DYNAMIC TERM WEIGHTING FOR PERSONAL PHOTO RETRIEVAL

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ABSTRACT

Personal photo retrieval is different from many search tasks in that all the targets are either known to the user, or they are about something the owner has seen. For this reason, generating queries for searching personal photos will more likely rely on an individual's memory. In a pilot study of *Personal file re-finding*, the results suggested a change of retrieval efficiency over time for different types of queries due to recall reliability. While auto-annotating of the photos with contextual information, we are seeking to develop a query weighting strategy, which takes the recall reliability into account, and give feedback to the user based on the searching queries to improve the searching efficiency.

1. INTRODUCTION

The prevalence of digital cameras (including camera mobile phones) and advances in storage devices, while enabling the recording of every memorable moment in our lives, is leading to huge amount of personal digital image data, which can be difficult for searching. Although techniques of content based retrieval for static images are becoming increasingly sophisticated, they may not suffice the needs of efficient retrieval in such large collections, due to the varied image quality and severe redundancy of content, and most importantly, that people do not always remember what the exact contents are, even of photos taken by themselves [1]. One possible solution is to do information retrieval (IR) basing on the photos' metadata (e.g. annotations) which the user can remember. The reason is that searching for personal photos can rather be viewed as information re-finding, as opposed to general information seeking in an unknown collection, like the World Wide Web. It largely depends on the individual's memory about the photos. For example, while we are looking for certain photos, we usually have some recollection of the occasion in which they were taken. In cases where no assistant retrieval tool is provided, we must reply on browsing the corresponding folders to find the required photos if the folders are labelled with time, location or event name, etc. This suggests that people may often have better memory about contextual information related to events than the details of the photos. Thus, we assume that if the photos are also annotated with contextual information that people remember well, the IR may be more efficient. In fact, some standard forms of context data are already been integrated into Personal Retrieval Systems, such as MediAssist [2]. [3] suggested that well remembered features include location (indoor/outdoor), season, year, people, weather, etc., but not the textual information in the photos.

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2. PILOT STUDIES

In our previous pilot studies [4,5], the participant recorded all her computer activities as well as corresponding contextual information such as her personal location, for a two month period, and indexed them with the Lucene search engine[6]. She generated 30 scenarios of information re-finding from her past two month's experiences. Queries of content only and content with all possible combinations of context were tested right after her data collecting period and six month later, in which her correctly recalled information were used. Both results (right after data collecting and six months later) suggested that the combination of correctly recalled context information improves searching efficiency, and the advantage was greater six months later. The recall results showed that she had better memory about perceptual information such as location, period of the day (e.g. morning, evening), weather etc., but not the textual (conceptual) information such as the hour or day. Also, her recalled contents are significantly less effective in searching, as evaluated by Lucene [5]. The drop of content-based query searching efficiency implies that the key content the user recalls may differ over time.

We assume that if the document can be annotated with what the user remembers at the time of searching, the retrieval effectiveness can be maintained. We aim to develop an algorithm, which can continuously update the status of the metadata, so that when the recalled metadata is entered as query, it can be weighted dynamically according to the estimated recall reliability as well as other traditional IR methods. Above all, annotations are required for all the photos to apply the algorithm.

3. DATA COLLECTION

Manual annotation of large volumes of photos is unrealistic. Thus, we need to do this automatically by capturing context information which can be synchronized with the photos. For example:

1) *Time and Date* can automatically be embedded into the photos when they were created.
2) *Location* can be recorded by GPS devices.
3) *Weather and light status* can be determined by combining time and location information at the time of creation [2].
4) *Emotional status* can be roughly interpreted from wearable biometric sensors such as heart rate monitor and the BodyMedia SenseWear armband.
5) Bluetooth tracking devices allow for the detection of other nearby Bluetooth devices. Thus it enables the recording of *objects or people* with Bluetooth devices (such as Mobile phones) at the time of photo taking.
6) *Content* tagging may mainly rely on third part content analysis technologies such as face detection.

4. DYNAMIC WEIGHTING SYSTEM

We propose to develop a dynamic weighting system, structuring the data partly based on a memory model, so that the recall reliability can be evaluated, with feedback to the user to generate more efficient queries.

4.1. Structuring and Weighting

Information processing theories have argued that the human memory exists in Associated Networks, that nodes of remembered information are linked to each other so that they can be retrieved tracing from the links [7]. In our model, we propose to create links from attributes to items and links between attributes or same level items. We assume that the same level links are usually created based on time proximity (belonging to the same events), but which types of attributes tends to link with each other is yet to be explored.

Instead of weighting independent nodes like the *Page rank* algorithm does, this model weights the links' strength, which estimate the likelihood of information on one end being retrieved if cued with the other end. Based on memory and learning theories, we propose to integrated several factors into an algorithm, such as time lapse from the last time the two nodes were associated, frequency of occurrence of the link, and encoding quality calculated from various factors [7]. The links' weight automatically updates (e.g. when triggered by encoding of new items).

4.3. Feedback Mechanism for Photo Searching System

The retrieval system is based on the above structure, inheriting traditional IR strategies, and implemented with a query evaluation and feedback mechanism.

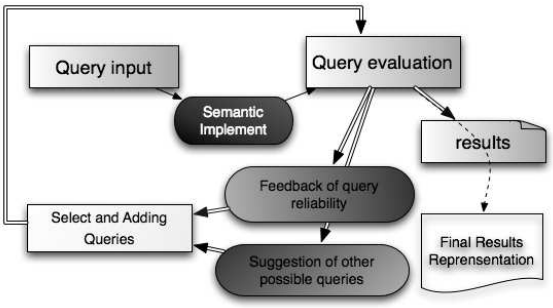

Figure1. IR system with query feedback

Simple semantic processing will be applied to the entered queries, mainly expanding query words to arrays of synonyms from the database. The *Query evaluation* step will estimate the reliability of recalled query features based on the memory model. In the first stage of our system developing, the searching interface will allow the users to judge the reliability of their recall for each query (very sure, guessed, etc.). This will also combined with traditional IR methods to provide feedbacks to the user about the queries' efficiency as well as potential possible queries or combination of queries based on the links, and leave the final decision to the user to refine their queries.

The above proposed system still needs a series of user studies which will be based on our on going data collection.

6. REFERENCES

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