行政院國家科學委員會專題研究計畫　成果報告

代理人架構之個人數位內容管理與分享

計畫類別：個別型計畫
計畫編號：NSC93-2213-E-002-087-
執行期間：93 年 08 月 01 日至 94 年 07 月 31 日
執行單位：國立臺灣大學資訊工程學系暨研究所

計畫主持人：許永真

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處理方式：本計畫可公開查詢

中　華　民　國 94 年 9 月 28 日

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代理人架構之個人數位內容管理與分享

Agent-Mediated Personal Digital Content Management and Sharing

計畫編號：NSC 93－2213－E－002－087
執行期間：93 年 8 月 1 日至 94 年 7 月 31 日

計畫主持人：許永真　國立臺灣大學資訊工程學系暨研究所
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一、中英文摘要

中文摘要
隨著數位內容的成長，如何管理並分享數位內容已成為目前一普遍的課題。其中以數位照片為例，目前照片的管理與分享所使用的方法仍十分繁瑣費時。在此計畫當中，我們提出一基於照片之上層資訊(Metadata)及使用者之社會網絡(Social Network)的多代理人系統，以期能使照片管理及分享更加容易。

關鍵字：多代理人系統、內容管理與分享、上層資訊、社會網絡

Abstract
With the growing of digital content, especially digital photos, content management and sharing across the network become a common and regular task that people are willing to do nowadays. Existing approaches to photo management and delivery are still tedious and time-consuming. This project proposes “Photo Agent”, a multi-agent system facilitating photo management and proactive photo sharing based on the metadata of photos and users’ social network.

Keywords: Multi-agent System, Content Management and Sharing, Metadata, Social Network

二、前言

The lifestyles of people nowadays have changed dramatically and unconsciously. People like to take photos anytime, anywhere, and with any situation. In 2005, digital cameras are starting to push traditional film cameras out of many markets [4] and according to InfoTrends Research Group, worldwide digital camera revenue is forecast to reach $24 billion in 2004, and grow to $31 billion in 2009. As you can see, the increasing ubiquity of digital cameras and camera phones has made possible for not only the professional manufacturers to produce mass digital photos but also ordinary people like us to create our daily personal ones. Besides, it is nature for human beings to share experience they create with their friends, and the photo is indeed popular one. However, it is tedious and time-consuming with the existing photo management system and photo sharing mechanism like e-mail and online albums. It always need too much people manipulation and interference to do photo management and sharing.

Also, a common experience we have is that people always carry their own digital camera while traveling. When we take a picture with a group of people, each camera is used to take a photograph of the same scene because everyone in the group wants to keep this picture by himself. However, we can do the same job with more smart nd timesaving way. Taking the benefit of “Photo Agent”, a photo with the same picture can be taken once and share automatically and pro-actively to people appearing in the photo.

In this project, we propose a multi-agent system named “Photo Agent” as a viable way to help photo management and sharing. The agents in the system autonomously cooperate to guarantee photo delivery efficiency, and pro-actively share photos to those we’re concerned with. With the help of “Photo Agent”, we can enjoy more fun to take photos and share them. The remainder of this report is organized as follows. We start by addressing some related works about photo sharing and social networking in Section 4. The overall “Photo Agent” architecture and implementation details are described in Section 5. Finally, this report gives a conclusion and the outlook of future research direction in Section 6.

三、研究目的

With the proliferation of digital information devices, it has become relatively easy for the average users to create digital content (e.g. documents, audio, images, video, software etc.) using the personal computers, digital cameras, audio/video

recorders, and even cell phones. As a result, there is an explosive growth of personal digital content that need to be managed and shared in some way.

The key challenge is to share and reuse personal digital content among a group of users related in some way. In the content life cycle, content are created so that they can be used productively. In a networked environment, a user should have easy access to content owned by himself and his circles of affiliates. For example, a user may want to share pictures taken at a college reunion with her classmates; a musician may want to share a new piece of melody with his friends; while a professor may want to share specific research results with his students and collaborators. It is therefore desirable to have a mechanism that facilitates such sharing while ensuring the protection of copyrights and privacy.

四、文獻探討

Extensive works has been done on issues of photo sharing and social networking. Here we will describe a few related examples.

There are many software packages, such as ACDSee [1] and Paint Shop Photo Album [8] can help people to manage digital photos and share them via emails and on-line album on the web. Many of on-line photo album web sites, such as Buzznet [2] and Flickr [5], are provided for people to upload their daily photos, manage photos and share photos by browsing the web. Also, Blogs, such as GJPix [7], forms a popular platform for sharing information on the web. People can publish their thoughts, post their photos and get feedbacks. Besides the feature of photo sharing, it also connects people while sharing photos with interests to construct social networking services. Many on-line photo albums including Buzznet and Flickr integrate with blogs and social networking functionality. On the other way, Friendster [6] and Orkut [11] are social network services which connect people together and sharing their experience including photos.

Garage Cinema Research at UC Berkeley aim to enable daily media content consumers to become daily media producers with high media capability of mobile devices today. Mobile Media Metadata (MMM) [3,10] use context-aware mobile media technology and applications that leverage contextual metadata (spatial, temporal and social) to infer photo content and support media management and automatically suggesting sharing recipients on the phone and in the web application based on sharing frequency and Bluetooth-sensed co-presence. With these technologies, it helps people manage and share photos on the constrained user interface. It indeed strengthens people’s motivation to share photos across the Internet.

Our prior work in photo sharing [9] has addressed using human-centric agents to

share photo autonomously over peer-to-peer network, so users can just specify which photos to share whom, rather than how to actually deliver photos. It gives users more time to enjoy photos with others rather than deal with the low end tasks.

五、研究方法

The architecture of our multi-agent system, “Photo Agent” is depicted as Figure. 1. The system consists of four agents, including Sharing Agent, Management Agent, Retrieval Agent and UI Agent. The agents will collaborate to accomplish the sharing task.

The UI Agent will interpret the command given by the user, and present the photos and the metadata to the user. The Management Agent will maintain the metadata of the photos, and other agents can query through it about the photos. The Sharing Agent will inform other peers of the information of the photos it want to share, and distribute the photos to the requiring peers. The Retrieve Agent will be informed of the photos which other peers want to share with it, and it have to decide which photos are desirable according to users' preferences.

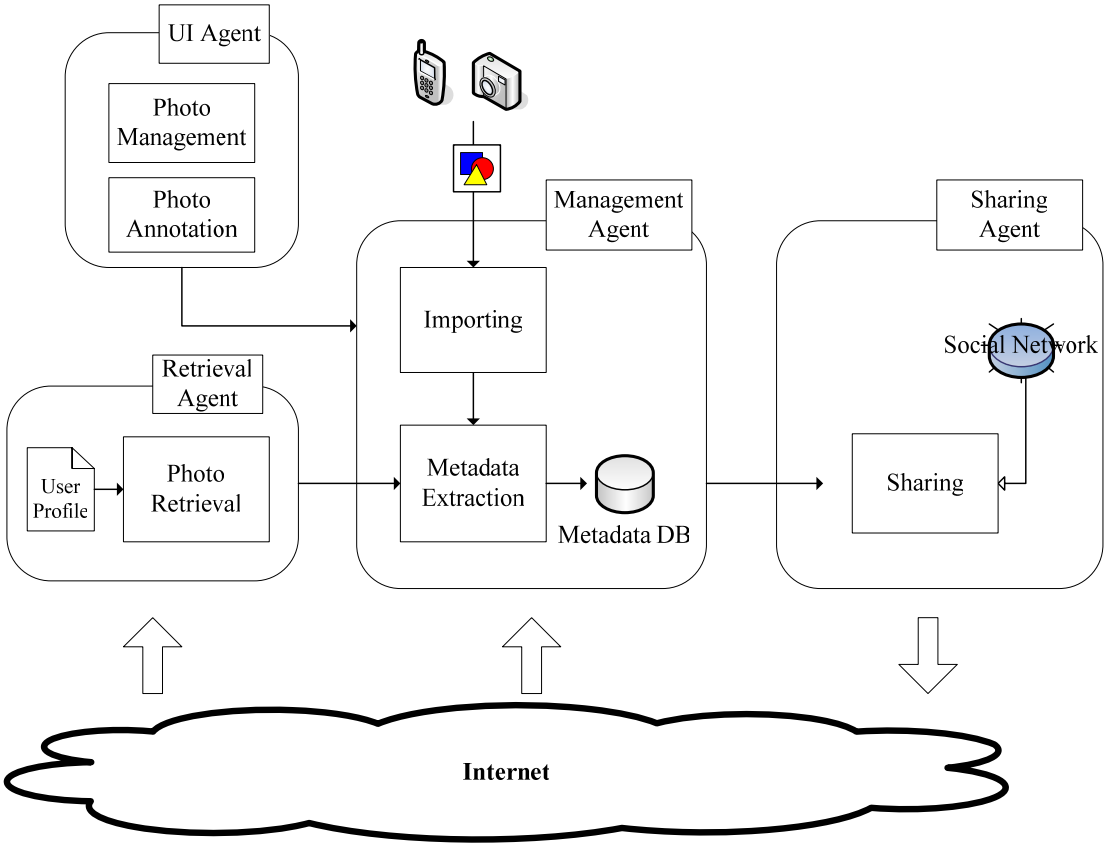

Figure. 1 System Architecture

We decide to use JADE as our development platform, which is a well developed environment with industrial and academic support for implementing multi-agent

systems (MAS). Since it is FIPA-compliant, many MAS developers have chosen this environment as a platform for their applications. Therefore, we use JADE as our implementation platform to design the Photo Agent.

Despite of its maturity, the current JADE message transportation protocols do not allow communication between agents behind firewalls and NATs. This significantly restricts the applicability of JADE, since in many cases JADE agents cannot communicate with each-other over Internet. Thus, development of Internet-based agent systems cannot be properly supported by JADE. Fortunately, the firewall/NAT issue has been solved in the current JXTA implementation.

The Photo Agent system takes advantage of user's social network. It extracts the user's social network from Microsoft MSN Messenger service first, and uses each person's e-mail as the Photo Agent system's user ID. Then the Photo Agent system utilizes the group relationship of user's MSN messenger social network to help user to share photos to related people.

UI agent is a medium for communication between user and the Photo Agent system. When a user imports some photos via the UI agent, the UI agent would notify the management agent to cope with metadata extraction and storage with regard to the photos. When the Photo Agent system receive some photos shared from other user, the UI agent would pop up a dialog box to notify the user of the incoming of new photos..

Management agent is the major agent of the Photo Agent system. It is in charge of all issues about photos' management, including metadata gathering, metadata management, and photos storage management. The metadata of a photo includes time, location, person taken in the photo, object, and event of the photo. At present, our management agent only could extract metadata about time, person taken in the photo. But with more components including in the future work, a user's calendar for instance, the management agent can extract more metadata about event, and maybe location with object. The management agent contains a face recognition component which using Intel OpenCV library to extract the metadata of people taken in the photo, and extract other useful information from JPEG file's EXIF (Exchangeable image file format), time, ISO, aperture, and camera shutter, etc. All these metadata and stored path are maintained in a database within the Photo Agent system. The management agent delivers photos' metadata to the sharing agent when these photos should be shared out, and maintains photos' metadata from retrieval agent when it had retrieved some interesting photos.

Sharing agent is in charge of photos' publishing to other peers. When a sharing agent receives a list of photos which have to be shared, it starts its publishing behavior. A sharing agent automatically decides which user to share with according to the

metadata of photos and the social network of the user. A sharing agent decides whom to publish to according to three policies: people with frequent subscription, people in the same event, and people with the same relationship group in the social network. Sharing agents analysis each photo's metadata to look for the relations between photos and people, and automatically publish to people who was related with.

Retrieval agent is responsible for handling publishing inform messages from publishing agents of other users, and automatically decides which photos to be subscribed for the user. Everyone has his own interests about some kinds of photos. Someone might want to collect photos about food, but there are some people don't like photos about food at all. The interests of the Photo Agent user are maintained in the user profile. A user profile is maintained in a XML document, and describes the category of the user's interest. The user profile can be expanded easily based on XML document's flexibility. When a retrieval agent is informed of some photos' publishing, it examines the metadata of the photos, and takes the interests of the user in the user profile into account to decide which photos should be retrieved. After completing the retrieval behavior, the retrieval agent notifies the management agent of new photos' coming.

We propose IST (Intelligent Sharing Tree) sharing algorithm which aims for two main purposes. One is to share content more efficiently and the other is to share content more reliably. Because the IST strategy should add some feedback mechanism to ensure the reliable sharing, we don't take that into consideration in the simulation. We compare IST and broadcasting algorithm, in which the source agent shares files to the target agents without others' help, and compare total sharing time while using these two algorithms. In order to simulate vividly, we construct a P2P network simulation environment with 54% of agent peers with 2M/256k download/upload bandwidth, 39% of agent peers with 1M/64k download/upload bandwidth and the rest number of agent peers have 10M/10M and 512k/64k bandwidth. The end-to-end connection, however, doesn't always run in full speed. For simulating dynamic network, we randomly assign the percentage of the agent peer's bandwidth for sharing. For each run of simulation, we randomly choose an agent as the source agent and the rest of agents as the target agents. We run 100 times of simulation in each different sharing condition and take the average total sharing time among these 100 runs.

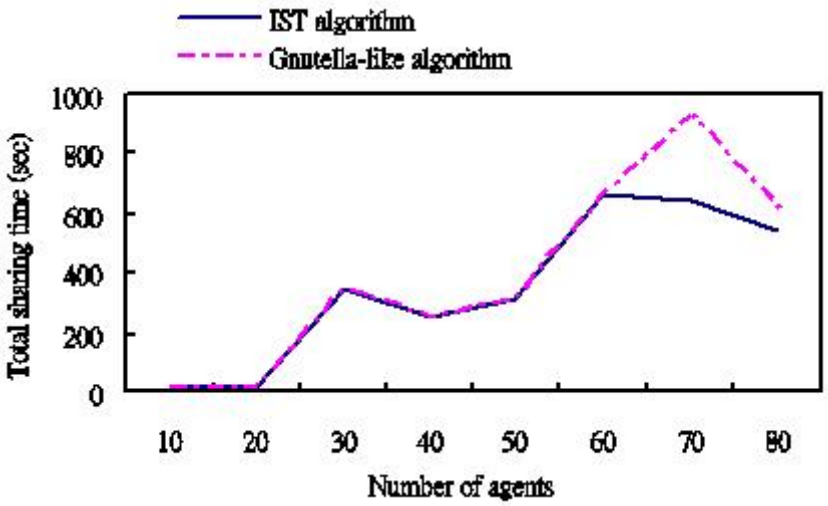

Figure. 2 Sharing with 50KB size

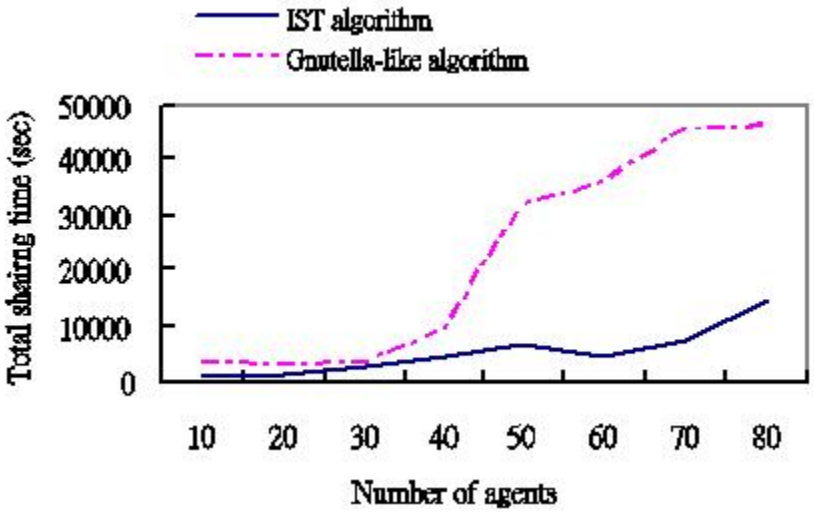

Figure. 3 Sharing with 500kB size

We simulate the sharing process with different contents size, ranging from 50 kilobytes to 50 megabytes. Also, we take the number of involving agents, ranging from 10 to 80 target agents, into consideration to show the performance of IST algorithm vs. broadcasting algorithm. The simulation results are below from Figure 2 to Figure 5. The simulation results show that time cost of broadcasting algorithm grows rapidly with intuitive geometric ratio when the number of agents increases. However, time cost of IST algorithm grows smoothly relative to the broadcasting algorithm. Comparing with these four figures, the gap of total sharing time between IST algorithm and broadcasting algorithm becomes more obvious when sharing contents become larger. That is IST algorithm indeed reduces sharing time cost with high performance while sharing in general P2P network. Although IST algorithm can have good quality to do sharing, the performance may not be revealed in some special

condition. As you can see from the Figure 2, broadcasting algorithm can even have the same time cost while sharing small contents. Besides, if all agents have bad connection quality, the sharing tree constructed by IST algorithm would be unbalance. It causes the performance of IST algorithm near to broadcasting algorithm. The IST algorithm can not only reduce the total time cost of the sharing process but also balance each involved agents' busy time.

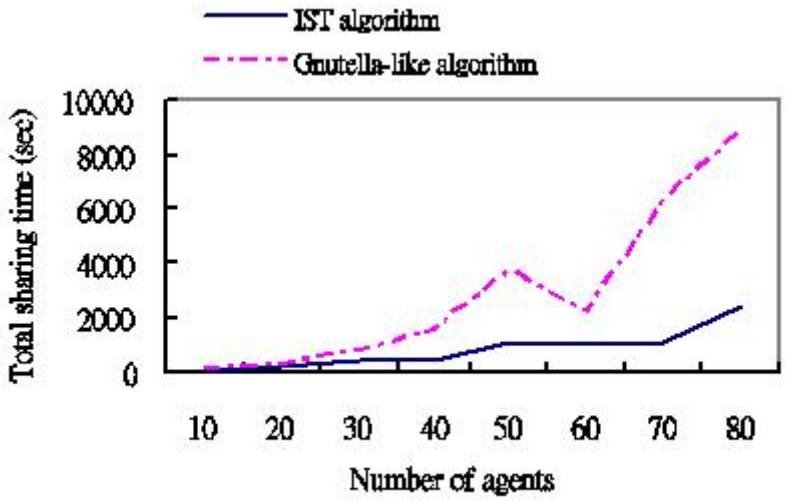

Figure. 4 Sharing with 5MB size

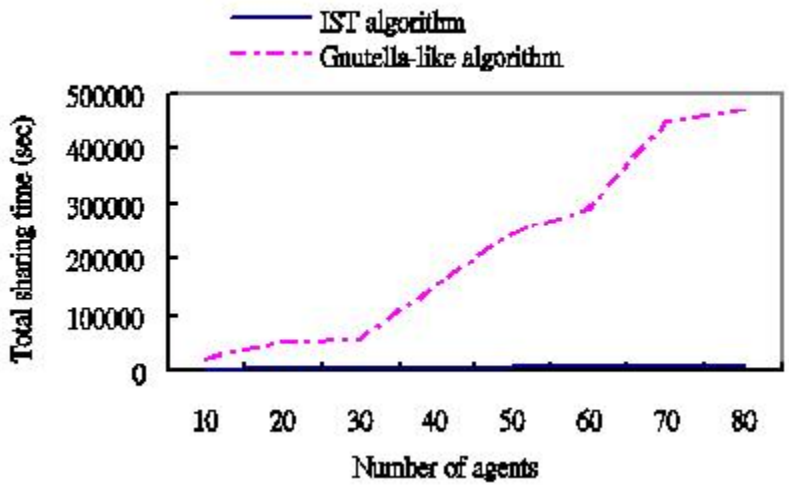

Figure. 5 Sharing with 50MB size

六、結果與討論

The proposed multi-agent system can facilitate the tasks of photo management and sharing by cooperation of the agents in the system. Based on metadata and social network, the photos pose more semantic to the user and the system in many ways.

We can expect with the advent of semantic web, there will be more applications

for this approach because more digital content will be distributed with semantics and the contained information the content can be reused across different applications.

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