Considering Human Memory in PIM

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1. INTRODUCTION

As the amount of information we create and use has increased, people rely less on their memory and more on tools to manage their information. Nevertheless, memory remains key to retrieving information with these tools[1]. Our work has focused on understanding the role that memory plays in PIM. What do people remember and forget about their information collections and objects within, and how are these memories used to solve information needs? Based on investigatory work tools have been developed to better support memory for information. These will now be evaluated to determine whether such an approach can assist PIM practices and to learn more about the role of memory in PIM.

This paper briefly summarises the work done so far, describes one of the interfaces created, and overviews a novel methodology to evaluate this and similar interfaces.

2. BACKGROUND AND PREVIOUS WORK

Previous research has shown the role of memory in PIM to be non-trivial. For example, [13] described office organisational problems as problems of categorisation, recognition and recollection; [3] proposed that memory and metaphor impact the way historians manage their resources; and [2] demonstrated that simple eight character filenames can trigger a detailed recollection of a file's content. It has also been observed that memory problems hinder PIM [10, 5, 7]. Further, many groups have designed systems to support known characteristics of memory. E.g. [9, 12] leverage episodic memories and the fact that events are framed temporally with respect to the times of other events; [11, 10] exploit strong human abilities to relate information objects to contexts in which they were created or used, and [6, 4] exploit the strengths of recognition over recollection etc..

Building on a thorough review of psychological literature and motivated by the link between what people forget and difficulties in re-finding objects, we investigated the everyday memory problems experienced by a wide range of individuals. The aims were to understand the difficulties associated with memory lapses, relate these lapses to PIM, and to better inform the design of supportive PIM tools. The study identified three principal types of memory lapse: retrospective lapses concerned with forgetting details of past events or previously acquired information; prospective lapses concerned with failures to remember future tasks or events; and action-slips - very short-term memory failures that cause problems for actions currently being performed. In PIM these lapses motivate user behaviour. For example, people re-find objects to overcome retrospective lapses and overcome retrospective lapses to re-find objects. People use documents as reminders to perform tasks. Filed documents can also cause prospective lapses because even when documents are filed in a meaningful place, people often fail to use documents because they do not spring to mind at the time when they would be useful [10]. Further, action-slips are detrimental to PIM in that loss of concentration, due to a distraction or switch of task, can lead to search failure. Our study uncovered various causal situations and provided insight into the strategies used to prevent and recover from lapses. Our investigatory work inspired the design of a memory-oriented photograph management tool (PhotoMemory), which abandoned design metaphors commonly associated with photograph management software in favour of an interface which supported the three types of memory lapse and incorporated the user strategies uncovered in our study. A similar interface for re-finding email messages is described below. Our work on photograph management and the PhotoMemory (PM) interface is described in [8, 7].

The evidence so far suggests that the type of memory-oriented interaction promoted by PM is successful for photographs: users liked the interface and showed improved ability to re-find personal images compared to the other interfaces tested. However, photographs are highly visual and are associated with a wide range of memory types; they have clear links to episodes, experiences, people and places. This may make annotated photographs particularly suited to our interface. We are currently building on our findings by exploring similar interfaces for other types of object (email messages and web pages). Below we describe MemoMail - an interface for re-finding email messages designed to leverage the positive characteristics of human memory.

3. MEMOMAIL

In MemoMail we attempted to use what we had learned to design an intuitive, simple to use email access interface that facilitates the use of the user's existing memories and prompts enhanced recall.

A popular means of recovering from **retrospective** memory lapses is to take "retrieval journeys" [7]. This helps people remember because it allows them to re-create previous facts or experiences in a controlled fashion - piece by piece. We tried to incorporate this approach into MemoMail by allowing users to interact with the system in the same way as they take these journeys; users take small steps towards the messages they are looking for using properties that they can remember. Previous work revealed that people rarely have complete or precise recollection of information objects. Instead they tend to remember fragments of the context in which the objects were used or acquired [8]. MemoMail supports this as it allows these recollections to be treated as "small steps". For example, users can query on specific fields e.g. subject, sender etc. or submit general queries. They can also use drop-down options to apply queries that leverage semantic memories e.g. the message contained a url / image / attachment(s) and temporal memories e.g. the email was received in the last day / week / month etc. These queries or "steps" are iteratively combined to produce a new query, the results of which are shown graphically to the user.

What the user sees is an overview of the information space with messages represented by icons (images of the sender). There is no reliance on the icons, but they may be helpful because people have been shown to be good retrieval cues [6] and it is easier to recognise than to remember [4]. Initially, all of the icons are of equal size, scaled to best fit the display, with messages clustered by some property (date, sender, subject etc.). In the current prototype messages are clustered by date [figure 2(a)]. Messages in the same cluster are positioned close together on the screen, with 200 messages shown at one time. Initially, messages which best represent the clusters are displayed, but after queries have been applied the top 200 results are shown. When the user submits a query, combined system relevance calculations are communicated to the user graphically by scaling the icons representing emails [figure 1a]. This further strengthens the journey metaphor and allows the simple navigation of a complicated information space; the user progressively moves toward the information they need. Additionally, spatial relationships between messages in a cluster are maintained as icons are rescaled, which allows spatial memory to be exploited. This supports the behaviour users exhibited in PM, where a common strategy was to locate an image to use as an anchor, then search around that image to find other, related images. Thus, MemoMail utilises semantic, temporal and spatial memories.

Another feature of the interface is that while the user interacts with the system, extra "cues" are offered to help the user remember more about messages they are looking for, the information space and applied queries. When icons are moused-over, a circular menu is shown detailing message attributes [figure 1c]. Not only does this give extra information about the message, but if a menu item is selected the system constructs a query based on that attribute. For example, clicking on "From: john.smith@mail.com" would query the collection on this string, specifically boosting messages that match on the sender field. Constructing queries in this way, where the user does not have to physically type the query terms, integrates browsing and searching behaviours and provides a fluid interaction. A preview pane displays messages as their icons are "moused-over". Further, as queries are applied, colour-coordinated bars showing the query string and appropriate field are added to a panel on the right of the screen [Figure 1b]. The bars act as reminders of applied queries and offer an explanation for the displays appearance. This aim here is to help overcome **action-slips** and re-orientate the user after a disruption or loss of concentration.

MemoMail was designed to allow the user to interact in a fluid manner, while presenting as much information as possible that may help the user remember more and influence the search process. The design also helps overcome PIM **prospective** memory lapses because the user is shown information that may help them find messages they would otherwise forget to look for. The style of interaction increases the chance that the user will interact with objects that don't necessarily match applied queries, but that trigger new trains of thought. The principle is the same as preventative prospective-lapse strategies observed during the lapse study, where participants left objects as cues to remind themselves to perform tasks. To illustrate this aspect of the interface, Figures 2(a)-(d) show an interaction sequence where a user is exploring his information space and his search behaviour is influenced through interaction with the system. (a) shows the initial display with messages clustered by time. The top left cluster represents the newest messages. Then, in reading order, the clusters contain older messages. The bottom right cluster contains the oldest messages. The user mouses over icons and notices a message from a particular sender. Interested in this sender, he selects the yellow menu item representing the query "from:Richard.Glassey@cis.strath.ac.uk". (b) shows the display after the query has been applied, with matching messages highlighted in red. The display shows the distribution of these messages over time - in the past the user received several messages from this sender, but more recently has received fewer messages. Interested in social messages associated with the sender, the user submits a general query for "drinks". (c) shows the results. Messages matching the most recent query are highlighted in red. Combined system relevance jugdements are scaled – thus messages matching both queries are large. There are a number of small highlighted messages. Interested in the sender of one of these messages, the user again selects the author menu item. (d) shows the state of the display after this query has been applied. The display shows that this second person also used to send messages frequently, but recently they have sent only a small number of emails. Also, some of the messages that matched the previous queries are still present in the display, but these are reduced in size.

As this example demostrates, the information shown to the user during interaction can clearly influence the search process. Here, the user was "reminded" about other messages as a direct result of the way information was presented to him. We now plan to investigate how this kind of tool would be used and establish if this form of interaction is indeed benefitial to PIM.

4. EVALUATING MEMOMAIL

The difficulties involved in evaluating PIM systems are well documented [4]. As PIM systems are specifically designed to leverage a user's memory of his own content, it is personal content that should be used to evaluate these systems. This makes task creation very difficult and raises privacy issues because each task must be tailored to each individual user. To overcome these difficulties we have devised a lab-based methodology, which complements previous approaches such as [4]. Using digital diaries, 42 users recorded real-life web and email re-finding tasks as they occurred for a period of three weeks. 412 tasks were recorded and these were categorised into 3 main types: 1) searching for specific information within a resource 2) searching for a resource 3)extracting information from multiple resources. Future publications will present analyses of these data.

What this work provides is a pool of real-life tasks, tailored to individual collections that can be used to compare the performance of systems on the three categories of tasks described above. We piloted the feasibility of this approach by asking 6 of the participants to re-perform a random selection of their tasks. Over 90% of tasks were able to be completed.

Our evaluations of our web and email interfaces will have 2 main aims. First, to test the usefulness of our design principles for different kinds of information objects. Second, to learn more about what people remember about these kinds of objects and how these memories are used in re-finding. The first aim will be achieved by comparing the performance of the interfaces with respect to other traditional interfaces. HCI methods will be used in similar way to our work with photographs. To achieve the second aim we have devised a novel approach to logging and analysing user interaction with the system. Each feature of our interface corresponds to a type of memory i.e submitting a query such as "sender:John Smith" involves remembering the author of an email, mousing over an icon shows a willingness to remember more about a particular object etc. By treating each interaction with the system as a state and by calculating the probability that a user moves from one state to another, we can create a state diagram, which visually depicts the user's interaction history. Such diagrams could be created for different types of user, task, information object etc. As system interactions correlate directly with particular types of recollection, we can use these diagrams as a means to examine what and how users remember. For example, a diagram with few states and few links between states with high probabilities attached to them shows a direct, predictable recollection. On the other hand, a diagram with many states, many links between states, each with low probability shows a less predictable, more exploratory type of interaction. When combined with more typical elicitation techniques such as "think-alouds", observations, interviews etc., this represents a hugely powerful research tool.

5. CONCLUSIONS

In this paper we have outlined our position on PIM research. We believe that to faciliate improved re-access and re-use of information, tools should be designed to better support the characteristics of human memory. We have briefly described our work towards an improved understanding of the role of memory in PIM. We have also described a memory-oriented PIM interface and outlined our thoughts on evaluation techniques.

6. REFERENCES

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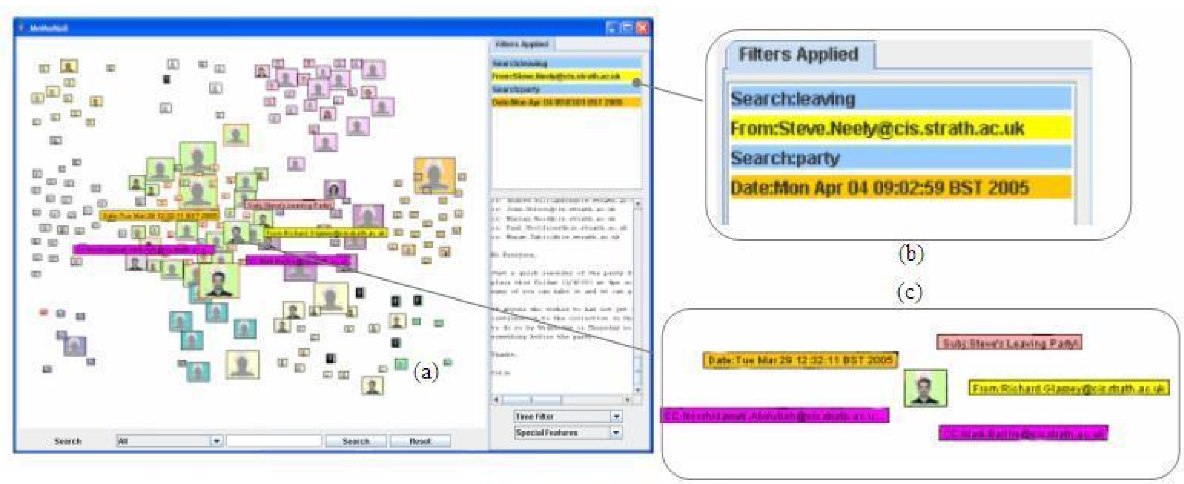

Figure 1: The MemoMail Interface

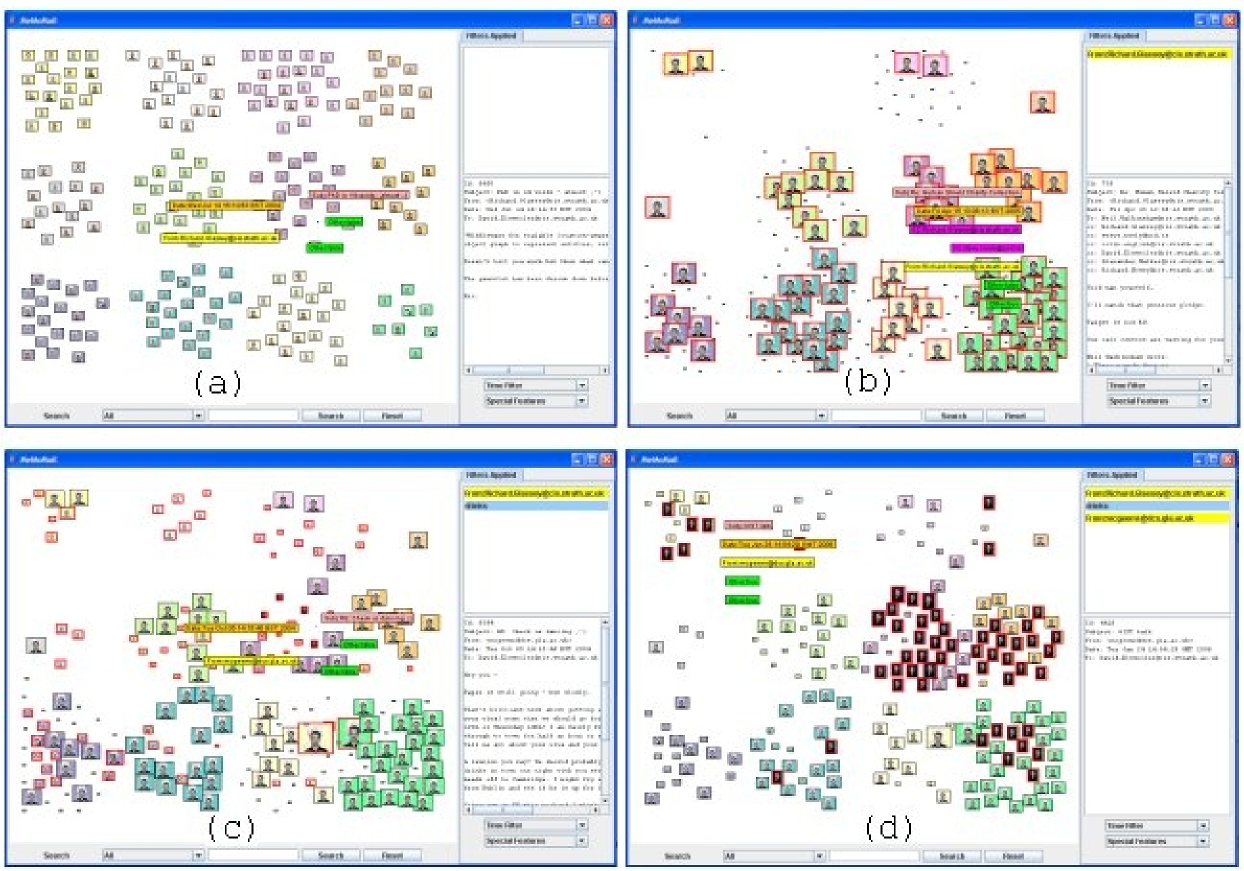

Figure 2: A MemoMail Interaction Sequence