

Proposal of Community-based Walking Trail Sharing Service

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With the rapid transition into an ageing society for various countries, health care services aimed for elderly people, namely elderly care, are more and more important and attract attention from governments. Since the fast-growing of the smartphones and the popularization of location-based services, nowadays, more diverse services can be provided for elderly people. In this paper, we propose a concept of community-based walking trail sharing service, which is aimed at middle- and old-aged people, to encourage them to go outside. This system lets elderly people utilize smartphone easily to acquire their favorite photos or walking information, and share the data with the server in the public place. Through our system, the users not only can share their information each other but also be able to receive suggestions or recommendations about walking trails from system server. By the recommendations, the users can find their potential friends who have same interests or hobbies, or obtain different walking trails for try. It is expected that the proposed service will make elderly people to express themselves, join more activities, and keep interact with people. As a result, the elderly people can maintain their healthy physically or mentally.

1. Introduction

According to the report of International Conference on Population and Development (ICPD) in United Nations [United Nations 2001], 'Aging of population' indicates the society is considered relatively old when the fraction of the population aged 65 and over exceeds 8-10%. Due to the medical progress, nutritional supplements sufficient, and the lower birth rates to advanced countries, they are entering the structure of aging society gradually. Aging population is the world trend. In order to raise the quality of life and the quality of community for elderly people, we can utilize information technology (IT) to provide them several services and cares, namely elderly care.

Since the diffusion of smartphones and powerful capability of its hardware, nowadays, it could plays an important role in elderly care services. For example, if an elderly person could get used to their smartphones, she/he could use them to query daily life information with wireless network, and to navigate surrounding location's information form location based service (LBS) application with GPS device. Moreover, Bluetooth device, with which smartphones are equipped, may receive data logs (like heart rates, body temperature, ECG) from health monitoring devices carried by elderly people.

This paper proposes an information sharing service for elderly people. When advanced information and communication technologies are going to apply to elderly support, keeping the motivation of going outside might be a concern. That is, elderly people can access much information and contact other people via the Internet from home, which might keep them away from going outside. Therefore, the proposed service focuses on elderly persons' habit of a walk, and let users share information about their

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walking trails. The service also utilizes local communication by Bluetooth in order to give users the motivation for going outside. Our solution lets elderly users to take their interesting photos quickly with their smartphone, and post the feeling to the photos with a designed simply step. Finally, the users may share their information by uploading their photos and feeling data to a public server with Bluetooth device of their smartphones. By not using the Internet connection but local connection, the proposed service can give users the motivation of going outside. A user can browse photos uploaded by self or others with his/her smartphone or computer, and can post his/her opinions for the photos. Not only that, this paper also proposes to analyze the users behavior automatically, and then recommend various information regarding their walking trail, which include potential friends, walking trails, time for walking, walking spots, favorite photos, and so on. We expect the elderly user not only can express comments, sharing photos each other, and raise interaction in the community, but also has willingness to try a variety of new things with the help of our recommendation service. Consequently, the elderly users will maintain their physical and mental health status in a certain degree.

In this paper, we introduce the concept of proposed information sharing service, as well as prototype system under development. First, we introduce the related works in Sec. 2. In Sec. 3, we propose our system configuration that is separated into sensing and service part. In Sec. 4, we introduce our system implementation.

2. Related Works

As an elderly person has different cognitive feature from a younger person, and are usually not familiar with information technology devices, special consideration is required when designing user interface for elderly people. Lin [Lin 2007] has in-

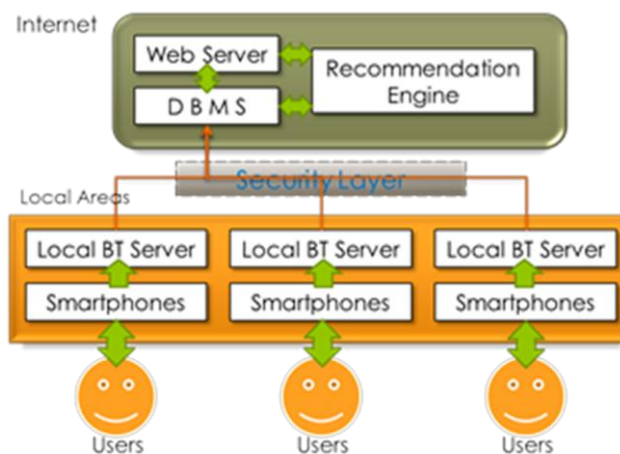


Figure 1 System configuration.

investigated how to design the user interface to suit the elderly users. Lin has indicated the web pages layout should pay attention for some conclusions, which includes: (1) the information should be displayed in a unique page and do not use scroll bar, (2) navigation bar should be fixed in one side of screen, (3) confirmation button should be located at fixed place as a static menu or float menu window, (4) simplify the operations of management tools, and zoom in that target object.

Wong [Wong 2009] has concluded eight tips to improve the usage of user interface for the elderly users on multi-touch smartphone. Hence, we followed the suggested tips to design the user interface to make clearly and simply in our smartphone application.

Recommendation is a kind of push technology, which suggests information or an item that might be interesting for a user. It is expected that recommendation service plays an important role for elderly support, as most of elderly people might have difficulty in finding required information by themselves. Su has published a comprehensive survey for collaborative filtering techniques [Su 2009]. Among various recommendation algorithms, the memory-based algorithm is more easy to implement, and has sufficient performance. Recommendation part of the proposed service employs the memory-based algorithm, which is described in 3.2.

3. Community-based Walking Trail Sharing Service

In order to encourage elderly people to go outside more often, we propose a service that focuses on local residents sharing information instantly. Figure 1 shows the system configuration of the proposed service. A local server will be set on a public site where many people gather, such as a train, bus station or a park. When users want to share their photos or ideas, they will need to walk to near the local server, and then upload their data to the server through the Bluetooth device of their smartphone. After the local server processes the received data, it will transmit the data into a database server via the Internet. Therefore, the users can browse the information shared by themselves and the others, and acquire several recommendations which will be described in

Sec. 2.3. In order for the proposed system to let users share their photos and feelings, and to provide them with several recommendation services, the proposed system is designed to induce the users to take photos which can show their personality, and then go to near the local server to upload their sharing information.

The system can be divided into the sensing part and the service part. Usually, an application on any smart phone takes care of the sensing part, which provides functions such as taking photos, completing instant text description of the photos, recording the EXIF information of photos, and uploading data through any Bluetooth device. The service part, on the other hand, is responsible for receiving and storing data uploaded by users. The recommendation engine in the service part processes data and provides different suggestions for different users. In addition, the service part needs to provide web pages of elderly-friendly design, which is easy for elder people to use and browse.

3.1 Sensing part

In order for users to upload data through the Bluetooth device of a smartphone, a set of session command is required. A set of session command allows the Bluetooth client and the server to exchange data through compatible communication. Table 1 is a list of session command we created.

On the other hand, in order for users to quickly describe the photos after taking them, we need to provide a set of item category, from each of which a user selects an item appropriate for describing the photo. The selected items are also utilized for recommendation, which is described in Sec. 3.2. We attempted to locate a set of commonly-used adjectives, which are used by users to describe their ideas about the photos they have taken. However, simply for describing colors, there have been more than 20 adjectives [Huang 2006] [Gao 2002], and it is difficult to show so many items on small display of a smartphone. Therefore, we apply the tagging system approach [Wu 2009] to let a user describe his/her photos with a few tag options provided in our application. Furthermore, a user can complement a description freely for the photo with an extra field in our application, if the user wants to express more feeling for the photo.

Generally, the tags of tagging system can be classified into several categories:

- Who/When/Where/What
- Description for subject or background
- Camera Information
- Community
- Albums
- Personal category
- Evaluation
- Feeling
- Association of ideas

According to our system functionality requirement, we eliminated some tag categories in order to provide more elegant select options for users to describe photos. The eliminated categories and its reason are shown in Table 2.

In addition, when a user takes a photo, EXIF information are automatically embedded, which includes the data of *When* (shooting date/time), *Where* (GPS information) and *Camera Information* as tag categories. Hence, a user does not have to fill

Table 1 The list of session command

Command	Send from	Parameter	Meaning
HI	Both	N/A	Test the socket session
LOGIN	Client	Username, password	Login to get permission
BYE	Both	N/A	Notify to disconnect
FILE	Client	SIZE, BEGIN	Transfer an image file. Must set size then do BEGIN so.
GPS	Client	Date time, Location	Send the GPS data for last transferred image.
OK	Server	N/A	Command received.
FAIL	Server	N/A	File transfer failed.
DONE	Server	N/A	File transfer successfully.

Table 2 Eliminated categories

Tag category	Reason
Community	We don't consider community function so far.
Albums, and Personal category	Just for personal collection, and irrelevant for sharing purpose.
Evaluation	We design rate function separately.
Association of ideas	It is for personal experience, same as Feeling category.

Table 3 Employed categories

Question	Sub Categories	Options
Is anybody in this photo?	N/A	None, Me, My Family, My relatives, My friends, Others
What kind of this photo (if without people in)?	Natural	Landscape, Animal, Plant
	Artificial	Building, Vehicles, 3C, products, Appliances, Others
	Human life or activity	Party/Meet, Foods, Show/Play, Daily Life

such data manually. On the other hand, the categories of *Description for subject or background* and *Feeling* cannot be designed as options for selection, since the contents of those categories are too widely to summarize. Therefore, the proposed system lets a user to write comments if he/she wants to describe such information.

As a result, for the function of rapid tagging to the taken photos, we only care about *Who* and *What* categories. Table 3 shows the tag categories employed in the paper.

3.2 Service part

In service part, the most important thing is what kind of information the service can recommend, and how to calculate them.

Our recommendation system applies the item-based collaborative filter [Linden 2003], which is one of memory-based collaborative filter techniques. The advantages of item-based collaborative filter are that it is easy to implement, easy to add new data, and easy to extend new items well with rated items. The item-based collaborative filter also has some shortcomings, like it depends on human ratings, performance decrease when data are sparse, cold start problem, and limited scalability for large datasets. Our system can avoid the most of them, since data are shared by only local residents. Regarding the rating for each item (photo), it is supposed that a user would upload only the photos in which they are interested.

When the recommendation service needs to provide a recommendation for a user, the weight w reflecting the similarity between users is calculated by Pearson correlation [Resnick 1994], which is shown in equation (1):

$$W_{u,v} = \frac{\sum_{i \in I} (r_{u,i} - \bar{r}_u)(r_{v,i} - \bar{r}_v)}{\sqrt{\sum_{i \in I} (r_{u,i} - \bar{r}_u)^2} \sqrt{\sum_{i \in I} (r_{v,i} - \bar{r}_v)^2}} \quad (1)$$

Where u, v are users of the system, I is the set of items to be recommended, r is rating score, and \bar{r} is the average rating score.

In this paper, an item corresponds to a tag attached to photos, and r for a tag is estimated with its ratio of being attached among all tags. The prediction value for a target user a on item i is calculated by equation (2).

$$P_{a,i} = \bar{r}_a + \frac{\sum_{u \in U} (r_{u,i} - \bar{r}_u) \cdot W_{a,u}}{\sum_{u \in U} |W_{a,u}|} \quad (2)$$

Let us consider the case where a user uploaded 17 photos to the server, and the number of attached tags are: Plant x2, Building x3, 3C products x1, Foods x5, Daily Life x6. Then our system rates the user's interest as: Plant 11.76%, Building 17.65%, 3C products 5.88%, Foods 29.41%, Life 35.29%. Based on this, the system can recommend the friends who have similar ratio of tags attached.

When the time for walking is to be recommended, shooting time of photos are divided into several bins like '8:00am - 9:00am', '1:00pm - 2:00pm', '7:00pm - 8:00pm' and so on. The recommendation is performed in the similar ways as friend recommendation.

4. System implementation

This section describes a prototype system which is under construction.

We develop our smartphone application on the Android platform smartphone. The local Bluetooth server is developed with J2SE SDK and Bluecove library. About the data storage, we currently employ MySQL to build our database server. The web service is developed with JavaServer Pages (JSP) in server side.

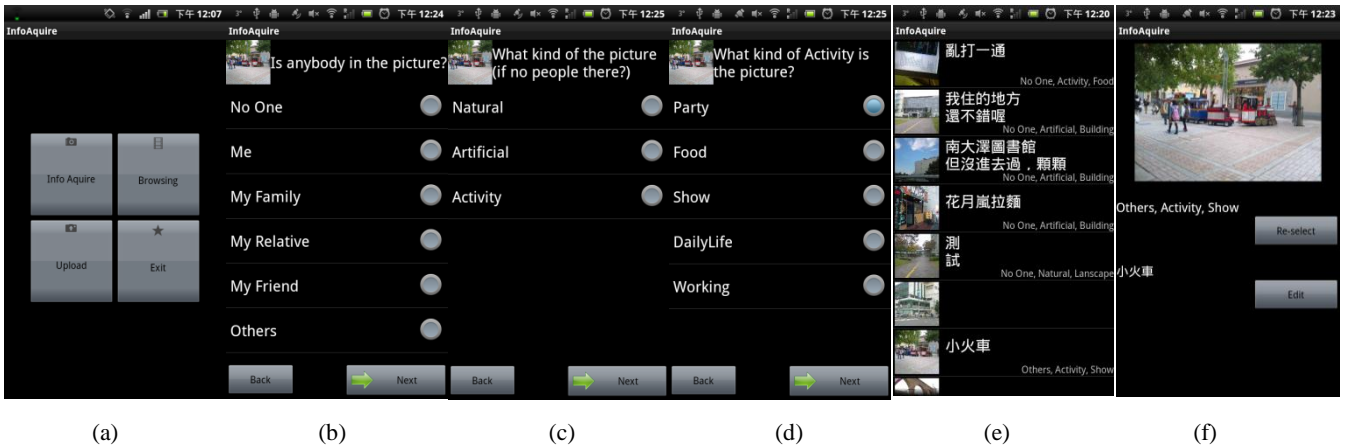


Figure 2 The system application on Android device

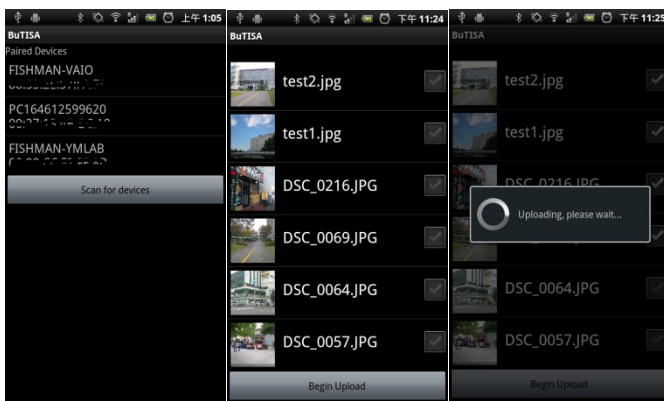


Figure 3 The uploading function



Figure 4 The web service of system

Therefore, we can develop our recommendation service more efficiently with JSP and Servlet by its characteristics. In order to let users browse the photos more conveniently, our system render photo data on the Google Maps. We apply Google Maps API v3 to implement the function. The Google Maps API not only can show photos on the map, but also can calculate the walking path and the nearby spots information. As the result, we don't need to construct the extra map data or point of interest (POI) data server.

4.1 Transmit data with Bluetooth devices

In Java platform, to utilize Bluetooth device for data transmission, a developer needs to follow the JSR-82 specification [JSR-82]. For Server side, first it needs to gain the control object of Bluetooth device, and then connect to Serial Port Profile (SPP) to wait the client connect in. For client side, after gaining the control object of Bluetooth device, the client needs to use the method of Service Discovery Profile (SDP) to broadcast nearby Bluetooth devices to return its information. The client may select one of the Bluetooth devices to query what the services are provided. If the device responds to the services which include SPP service, then the client can connect to the device, and construct a socket channel to exchange data.

However, the Android framework does not implement the Bluetooth APIs following JSR-82 specification. Hence, we need to generate a UUID code, and register it to our upload service of the Bluetooth server. Also, the Android client registers the UUID

code instead of the SPP UUID in JSR-82. Thus, the client can skip to query the services of the server and connect directly into our Bluetooth server. Therefore, our server and client are able to work with the session commands shown in Table 1.

In order to skip the Bluetooth pairing operation, which happens before building a connection and may confuse novice users, we apply the insecure (non-encrypt) method to request the connection. Because the Android platform supports the insecure connection of Bluetooth device at least version 2.3.3, our developed application requires the Android smartphone of version 2.3.3 or later. Fortunately, the population of the devices of Android version 2.3.3, which is codenamed Gingerbread, in all of the Android devices has more than 60% [Android 2012]. The requirement of our application almost does not affect to our users.

4.2 UI design for elderly people

In order to make an elderly user use our application more intuitive, we simplified the usage complexity of the application user interface. The application reduces the need of scrolling the screen, provides step-by-step functions, and fixes the operation button at bottom of screen as possible.

In the main menu (Fig. 2-a), we only layout the functionality button of the camera, browse photo, upload, and exit. After a user takes a photo with the camera function, the user will be asked for selecting some tags for the photo (Fig. 2-b, 2-c, 2-d). In the browsing function, it shows the thumbnails of all photos and

tag contents (Fig. 2-e). This function also can show a photo in detail page when the user clicks one of the list items, and allows the user to modify and remove data (Fig. 2-f). Finally, the function of upload can enable the Bluetooth device and search for the server. After login with the Android device id, the application will confirm the user of uploading photos which have not yet shared. Then the user is able to upload data by only clicking the upload button (Fig. 3).

4.3 Applying Google Maps API

To provide the web service for users, we apply the Google Maps API to implement several functions, which are: display photos on the map, query interesting spots, and render the walk path with photos. We can feed the GPS value of photos into the Google Maps, and request to compute the moving path. Because Google Maps only accepts only 9 waypoints to compute the moving path, when feeding GPS values more than 9, we need to separate the values many times to let Google Maps compute, and combine all result in a one map screen (Fig. 4).

5. Conclusions

This paper introduces the concept of community-based walking trail sharing service as well as the prototype system. The system is under development, and current main focus is on the implementation of recommendation part. Parts already implemented should also be improved. In particular, the interface design of the webpage service requires further improvement. The function of the user feedback mechanism also needs to be completed. In addition, we will try to present the results of the system recommendation on the smartphone in a user-friendly way, and help users acquire information conveniently.

In this paper, we combined the client-server system architecture, smartphone, Bluetooth transmission, and recommendation system to provide a well-functioned elderly care service system. Our system will enable users to walk out in open air to take pictures, share their information with people, and acquire all kinds of activities and information of their preference through customized recommendation. All these functions will help achieve the goals of participating in outdoor activities and social networking, and thus bring them a balanced mental and physical health.

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