37

☐ 38 - 47

☐ 48 or over

3. How you usually record your life experiences? **(Please tick all applicable)**

☐ Take note (Pen & Paper)

☐ Take note (cell phone)

☐ Take photo

☐ video recording

☐ voice recording

☐ Combination of photo, Text , video and voice

☐ Other (Please explain) .....

.....

.....

4. What kind of information helps you to remember your past experiences? **(Please tick all applicable)**

☐ Time/date

☐ location/ places

☐ Names of people or building

☐ What were you doing

☐ Other (Please explain).....

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1

5. How you typically organize your recorded memories to make them accessible for you when you need them?

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6. Have you ever faced any problems when trying to record an important event such as a conversation? **(please explain)**

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7. Are you interested in using technology in your everyday life? (circle)

Not interested Very interested

1 2 3 4 5

8. How good is your memory for recalling past events? **(circle)**

Very weak Very strong

1 2 3 4 5

9. Do you take a photo when you need to remember something? **(Yes/ No and why)**

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10. Do you use voice recording to record any of your past experience? **(Yes/ No and why)**

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2

11. What kind of person you are?

□ **Visual learners** (you usually can remember best things you've seen or you recall information better when you use photo, colour, maps or any visual materials)

□ **Auditory learners** (you usually can remember best things you've heard during conversations or lectures).

□ **Reading/writing-preference learners** (learn best by reading and writing down information.)

□ **Kinaesthetic learners or tactile learners** (learn through experiencing/doing things).

May we contact you about your input at a later date?
If so, please provide your e-mail address.....

Appendix D

Behaviour Observation Form

Participant No. …… Date……..

Study Condition …… Time……

Comments:

No.	What (Situation)	How (recording behavior)	When/ Antecedent	comments

Appendix F

Confirmation Letter

Computing and Mathematical Sciences
The University of Waikato
Private Bag 3105
Hamilton 3240
NEW ZEALAND

Phone +64 7 838 4322
www.scms.waikato.ac.nz

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

To whom it may concern,

This letter serves to confirm that **Mr/Ms**..... is one of our participants in a research project conducting by the University of Waikato, Computer Science Department Hamilton, New Zealand on ....., **2011.**

Our project is about investigating the collaboration between human and technology to support remembering. Therefore, we ask the participants to record the interesting moments or events that he/she would like to remember later on by using mobile phone.

We discussed performing our user study at the Hamilton Zoo with Ms. Prowse, from the Education Administration Assistant and we received a generous offer which is a discounted rate of $5 per person per visit. Therefore, we kindly ask you to charge our participant $5 an entrance fee only. We are aware that the Zoo will tread our participants as ordinary visitors and there are no extra services requested from the Zoo.

If you have any questions or need additional information, please feel free to contact me.

Thank you for your courtesy and cooperation

Sincerely,

Jehan S. Alallah
University of Waikato
Computer Science Department
Hamilton, New Zealand
Email: jalallah2@gmail.com
Tel: +64 7 838 4021 Ext: 6011
Mobile: +64 21 114 3136

This is a part of Master's project supervised by:

Dr. Annika Hinze
Department of Computer Science
The University of Waikato.
Email: hinze@cs.waikato.ac.nz
Tel: +64 7 838 4052 Ext: 4052

Appendix G

Structured interview

Questionnaire for the interviews #1

Unobserved Visit

1- What would you like to remember about this trip?

.....

.....

.....

.....

a. Have you recorded any information such as (photo, write note)?

(1) If YES:

1. What did you record information of? (The situations)

.....

.....

.....

.....

2. When do you record this information (photo, note)?

.....

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(2) If NO why not?

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.....

2- Is there any information that you came cross while you were at the zoo you wish you record it? If yes why?

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.....

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3- What kind of tools/strategies do you usually use when you need to record your experience in similar situations (Zoo, Museum, and Garden)?

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4- What is your typical method of recording events or trips, keeping them and how you recall them?

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5- What would encourage you to record your past experience?

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6- What would prevent you from recording your past experience?

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7- What you do you think about (Marking moments) during the day then you go through at night and filter them or/and add more information? Do you think it will work with you? explain

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Questionnaire for interview #2

Shadowing

1- The situation:

a. Give me an example about a situation where you recorded information while you were at the Zoo? Why this information in this situation was important for you to record?

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b. Did the information which you record depend on the situations or you usually record similar information regardless to the situation?

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c. Did anything in the Zoo or anywhere else help you recording? Did anything prevent you from recoding? (people around, physical thing..)

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2- Information

a. What kinds of information are important for you to be recorded? And why?

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b. What would you do with the information? How you would organize it? How would you do to recall record informant?

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c. Are you satisfied with the information that you recorded or you prefer recording more information? Please give me examples?

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d. Have you ever face a situation where you miss something important while you were busy in recoding information? Explain.

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3. General

a. What would you like to remember about this trip?

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b. Have you recorded any information such as (photo, write note)?
    a. If YES: What did you record information of?
    (The situations)

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    .....
    .....
    .....
    .....

    b. If NO why not?

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    .....

c. Is there any information that you came cross while you were at the zoo you wish you record it? If yes why?

.....

.....
.....

d. What kind of tools/strategies do you usually use when you need to record your experience in similar situations (Zoo, Museum, and Garden)? keeping them and how you recall them?

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e. What would encourage you to record your past experience?

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f. What would prevent you from recording your past experience?

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g. What you do you think about (Marking moments) during the day then you go through at night and filter them or/and add more information? Do you think it will work with you? explain

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Open questions

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Questionnaire for interview #3

Using Indicator

1- What you think about the device which you used during this experiment at the Zoo? Do you feel you comfortable using it or you feel it is was hard to use such a device to recorded date? Explain.

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2- Do you think it was convenient to press one button to record the data which you might need to use later on?

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3- Can you explain to me how do you think this devise works?

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4- What do you think the advantages and the disadvantage of this devise?

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5- Can you remember how many times did you use the device and When?

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6- Over all, how do think about your experience of using the device?

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7- Did you face any problems using the device?

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8- What kind of feedback do you expect from the device after recording data?

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9- What kinds of data do you think that the device recorded?

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10-Open questions depend on the observation?

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Questionnaire for interview #4

Wizard of Oz

1- Do you remember the important events/ moments which happened at the Zoo?
   - All
   - Most
   - Some of them
   - Nothing at all

2- Do you remember the name of the animal which you asked me to recoded?

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3- Do you think it is important to record the place where you meet this data? You did not ask me to record the location of the Zoo? Why.

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4- What about the time? People around you?

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Most of the times you ask me to take photos. Do you think photos are enough and you don't need to write down any note or record any other data? If you have a device how do you like to enter these notes? Writing or voice recording?

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5- I would like to show you some pictures and I'd like you to tell me why did you ask me to take photo for these animals?

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.....

6- Do you remember the "....." after long period such as a month Which of the following keywords would help you to remember it:
   - Hassan, Bassam, Abdurrahman, my name.
   - Hamilton Zoo
   - 6th of January 2011 10 am
   - The weather was 26°C Cloudy.
   - Others such as:

7- Which of the flowing you think it not important to be recorded
   - The exactly location for each animal.
   - The sounds and smells.
   - 3D image for the animals and their places.
   - Environmental information like the temperature, light and humidity.

8- From your point of view, what kind of data do you think it so important to be recorded when you don't have time?

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9- Open questions.

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Questionnaire for interviews #5

Using technology

1- **A- How often do you use your mobile/ digital device to record information and why?**
   - Always
   - Most of time
   - Some time
   - Seldom
   - Never

   Why.....
   .....
   .....
   .....

   B- In which situations you use your mobile to record memories?
   .....
   .....
   .....
   .....

2- **What kind of data did you recorded at the Zoo? And what different type of data do you usually record? For example** calls, quick note etc.
   .....
   .....
   .....
   .....

   (Check if the participant captures the location, people around…)

3- **A) What is the next step? What do you usually do with the recorded data?**
   - Keep it on your mobile for certain time then delete.
   - Move it to computer and keep a copy of it on your mobile.
   - Move it to computer and delete it from your mobile.

   b) **How? How do you transfer data from mobile to PC? For example: synchronization using Cable and Software, Bluetooth, copy and paste, email to you your email**
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4- **What do you do with your data which you're recoded using your mobile?**
   - Just transfer it.
   - Organize it? Archive it? **How** keep it till you need it or just delete it when you think it is useless.
   - Edit and what kind of editing.

5- **Do you prefer browsing the recorded data on your device or on your desktop/laptop?**

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6- **What do you think about your mobile phone as a device to record your memories? Do you think the size, integrated camera and other features are helping you to capture your memories? Or you think there is something missing?**

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