PerAd-Service: A Middleware Service for Pervasive Advertisement in M-Business
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Abstract
In this paper, primarily, we delineate the numerous challenges that can arise in mobile-business (m-business) to provide the highest degree of proliferation of pervasive advertisement. Later, we demonstrate the feasibility of PerAd-Service, an integral part of MARKS (Middleware Adaptability for Knowledge Usability, Resource Discovery, and Self-healing) to address those challenges.

1. Introduction
The rapid expansion of ubiquitous/pervasive market (255 billion USD to 791 billion USD within next 5 years) [1] makes it obvious that pervasive advertisement is going to play a very imperative role in near future. It will provide even better advertisement platform than effective online advertising [2, 3]. Here, three types of people are closely related: users, advertisers, and ad-providers. The users are those targeted people to whom the advertisements (ads) should be reached. The advertisers want to exhibit their product’s ad to the users through the ad-providers. The ad-providers are responsible for making ad, doing all arrangements for keeping and displaying all the necessary ads etc. By doing so, they expect money from the advertiser. To have the full-fledge benefit of pervasive advertisement, it requires the solution of all the following challenges:

1.1 Challenges from the user’s view
No payment for viewing the ad: In case of online ad, although viewing the ad costs nothing, but users need to pay to Internet or cell-phone companies during registration. How is it possible to make the pervasive ad absolutely free for users?
Privacy and Security: The user’s privacy and security should not be breached. User’s preferences, if needed, should be kept in user’s own device, not in any company. How can it be achieved?
Ubiquitous access: The ad should be accessible from anywhere at anytime according to user’s will.
Follow up the ad [2]: How will the user response regarding to an ad? How will the wireless connection be used for communication?
Ad viewing time: When the user will view the ad? Just after choosing the ad? At free time? In that case, how should the references of the ad be kept? Who will keep that?

1.2 Challenges from the advertiser’s view
Reach to the right people with right ad at right time in the best way [2]: How is it possible to choose the right people for a specific ad or to choose the perfect ad for a specific person? Is it really possible to determine the right time for each and every person? Bombarded by sudden ad in mobile devices, in most cases, makes the users annoyed [4]. Hence serendipitous advertising [2], the advertising which seems not to be important for the users, but may make them interested about that, is not effective way to reach people. Hence, which is the best way for that purpose?

1.3 Challenges from the ad-provider’s view
Use of existing resources: Is it possible to incorporate the ads in their existing infrastructure to make the process very cost-effective?
Collection of ad revenue [2]: How will the ad-provider collect the ad revenue from the advertisers?

2. PerAd-Service: Our Approach to Address the Challenges
We have developed the first prototype of MARKS [5] to use in mobile devices including Pocket PCs, Palm devices etc. Currently, we are working on PerAd-Service of MARKS, which can be deployed to solve most of the challenges mentioned above. To maintain the security issues, we are building a trust model.

2.1 Proposed Architecture of Pervasive Ad
Unlike [2], to make all the advertisements worthwhile, here we assume that the advertisements will exhibit only in mobile devices; not in another places like wall, walkway etc. The ad-providers will store all the ads of the advertisers inside the ad-keeper, which might be any suitable existing devices like vending machines. PerAd-Service will serve the functionality of the middleware for both user’s devices (let, PerAd-Service_u) and ad-keepers (let, PerAd-Service_a), which will provide the communication among those devices. To make each ad unique, it should have unique ID (like C10109), which consists...
of advertiser’s ID (here, C1) and the ad ID (e.g. 0109).

2.1 Solution of the User’s Challenges

PerAd-Service will use the functionality of Knowledge Usability (KU) [5], a fundamental part of MARKS. Like the user’s proxy, KU keeps the user’s preferences provided by them during the installation of MARKS. Figure 1 shows the overall structure of MARKS along with PerAd-Service.

In pervasive ad, the users do not need to register, hence do not need to pay anyone. Due to having proper knowledge of user’s preference, the KU of PerAd-Service, will communicate with the PerAd-Service, and will keep all the ad-IDs (according to the user’s preference) along with necessary information like contact numbers, web addresses etc. Unlike [2], since the users do not need to store their information to add-keeper or any other devices, privacy of the users is automatically preserved here.

The KU maintains the schedule and the to-do list of the user. After consulting with the KU, the PerAd-service determines the user’s best time to display the ad in his mobile device, though the user can see those anywhere at anytime. The user can follow up the ad according to the information stored by PerAd-Service.

In case of instant follow up, PerAd-Service, will communicate to the corresponding advertiser. As security is susceptible to breaches during communication, to achieve the required degree of security, the GETS Self-healing, another significant part of MARKS, is exploited in our design.

2.2 Solution of the Advertiser’s Challenges

As the user’s guide, the KU of the PerAd-Service, assists the advertiser to choose the right people and the suitable ad. The advertiser does not need to think about the perfect time and the best way to display the ad since these two variables would be handled by PerAd-Service, of the user’s device itself.

2.3 Solution of the Ad Provider’s Challenges

To collect the revenue (Rev), PerAd-Service, will keep track of all the ads (let, N1, N2,.. Nr), whose ID are collected by the KU. So,

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Rev = \sum_{i=1}^{r} N_i * W_i * R_i
\]

Where N, W (Weighting factor), and R (Expense Rate of an ad) are prefixed by the ad-provider and the advertiser.

3. Prototype Implementation and Conclusions

We are at the edge of the first prototype of Per-Ad service of MARKS using Microsoft’s C# and .NET Compact Framework. Figure 2 describes how the PerAd-service shows the user all the stored ads at his available time. Here, the user chooses “Basketball Ticket Sale” option to see its details.

In this paper, we have described how MARKS can be utilized in pervasive advertisement, a very potential area in pervasive computing. In near future, after finishing the development of PerAd-Service, this entire system would be evaluated in real world situations.

References