

Measuring Supportiveness of the Internet and Mobile Platforms for Personalized Ad

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Abstract. With Internet advertising revenue ever increasing, mobile advertising revenue is rapidly growing as well. One of the main characteristics of the Internet and mobile advertising is that they can deliver personalized advertisements to each user. However, the notion of personalized ad method is not a single concept, and the required information for personalization depends upon the type of service platform. So some personalized ad method matches with a certain service platform better than the others. To characterize the mapping between personalized ad methods and service platform, this research measures the supportiveness of typical Internet and mobile platforms for the seven types of personalized ad methods. For the measurement, a constraint satisfaction problem (CSP) approach is adopted to assess the degree of the match between the personalized ad methods and platforms via the required information that are necessary to create the personalized ads. The results of this research help web publishers assess their potential to deliver specific personalized ad methods.

Keywords: personalized ad, the Internet and mobile platforms, supportiveness, Constraint Satisfaction Problem.

1 Introduction

Web publishers such as search engine and SNS freely provide their contents while earning revenues through advertisements [13]. The Internet advertising revenues in the United States have reached \$17 billion in the first half of 2012 [14], an amount more than five times the \$2.98 billion that was reached in the first half of 2002. It has been forecasted that the increase will continue and will eventually surpass the TV advertisement revenue by 2017 [30]. Along with the expansion of Internet advertising, mobile advertising revenue is rapidly rising with the diffusion of smart phones. Mobile advertising revenue in the United States has reached \$1.45 billion in 2011 and has been forecasted to reach \$6.62 billion in 2014 [7]. This proliferation of the Internet and mobile ad market has led web publishers such as Google and Facebook to provide new ad methods on the Internet and mobile platforms to garner more profit [22]. Also, location-based ads are growing in the mobile platform and

expected to become another main source of ad revenue [24, 26]. One of the main characteristics of the Internet and mobile ads is that they can deliver personalized ads tailored to each user by utilizing his/her personalized information. Personalized information lets web publishers generate more relevant ads to users' contexts and interests, boosting the Internet and mobile ads effectiveness. It has been shown that the effectiveness of the Internet banner ads fall 65% when personalized information is not used compared to when it is used [9]. Personalized ads elicit more satisfaction from the users than non-personalized ads [31]. To facilitate the adoption of personalized ads suitable for the characteristics of the Internet and mobile service platforms, this research investigates the match between the personalized ad methods and the Internet and mobile service platforms.

Authors' previous research classified personalized ad methods depending upon the information each ad method utilizes [15]. The personalized ad methods are classified into three basic ad methods (Activity based ad, Individual based ad, and Location based ad) and four composite ones. Specific personalized information is required to deliver a certain personalized ad method. This research measures the supportiveness of each service platform for each personalized ad method by matching the required information of a personalized ad method and the supporting information provided via a service platform. For the measurement, a Constraint Satisfaction Problem (CSP) approach [17, 20] is adopted to assess the degree of the match between the personalized ad methods and the Internet and mobile service platforms. We have demonstrated the supportiveness with four typical platforms (search portal, e-shop, SNS, and mobile banking). The outcome of this research will help web publishers to assess their potential to deliver specific personalized ad methods.

This article is organized as follows. In section 2, we introduce the classification of personalized ad methods depending upon the necessary personalized information. In section 3, we define the measure of supportiveness of each service platform in creating each personalized ad method. The approach is demonstrated with example cases. The article concludes with discussion and implications.

2 Classification of Personalized Ads

The Internet and mobile ads are classified based on several standards including ad format, ad type, and ad feature [25]. For example, Internet ads are often classified as banner ads, sponsorships, interstitials, rich media, keyword search, 3-D visualization, and advergame [18]. Also, mobile advertisements have been classified into short message ads, mobile video ads, and location-based ads [29]. Nowadays, mobile games are becoming as important as another type of mobile ads [16, 27]. Different from these approaches, we classified personalized ads based on the required information they use. Since the earlier version is published in Korean language [15], we describe them here in English.

2.1 Classification of Personalized Ad Methods

Personalized information is essential to provide personalized advertisements. In the area of context-aware computing, there have been various attempts to utilize users'

information for enhanced computing experiences (e.g., [1]). In this context, Dey and Abowd [3] have defined the context as “any information that can be used to characterize the situation of an entity,” and has suggested activity, time, location, and identity as the four primary types of context. Here, “activity” refers to the information about what is occurring in the situation, “time” refers to date and specific time, “location” refers to the current location of an entity, and “identity” refers to the unique identifier of an entity. These provide information about what’s, when’s, where’s, and who’s of entities [3, 4]. These types of context provide a useful standard for the classification of personalized information used by personalized advertisements in the Internet and mobile platforms. That is, we adopt Dey and Abowd’s [3] notion to classify personalized information needed for personalized ads. They are current activity information, individual information, and location information. Since time provides information about the current situation, we included it as current activity information. We classify personalized ads into three types based on this classification of personalized information. They are *Activity based ad method* (A-ad), *Individual based ad method* (I-ad) and *Location based ad method* (L-ad). These ad methods use one of the three types of personalized information and thus are called as basic ad methods. Table 1 describes the characteristics and the examples of basic ad methods.

Table 1. Classification of Basic Ad Methods

Type	Characteristics	Examples
A-Ad	Activity based ad utilizes only the current activity information. Keyword ad is a good example.	Google AdWords [10]
I-Ad	Individual based ad utilizes only individual information such as demographic factors.	Facebook ads [8]
L-Ad	Location based ad utilizes only the location information and generates customized ads based on this information.	SeeOnShop ads provided by SeeOn in Korea [28]

Some personalized ads have characteristics of more than the two basic ad methods at the same time. In this research, we classify these kinds of ad methods as composite ad methods. That is, composite ad methods are formulated by combining the two or more types of basic ad methods as shown in Figure 1. Table 2 shows the characteristics and examples of composite ad methods.

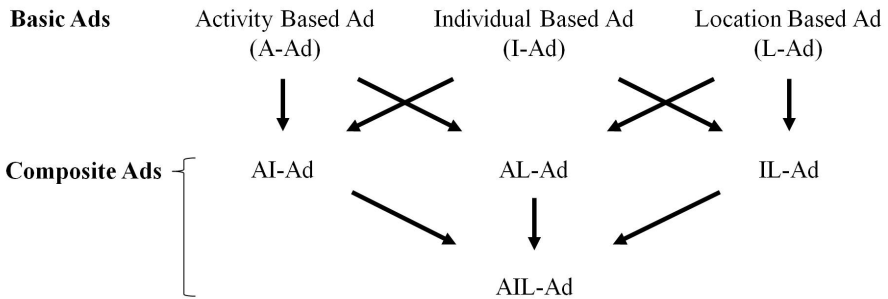


Fig. 1. Basic and Composite Ad Methods

Table 2. Classification of Composite Ad Methods

Type	Characteristics	Examples
AI-Ad	Utilize current activity and individual information.	YouTube provides targeted ads that are relevant to users' search keyword based on users' individual information [33].
AL-Ad	Utilize current activity and location information.	Groupon Now, provided by Groupon, creates ads of locationally nearby shops that are relevant to users' search keyword [11]. Naver, a search portal in Korea provides local link ads, which present ads when the name of a location is entered as a search keyword [21].
IL-Ad	Utilize individual and location information.	Foursquare, a location-based SNS, offers "Local Update," which provides ads of nearby shops. The frequency of the ad is adjusted based on users' past activities [12].
AIL- Ad	Utilize current activity, individual, and location information.	Foursquare offers "Promoted Update," which provides ads of nearby shops according to the search keyword and users' past activities [6].

2.2 Required Information for Personalized Ad Methods

To deliver each personalized ad methods, they require specific personalized information. Here, we identify required information for each type of personalized ads.

A-Ad. Required information for activity based ad includes users' current interest and action. Users' current activity lets publishers know what kind of customized ads is relevant to these activities [19]. For example, when a user uploads a photo, publishers may present ads about digital cameras or photo-editing tool.

I-Ad. Required information for individual based ad includes demographic information and users' general interest. Users' demographic information lets publishers target specific groups of customers based on age, gender, residence, or other factors [2].

L-Ad. Required information for location based ad includes users' current location and users' interesting location. Users' current location lets publishers generate ads that are specific to their current location [5]. Users' interesting location to search also lets publishers generate location-based ads. The users' interesting location may differ from users' current location.

For composite ad methods, combination of required information mentioned above is required. For example, to deliver AI-Ad, users' current interest or action and users' demographic or general interest information are needed.

3 Supportiveness of Personalized Ad Methods

The classification presented above described the required information that is necessary to present personalized ads. Now, we need to study whether users' specific

activities during their use of service platform can create such information. If the service platform can create full information necessary for the personalization, we regard the platform is fully supportive. However, when the platform can only create a part of necessary information, it is partially supportive. As such, the supportiveness is a matter of degree. So this research maps required information with supporting information to derive the degree of supportiveness of a website for a specific personalized ad method. That is, the supportiveness is defined as the degree of match between required information of a personalized ad method with supportable information from a website. To measure the supportiveness, we adopted a Constraint Satisfaction Problem (CSP) approach. CSP is one of the problem solving methods developed in the area of Artificial Intelligence [20]. CSP solves a problem by assigning values to variables that satisfies all the constraints (e.g., [17]). Figure 2 shows the framework of deriving the supportiveness in this research. The necessary personal information is regarded as the values of personalized ad methods, while the supportable information is regarded as the values of service platform. By mapping the commonly feasible values, we can find compatible solution between the different variables. If the matching is not exact, we can measure the degree of matching between the personalized ad method and service platforms.

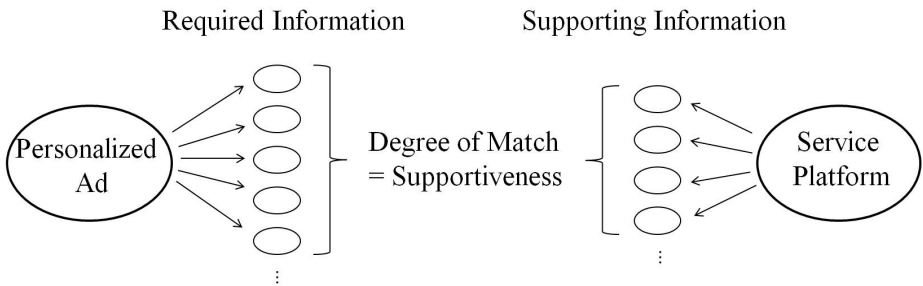


Fig. 2. CSP Approach in Measuring the Supportiveness

3.1 Required Information Sources

Required information is gathered through specific activities by users, publishers, or both of them. We call these activities as required information sources. Here, we identify required information sources of each personalized ad that are necessary to gather required personal information. There are numerous activities users can perform on the Internet and smart phone platforms. For instance, suppose the activities that are found in popular websites such as Google, Facebook, and Amazon. From these websites, we identify the activities that are possible for the users. That is, we identify the ways a service platform can garner personalized information. These information sources can be mapped with the required information for each ad method.

Sources of Information Required for Activity Based Ads

The required information for Activity based ads (i.e., current interest and action) stem from users' various activities in the service platform.

Current Interest. When users access or create contents, these activities may reveal their current interest. Thus, various activities in relation to contents are mapped to the required information of users' current interest. These activities include searching keyword, contents of current web page, posting reply or comment, rating a product or a video clip, participating in a poll, compiling a list (e.g., wish list), placing an order, creating a personal page (e.g., blogs and Facebook timeline or pages), reading others' posts, presenting ones' interest (e.g., like or follow), involving in the instant messaging, posting a photo, and adding a place.

Current Action. Users' activities that are focused on the specific actions regardless of the contents provide chances for web publishers to provide tailored ads that are related to these actions. These activities include searching, creating a personal page (e.g., blogs and Facebook timeline or pages), adding a friend, posting a photo, adding a place, and checking bank account or transferring. Note that some activities such as searching, creating a personal page, and posting a photo are associated with both user's current interest and action.

Sources of Information Required for Individual Based Ads

The required information for Individual based ads (i.e., demographic information and general interest) stem from four types of sources such as registration, personal pages, and linking customer's database, and pattern of historical activities.

Demographic Information. Users' demographic information is garnered by several methods. User registration is the most common method. Users input their demographic information when registering for a website for use. Although common, it is also an obtrusive way to incur customer dissatisfaction. Users' personal pages are a way to gather customers' demographic information such as the area of residence, the name of the universities they have graduated, or even religion. Facebook for instance utilizes this kind of information to target specific customers. As another way, special websites or apps may utilize their existing customer database. For example, to use an Internet banking service, users first need to register off-line to open bank account. This allows the gathering of demographic information of on-line customers by associating them with the existing customer database for off-line customers.

General Interest. Users' general interest can be gathered by the abovementioned sources including registration, users' personal pages, and linking to customer database. For example, Facebook lets users to specify their various interests in their personal pages. Another way of gathering users' general interest is by recording and

analyzing users' historical web surfing activities (i.e., behavioral targeting [32]). The keywords and websites that a user continuously uses reveal their interest in general.

Sources of Information Required for Location Based Ads

The required information for Location based ads (i.e., current or interesting location) can be gathered by various ways.

Current Location. There are a number of ways to know users' current location. When users access the website using a desktop platform, the IP address reveals their current location. When a user accesses a website using a mobile platform, GPS or 3G/4G network reveal his/her current location [29]. When users have personal pages and fill in their area of residence, this also can be used as users' current location. A user may fill in the current addresses when placing an order for a product in e-shopping sites, but the current address may not be the same as the current location itself.

Interesting Location. Users may enter the name of a location as a search keyword. This implies that they are interested in this location. The tour site and the map that a user visits for information provide another source of interesting locations. The shipping addresses in e-shopping sites, which may not be the same as the current address, also provide the location that a user is interested in.

If a service platform supports required information sources described above, the platform can support relevant personalized ad methods. Otherwise, the site will not be able to adopt this kind of personalized ad.

3.2 Service Platforms and Supporting Information Sources

Web publishers on the Internet and mobile platforms provide various services to users. Typical services include knowledge search, e-mail, news, e-shopping, SNS, learning, and financial transactions. Among various services, this research concentrates on the four popular ones [23]: search portal, e-shopping, SNS, and mobile banking. In this illustration, we generalize the functions of these platforms and do not discriminate the distinction among the specific sites although they may be different in practice.

Each service platform provides a number of activities that enable the collection of personal information. Let us call these activities as supporting information sources. To demonstrate each platform, we select typical and popular web pages: Google as a search portal, Amazon.com as an e-shopping, and Facebook as an SNS. As a mobile banking platform, we selected the smart banking service of Wooribank in Korea. For each service platform, we identified supporting information sources it provides. Then, we mapped supporting information sources to personalized ad methods and their relevant required information. Table 3 shows the mapping between supporting information sources of service platforms and personalized ad methods.

Table 3. Supporting Information Sources for each Service Platform

Type	Supporting Information Sources	Supporting Personalized Information
Search Portal	Search keyword, browse contents	A Type
	Statistics of historical activities, registration	I Type
	IP address, searching location	L Type
E-shop	Search keyword, browse contents (e.g., products), posting a reply or comments, rating products or reviews, participating in a poll, compiling a list, placing an order	A Type
	Statistics of historical activities, registration	I Type
	IP address, residential location (current or shipping addresses)	L Type
SNS	Search keyword, browse contents (e.g., persons), creating a personal page, adding a friend, viewing others' posts, presenting ones' interest (e.g., like or follow), instant messaging, posting a photo, adding a place	A Type
	Statistics of historical activities, registration	I Type
	IP address, residential location (residential area)	L Type
Mobile Banking	Browse contents (e.g., financial products, interest rates, and funds), checking bank account or transfer, placing an order	A Type
	Statistics of historical activities, linking customer CRM	I Type
	GPS or mobile networks	L Type

3.3 Measurement of Supportiveness

As described earlier, the supportiveness refers to the degree of match between the required information and supporting information, which are collected via required and supporting information sources. We adopt a CSP approach and define metrics to calculate the supportiveness. Specifically, supportiveness is defined as the following.

$S(i, j)$: Supportiveness of a service platform j toward a personalized ad method i .

$$S(i, j) = \frac{N(s(i, j))}{N(r(i))}. \quad (1)$$

$i = \{A, I, L, AI, AL, IL, AIL\}$

$j = \{\text{Search Portal, E-shop, SNS, Mobile Banking}\}$

$r(i)$: Required information sources for a personalized ad method i .

$s(i, j)$: Supporting information sources of a service platform j that matches with required information sources for personalized ad method i .

$N(r(i))$ = Number of required information sources for a personalized ad method i .

$N(s(i, j))$ = Number of supporting information sources that match with required information sources for personalized ad method i .

Required information sources are defined as the following.

$r(A) = \{\text{Search keyword, browse contents, posting a reply or comments, rating a product or video), participating in a poll, compiling a list (e.g., wish list), placing an order, creating a personal page (e.g., blogs and Facebook timeline or pages), adding a friend, viewing others' posts, presenting ones' interest (e.g., like or follow), instant messaging, posting a photo, adding a place, checking bank account or transfer}\}$

$N(r(A)) = 15$

$$\begin{aligned}
r(I) &= \{Statistics of historical activities, registration, personal pages, linking customer CRM\} \\
N(r(I)) &= 4 \\
r(L) &= \{IP address, GPS or mobile networks, searching location, residential location\} \\
N(r(L)) &= 4
\end{aligned}$$

Supporting information sources of the search portal are defined as the following.

$$\begin{aligned}
s(A, Search\ Portal) &= \{Search\ keyword, browse\ contents\} \\
N(s(A, Search\ Portal)) &= 2 \\
s(I, Search\ Portal) &= \{Statistics\ of\ historical\ activities, registration\} \\
N(s(I, Search\ Portal)) &= 2 \\
s(L, Search\ Portal) &= \{IP\ address, searching\ location\} \\
N(s(L, Search\ Portal)) &= 2
\end{aligned}$$

Supporting information sources of the E-shop are defined as the following.

$$\begin{aligned}
s(A, E-Shop) &= \{Search\ keyword, browse\ contents\ (e.g., products), posting\ a\ reply\ or\ comments, rating\ products\ or\ reviews, participating\ in\ a\ poll, compiling\ a\ list, placing\ an\ order\} \\
N(s(A, E-Shop)) &= 7 \\
s(I, E-Shop) &= \{Statistics\ of\ historical\ activities, registration\} \\
N(s(I, E-Shop)) &= 2 \\
s(L, E-Shop) &= \{IP\ address, residential\ location\ (current\ or\ shipping\ addresses)\} \\
N(s(L, E-Shop)) &= 2
\end{aligned}$$

Supporting information sources of the SNS are defined as the following.

$$\begin{aligned}
s(A, SNS) &= \{Search\ keyword, browse\ contents\ (e.g., persons), creating\ a\ personal\ page, adding\ a\ friend, viewing\ others'\ posts, presenting\ ones'\ interest\ (e.g., like\ or\ follow), instant\ messaging, posting\ a\ photo, adding\ a\ place\} \\
N(s(A, SNS)) &= 9 \\
s(I, SNS) &= \{Statistics\ of\ historical\ activities, registration\} \\
N(s(I, SNS)) &= 2 \\
s(L, SNS) &= \{IP\ address, residential\ location\ (residential\ area)\} \\
N(s(L, SNS)) &= 2
\end{aligned}$$

Supporting information sources of the mobile banking are defined as the following.

$$\begin{aligned}
s(A, Mobile\ Banking) &= \{Browse\ contents\ (e.g., financial\ products, interest\ rates, and\ funds), checking\ bank\ account\ or\ transfer, placing\ an\ order\} \\
N(s(A, Mobile\ Banking)) &= 3 \\
s(I, Mobile\ Banking) &= \{Statistics\ of\ historical\ activities, linking\ customer\ CRM\} \\
N(s(I, Mobile\ Banking)) &= 2 \\
s(L, Mobile\ Banking) &= \{GPS\ or\ mobile\ networks\} \\
N(s(L, Mobile\ Banking)) &= 1
\end{aligned}$$

According to the definition of supportiveness, we derive the supportiveness of each service platform for each personalized ad method as summarized in Table 4. Composite ad methods are formulated by combining basic ad methods. Since the composite ad methods require all the personalized information which their constituent basic ad methods require, the minimum value among the supportiveness of basic ad methods becomes the supportiveness of composite ad method. The following equation shows how to calculate the supportiveness of a composite ad method from the supportiveness of basic ad methods. Let us define the notation as $A \oplus B = \min(A, B)$ and $A \oplus B \oplus C = \min(A, B, C)$.

$$S(AI, j) = S(A, j) \oplus S(I, j) . \quad (2)$$

$$S(AL, j) = S(A, j) \oplus S(L, j) . \quad (3)$$

$$S(IL, j) = S(I, j) \oplus S(L, j) . \quad (4)$$

$$S(AIL, j) = S(A, j) \oplus S(I, j) \oplus S(L, j) . \quad (5)$$

Table 4 shows the supportiveness of service platforms toward composite personalized ad methods.

Table 4. Supportiveness for Basic and Composite Personalized Ad Methods

Type	Search Portal	E-mail	SNS	Mobile Banking
A-Ad	$\frac{2}{15} = 0.13$	$\frac{8}{15} = 0.53$	$\frac{9}{15} = 0.6$	$\frac{3}{15} = 0.2$
I-Ad	$\frac{2}{4} = 0.5$	$\frac{2}{4} = 0.5$	$\frac{2}{4} = 0.5$	$\frac{2}{4} = 0.5$
L-Ad	$\frac{2}{4} = 0.5$	$\frac{2}{4} = 0.5$	$\frac{2}{4} = 0.5$	$\frac{1}{4} = 0.25$
AI-Ad	$\frac{2}{15} = 0.13$	$\frac{2}{4} = 0.5$	$\frac{2}{4} = 0.5$	$\frac{3}{15} = 0.2$
AL-Ad	$\frac{2}{15} = 0.13$	$\frac{2}{4} = 0.5$	$\frac{2}{4} = 0.5$	$\frac{3}{15} = 0.2$
IL-Ad	$\frac{2}{4} = 0.5$	$\frac{2}{4} = 0.5$	$\frac{2}{4} = 0.5$	$\frac{1}{4} = 0.25$
AIL-Ad	$\frac{2}{15} = 0.13$	$\frac{2}{4} = 0.5$	$\frac{2}{4} = 0.5$	$\frac{3}{15} = 0.2$

4 Conclusions

In this research, we derived the supportiveness of service platforms for the personalized ad methods on the Internet and mobile platforms. For this purpose, we first adopted the classification scheme of personalized ad methods. For each ad method, we identified various sources that are required to collect relevant personal information that are necessary to create each personalized ad method. Also, we identified supporting information sources of service platforms such as search portal, e-shop, SNS, and mobile banking. From these required information sources and supporting information sources, we derived the supportiveness of each service platform for each personalized ad method. To this end, the constraint satisfaction problem (CSP) approach is adopted. As Table 4 illustrates, e-mail and SNS were the two most highly supporting platforms for A-Ad. As for I-Ad, all the platforms equally supported this type of personalized ad method. As for L-Ad, search portal, e-mail, and SNS were equally supporting this type of ad method. As for the composite ad methods, e-mail and SNS were most highly supporting platforms. These results indicate that service platforms that provide more activities to users are more supportive to personalized ads.

This research provides a systematic approach to derive the degree of supportiveness for both basic and composite personalized ad methods. This measure helps web publishers on the Internet and mobile platforms in planning their personalized ad methods. First, the supportiveness shows the potential of a website for delivering a specific type of personalized ad method. Thus a website publisher can

identify feasible personalized ad methods that can be provided by its website. This can guide their ad service strategy. Second, the supportiveness shows what ad methods opportunity web publishers are currently missing. That is, the results enable them to identify what additional information sources are needed to deliver a certain kind of personalized ad.

This research is without limitations. First, supportiveness was derived by the number of required and supporting information sources. Some supporting information can be more frequently used or gather richer information than the others. These characteristics between information sources should be addressed in the future research. Second, this research has covered only four typical service platforms. But the same approach can be applied to other types of service platforms without losing generality. Third, we have not considered various service platforms provided by one company. For example, Google gathers users' information from several services including Google search and Youtube. As another example, Social Login allows to login to a specific website from different service providers such as Facebook or Twitter. In these cases, a service platform can utilize personalized information gathered by the other associated sites.

The dimension of personalization may be expanded in the following researches. This also will expand the necessary information to realize it. On the other hand, the more user information will be able to be collected from big data as technology and service platforms evolve. Regardless of these changes, later analysis regarding personalized ads can adopt the notion of supportiveness developed in this research.

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