

Personalized Advertisement Recommendation System based on user profile in the Smart Phone

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Abstract— In this paper, we proposed the personalized service using user's profile in the smart phone environment. The wallet app in the smart phone gathers personal information, and generates the user profile, privacy is guaranteed. The server uses this profile and environment information to recommend personalized services. And using the feedback of user selection, the user's satisfaction rated could be improved.

Keywords—Personalization, Recommendation, Privacy, Mobile Wallet, Mobile Environment,

I. INTRODUCTION

We proposed the user profile based recommendation system in the smart phone environment. Currently widely used personalization technologies are content-based and collaborative filtering. They are mainly the server-based. They store the user's history, analyse the user's behaviour patterns, find the neighbours who has similar patterns and then recommend the customized services.

However, recent events in the server's user information leakage are causing a lot of privacy issues. In this paper, the server does not store personal information and only using the profile the user transmit to provide a personalized service

II. ENVIRONMENT

Personalization service is to provide tailored services to individuals based on knowledge about their preferences[1, 3, 4]. Personalization service could be classified into server based and client based.

A. Server based Personalization

This paper uses a user-based recommendation approach, but existing recommendation system is primarily a server-based recommendation. Server-based recommendations have recorded user's history and use this information to recommend

services. The recommendation system predicts the rating of the service that the user has not been provided based on the service ratings of other users with similar preferences, who are commonly referred to as 'neighbors'[2]. This is called collaborative filtering. Collaborative filtering has shown good results, but user's history must be accumulated on the server.

Recently the personal information in the large portal sites and financial companies was exposed to outside and was abused. The most obvious way to solve the problem is to not store personal information on the server.

B. Client based Personalization

Client based method uses the preference provided by user to recommend customized services. The server has kept contextual information about services. These are to represent information of any attribute whether user like the service.

By comparing the user preference received from the client with context information of the service, the server finds well-matched services to provide to the user.

The disadvantage of the client based approach is that recommendation is not easy to satisfy the user even if it finds the well-matched services.

Contextual information of the server represents what natures to be associated with the service. The information is only prediction of the service provider. And although the user directly represents own age, gender, preference, these information could not accurately represent the user's own interest.

To overcome these problems, we used the feedback of user selection. Feedback information is used to correct the user's preference and server's

contextual information. Then the use of feedback can improve the user satisfaction rate.

C. Smart Wallet

Prior to this paper, we have developed the smart wallet that manages the user information and provides various services in smart phone. In smart wallet, the user's age, address, gender, credit card, certificate and etc. are managed. And it provides payment service to make convenient payments and easy authentication service. Related to this paper, smart wallet has collected the location information, receipts, etc.

III. RECOMMENDATION SYSTEM

The proposed specific objective is to increase the hit rate of the advertisement that appeared in the free application. These ads in free apps have not attracted the attention of users because these are not associated with the user.

This study of the system environment is shown in figure 1.

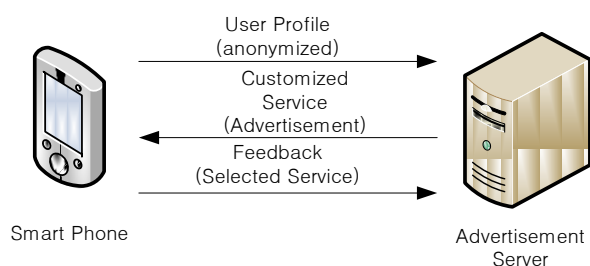


Figure 1. System Environment

The smart phone collects the user information, creates the user profile and sends it to the advertisement server. The server selects targeted

advertisements using the user profile, ad context and environment information, and sends ads to the smart phone. The user select the ad on the smart phone, this information is passed to the server. The server improves its knowledge information using feedback. Figure 2 shows the internal structure of the system.

A. User Profile

The smart wallet collects the user information which is consist of location information, payment result and frequently used apps in smart phone.

The location information is gathered under user permission. How to record data is based on the place not the time. This does not mean where the user was at which time. This means how long have the user been in a place. Moving information between places is not saved. By doing so, users favourite places, the most long-stay places such information could be generated.

The payment information is collected from the mobile receipt. And frequently used stores, favourite item and purchasing power are extracted from the payment information.

The used app information is recorded whenever the user uses the app. From this information, frequently used apps and long-time used apps are extracted.

The collect information, which is Location information, payment information, frequently used app and etc, is just data. However, processing it, the user's behavior pattern and nature information can be extracted. *Distiller* in figure 2 is responsible for this process.

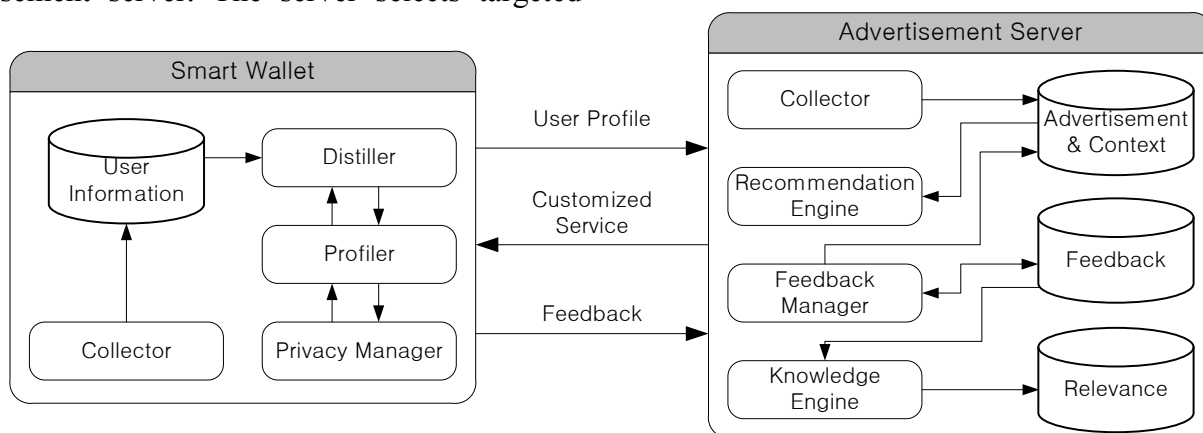


Figure 2. Smart wallet and advertisement server

Profiler generates the user profile, which consists of static information (age, gender, address), dynamic information (frequently used stores, favorite items) from distiller and current location from GPS or Wi-Fi. In this study, the user profile used in advertising service is shown in table 1.

TABLE 1. PROFILE FOR ADVERTISEMENT SERVICE

Name	Description
Preference	User preference
Age	Age
Sex	Sex
Job	Job
CurrLoc	Current location
FavLoc	Favourite location
ConsLoc	Consumption location
FavStore	Favourite store
FavItem	Favourite item
App	Frequently use application

B. Recommendation Algorithm

Recommendation algorithm uses the user profile P , ad context C and environment information E .

Advertisement information A includes advertisement information itself, *ad info*, and contextual information C . And the contextual information c consists of $c_1, c_2, \dots, c_{n+m}$, for example age, sex, job, preference and etc.

Profile P consists $p_1, p_2, \dots, p_n$. The n is the number of the profile entry. Environment E consists $e_1, e_2, \dots, e_m$. The m is the number of the environment information entry. And W represents the weight values of each entry of contextual information.

$$A = \text{ad info} + C$$

$$C = \{c_1, c_2, \dots, c_n, c_{n+1}, \dots, c_{n+m}\}$$

$$P = \{p_1, p_2, \dots, p_n\}$$

$$E = \{e_1, e_2, \dots, e_m\}$$

$$W = \{w_1, w_2, \dots, w_m\}$$

Matching function is shown below.

$$\text{Matching}(x, y) : \text{if}(x == y) \text{ result} = 1 \\ \text{else result} = 2$$

Calculation of recommendation about ad i is shown below.

$$\text{Recommend}(A_i, W, P, E) = \sum_{i=1}^n (\omega_i \times \text{Matching}(c_i, p_i)) \\ + \sum_{i=1}^m (\omega_{n+i} \times \text{Matching}(c_{n+i}, e_i))$$

Recommend function is the sum of the values that results of *matching* function multiplied by the weight value of each entry.

C. Recommendation System

Examples system of recommendation algorithm was implemented as follows.

Ad server received the user profile from the client. The server selects the ads that matched by the user profile and the ads contextual information.

When the ads are input to the server, the contextual information is also input. The contextual information is predictive value, represent whether the user like the ads, from the ads owner.

Contextual information is shown in table 2. The feedback column of table 2 indicates which fields are updated, when the server receives the feedback information

TABLE 2. ADVERTISEMENT CONTEXT

Name	Description	Feedback
AdID	Ad identifier	
AdName	Name of Ad	
AdLink	Web page link for user selection	
AdType	Type of ad (Brand ad, Retail ad, Item ad)	
AdPriority	Priority of d	
StoreType	Type of retail ad	
Preference	Preference related to ad	O
Age	Age related to ad	O
Sex	Sex related to ad	O
Job	Job related to ad	O
Location	Location related to ad	O
Weather	Weather related to ad	O
Time	Time related to ad	O
Month	Month related to ad	O
Week	Week related to ad	O
Anniversary	Anniversary related to ad	O

Recommendation algorithm finds well-matched ads by using the user profile, contextual information, and the environment information (weather, time, month, and week).

In this study, ad type was classified as brand ad, retail ad and item ad. On the type of ad,

comparative entry and each weight values are different.

The weight values used in recommendation was generated by using geometric means.

For example, in brand ad matching, 5 criteria are used. Table 3 shows weight values of each entry in brand ad. Consistency index is 0.0829.

TABLE 3. WEIGHT FOR MATCHING BRAND ADVERTISEMENT

	Pref-Each	Pref-Group	Age	Sex	Anniv ersary	GM	Weight value
Pref-Each	1.00	5.00	5.00	7.00	5.00	3.8761	0.5589
Pref-Group	0.20	1.00	1.00	3.00	1.00	0.9028	0.1301
Age	0.20	1.00	1.00	3.00	1.00	0.9028	0.1301
Sex	0.14	0.33	0.33	1.00	0.33	0.3505	0.0505
Anniv ersary	0.20	1.00	1.00	3.00	1.00	0.9028	0.1301

D. Feedback

Feedback information is the only way whether the user likes the ads recommended by the server.

Recommendation function uses the user profile and ad contextual information. Recommendation algorithm is important, but it may be more important that the content of these data is correct. Using feedback information, user profile and contextual information could be improved.

For example, although the real age of the user is 40, his tastes may be the younger. And the ad owner expects that the sporting people like this ad, but this ad is popular among car enthusiasts.

Feedback information is processed in the client and the server. In the client, when the user clicks the ad, the contextual information about selected ad is stored in the feedback table. And the wallet periodically analyses the feedback table, then the user's favourite ad of preferred age, preferred

occupation and gender is obtained. Using this information the wallet updates the table 1.

When ad information selected by the user is transmitted to the server, the user profile is also transmitted. The ad identifier and user profile of selected ad are stored in the feedback table of the server. Then the periodic analysis being processed, table 2 that contains contextual information is updated.

The feedback information is accumulated to the server, the server could utilize the feedback more than the initial contextual information.

$$Recommend = (1 - \alpha) \cdot Original + \alpha \cdot Feedback \quad (0 < \alpha < 1)$$

The α is the weight value of feedback. More feedback information is collected, the more α is increased.

IV. CONCLUSIONS

We have described the user profile-based recommendation system. The recommendation algorithm on the server uses user's profile, environment information and service contextual information to recommend services. And feedback information is used to improve the satisfaction rate.

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