Personalized Indoor Transit Advertising

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Abstract. In this paper, we present a new approach to the problem of determining the most interesting ads to display at each moment, which we intend to do by considering the current context (date/time, current location, etc.) and information about the passenger profiles. The final goal is to deliver more targeted, relevant, new and diverse ads to the passengers in order to maximize the eectiveness of the campaigns.

Keywords: Pervasive advertising, transit advertising, novelty, surprise, relevance, diversity, user profiles, personalization.

1 Introduction

Throughout the centuries, the different civilizations have been using all the available means to promote their ideas, products, services and events.

From drawings in papyrus and walls in Egypt to the most recent digital advertising techniques [1], the advertising industry has been able to evolve and adapt to the new needs and technologies like no other.

One of the scenarios where the advertising business has successfully been focused on in the last few years is the public transportation systems.

In [2], the Transportation Research Board (TRB) presents some interesting results about the revenue derived from advertising on public transit facilities and vehicles. According to the TRB, this industry is worth approximately 1 billion dollars annually, in the USA alone. These are some interesting numbers, especially if we extrapolate them to rest of the world.

In terms of advertising on public transportation vehicles, we have two considerably different types: indoor and outdoor. The first group refers to all the advertising means that can be found inside the vehicles as illustrated in Fig. 1A, while the second group comprises the advertising means that can be found outside the vehicles as shown on Fig. 1B.

While there are some interesting challenges concerning outside advertising, in the current work we are especially focused on digital advertising inside vehicles.

Nowadays, advertising is ubiquitous and we have gotten so used to it that, in some cases, we dont even pay any attention.

To overcome this loss of interest, new approaches and techniques must be developed in order to regain the attention of the passengers. One possible way to achieve that is to associate the digital advertising systems with other services,

like the presentation of TV programming, daily news, alerts, weather forecasts, just to mention a few.

A B

Fig. 1. Examples of indoor and outdoor transit advertising (source: www.titan360.com)

One important fact related with these systems is that besides being able to gain the passengers attention, they may also help reducing the psychological time of the journey, since the passengers are occupied with something besides the journey itself. If only advertising was being displayed, the passengers could feel more easily bored and ignore what is being displayed, making the campaigns less effective.

In the next sections, we will characterize in more detail the existing systems for advertising inside public transportation. We will continue to present our approach to the process of selecting the advertising to be displayed as well as some of the main challenges involved in that process. We will end with some conclusions and ideas for future work.

2 Indoor transit advertising

In the last few years, a large number of advertising companies started to switch from static paper ads to digital dynamic displays, both indoor and outdoor.

Besides environmental advantages, this type of displays allows new and interesting ways of presenting ads to the passengers, pedestrians, etc. It is now possible to change the ads that are being presented, based on different criteria such as current location, date/time, demographics, just to mention a few.

In our increasingly busy and demanding daily lives, we are constantly seeking for information. Recently there are emerging several services like Transit TV [3], which allows the users to have access to information even when they are commuting. Of course this new market is very desirable for the advertising industry, since people are more likely to pay attention to what is being shown.

In one research study from 2006 about the deployment of the Transit TV service in Los Angeles (USA) [3], is mentioned that the passengers expect to spend approximately one and a half hours in the bus every day. Its also mentioned

[3] http://www.transitv.com

that an average of 80% could recall one or more commercials aired that week. Another important result was that 64% of the inquired passengers felt that the commute was going faster.

These results seem to indicate that these new advertising means are indeed both interesting for the passengers and effective for the advertisers.

In [4] Florian Alt et al. propose that these "information" systems could also be deployed in taxi vehicles. The idea is to provide access to selected internet services like news, weather forecasts, email and social networks using one computer installed behind the front seats of the taxi, in exchange of the advertising display. In Fig. 2 it is shown one example of such systems.

Fig. 2. Image of the Taxi interactivo system. (source: www.inventadigital.com/)

The service, which is supposed to be free of charge for the passenger, is seen as an interesting service for the client, a good opportunity for the advertisers and finally an important source of revenue for the taxi companies.

With the price drop of LCD displays, we could easily say that in a near future, these systems will be available in other public transportation means like city buses or trains. These systems will certainly provide interesting services for the passengers, eventually leading more persons to start using public transportation instead of their private vehicles.

Because the displays will supposedly be used for a single user at each moment, it allows the development of new more targeted advertising techniques, which eventually will result on higher revenues for the advertisers.

Recently, several companies worldwide started to offer their passengers WiFi access (using the passengers own devices like smart phones, laptops, etc.) in exchange of some ads being displayed once in a while. This new service can be very interesting to the daily commuter in urban bus/train/subway, but also to longer journeys on train/coach.

Icomera [4], one of the worlds leading companies offering these internet access services which have deployed their solution worldwide has developed their own advertising system, MoovManage Ads [5], which is prepared to deliver advertising on several different ways like banners, sponsored links, etc.

[4] www.icomera.com

2.1 Personalized indoor transit advertising

One possible way to categorize the indoor transit advertising systems is according to their personalization level. For this purpose, we have defined three different groups: non-personalized, personalized (off-line) and personalized (on-line).

Non-personalized

In the first group, we find the digital advertising means that present the ads regardless of any kind of context information. The ads are merely displayed randomly or according to a predefined order (similar to a playlist).

Personalized (off-line)

The second group comprises the systems with the capability of displaying the ads according to some, but limited, context information.

According to Dey [6], context is any information that can be used to characterize the situation of an entity. In this particular case, information such as current date/time and location is generally used.

These systems have the ability to display specific ads depending on the simple context features mentioned, allowing them to reach more precise targets.

In this group we also include the systems that use additional information, for example, results from demographic studies, to determine the profiles of the people who usually use those vehicles in order to display the ads that have those profiles as main targets.

For instance, if it is known that on specific regions live mainly college students, this information can be used to display ads that are targeted to college students, on the bus/subway lines that pass through that area.

As an example of such systems, we have the GEM system [5], which has been deployed in the Public Transport System of Ljubljana (Slovenia).The system consists of approximately 450 displays installed on nearly 130 buses.

On Fig. 3 is presented an example of the described system.

Fig. 3. Image of the system deployed on the Ljubljana City public transport system (source: www.gem.si/)

[5] http://www.gem.si

In this particular case, the ads are displayed based on current location and temporal aspects, but also on the passenger profiles. These profiles resulted from demographic studies about the population that use the public transport systems in Ljubljana.

These systems are more effective on delivering the ads than the systems from the first group. However, they may still deliver ads that are not in any way related to the persons that are, in fact, inside of the vehicles.

Personalized (on-line)

In this last group, we have the digital advertising systems that use all possibly available information to deliver targeted ads to the persons that are, in fact, inside a vehicle at a specific date/time.

As mentioned by Ross Shannon et al. [7] in their work about supportive advertising, both the consumers and the advertisers can benefit on collaborating. The users provide the items of information that they want, and this way they are helping the advertising systems to deliver more targeted and interesting ads.

Florian Alt et al. [8] and Jorg Muller et al. [9] have also worked on building and maintaining user profiles in order to deliver more targeted advertising.

In [10] Antonio Di Ferdinando et al. it is presented MyAds system that, according to them, can autonomously adapt the advertisement process to the trends of interests detected among the audience in a venue.

Although the previously presented works are not specifically related with transit advertising, we are almost sure that some of the main concepts could also be applied in this scenario.

Besides the already mentioned simple context features, like current date/time and location, these systems use more detailed user-centric information. The main idea is to identify and obtain information about the passengers who are inside the vehicles and use that information in conjunction with the context information to display the ads that are more relevant to them.

One of the main sources of information about the passengers is provided by themselves when they fill the subscription forms. From these subscription forms, we may have access to several relevant information items like gender, age or occupation that can be used to deliver more targeted and personalized ads.

Besides these information items that allow us to build simple user profiles, Ross Shannon et al. [11] propose to enrich the profiles using other sources of information like the Internet, or more specifically social networks like Facebook [6] or Twitter[7]. From these sources, we may obtain other useful pieces of information like personal interests, favorite sports, and so on.

All these information items can then be gathered to allow the delivery of more targeted ads, which eventually will call the passengers attention and result on higher sales to the advertisers and to the advertising companies.

This third group of systems is the one that we are particularly interested in, especially due to the challenges involved.

[6] www.facebook.com
[7] www.twitter.com

3 Our approach to On-line Personalized Transit Advertising

One of the most important components of a system like the ones described in the last section concerns to determining which ads should be displayed at each moment based on the available information.

Some authors [9] [15] [16] suggest that the process of deciding which ad to show should be based on auctions, similar to what happens with Google AdWords [8], where the announcers bid for the opportunity to display their ads.

We think that the best way to achieve success is to center the attention on the passengers. This way we should display ads based on the users preferences and not letting the advertisers decide what should be displayed. We also think that it is important to notice that human beings prefer (like) new and diverse experiences over the constant repetition of information. (not the same thing day after day.)

For this purpose, we propose the use of a three-step (relevance, surprise and diversity) filtering approach, similar to the one used in [12] for filtering geo-referenced points of interest. The process is represented on Fig. 4.

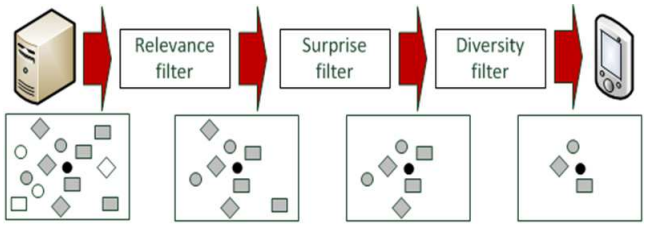

Fig. 4. Three-step filtering process.

Given the current context attributes (date/time, current location, list of next stops, etc.) and the perceived profiles of the passengers, we start by selecting from the list of advertising images or videos the ones that best meet the present scenario and user profiles (i.e. the most relevant ones).

To determine the relevance or irrelevance of an ad to a specific profile, it is important to define the target profiles for each ad when it is inserted on the system.

If, for some reason, it is impossible to identify the passengers, then a generic profile derived from historical information will be used.

The system shouldnt be providing always the same ads for the same scenario, even if they are the most relevant ones. If that happens, the regular users will eventually start to lose interest in the system and will stop looking at it, since they already know what is going to be shown.

[8] http://www.google.com/adwords

The second step of the process consists of selecting from the list that resulted from the previous step the most surprising items (i.e. items that the user is not used to see in the current context).

To achieve this, we rely on the computational model of surprise proposed by Macedo et al. [13].

The idea is to determine the surprise "felt" by one user (or profile) when confronted with a specific list of ads within the current context. The ads with the highest surprise values, which are the ones that the user most probably has never seen before, are then selected for the next step.

To determine the surprise value for each ad, we need to calculate the appropriation level, which defines the relation that the user/profile has with each ad based on previous "contacts".

For this purpose we have identified different types of "contacts":

- The ad was displayed with the users "eventually" still inside the vehicle (without information if they saw it or not);
- The ad was displayed with the users certainly inside the vehicle (without information if they saw it or not);
- The ad was displayed with the users certainly inside the vehicle (with information that they saw it);
- The ad was displayed with the users certainly inside the vehicle (and they interacted with it).

Different weights are attributed to each "contact" type, therefore, the appropriation level for each ad X is the result of the sum for all weights associated to the past k "contacts" between the user and the ad (1).

$$AL(X) = \sum_{i=1}^{k} wi \tag{1}$$

The appropriation level for each ad will be used to determine the probability that it has of being presented to the user. The probability of a specific ad X_j being chosen from a list with m items is given by:

$$P(Xj) = \frac{AL(X_j)}{\sum_{i=1}^{m} AL(X_i)} \tag{2}$$

Finally, we determine how surprising each ad is to the user/profile using:

$$S(X) = log_2(1 + P(Y) - P(X)) \tag{3}$$

Where X represents each individual ad and Y represents the ad with the highest probability of being selected.

After determining the surprise value for each ad using (3), the ads with surprise values higher than a specific threshold are selected to the next phase. These ads are those with which the user had less contact in the past, or at least the less significant contact.

To support future decisions, each time that one ad is displayed; we must store information about that, as well as which were the target profiles and the context attributes at that moment.

From the previous step, we will receive a list with the most relevant and surprising items, however, it can have ads for similar type of products/services (e.g. restaurants: McDonalds, Burger King, Pizza Hut, etc.).

To avoid providing several consecutive ads of similar products or services, in the third and final step of the process, we will select the ads that are more unrelated.

The approach used to determine the most diverse ads is inspired by Gago et al. [14] and involves determining the difference between each ad and all the others, based on their attributes.

To achieve this, it is fundamental that the ads are annotated according to specific ontology.

The system starts by selecting randomly an ad from the list produced by the surprise filter. Then we calculate the distance from this ad to all the others. The one most distant from this one is the second ad entering the group of selected ads.

From this point and for all the remaining ads we calculate the average distance between them and the ones previously selected. The one with the highest average distance to all the selected ones is the one entering the selected group. The process stops after n ads are selected.

In the end, we should have come up with a list of relevant, surprising and diverse ads to be displayed to the passengers.

3.1 Main chalenges

The proposed approach has several different and interesting challenges; next we will present some of them.

Identifying the passengers

Since contactless ticket validators are present in most buses/subways and are even used as the main way to control admissions to the vehicles we may think of using them to identify the passengers.

Unfortunately, these systems can only be used to identify the users who have any kind of subscription that involves filling registration/admission forms; as a result, we must find alternatives to identify the rest of the passengers.

Determine who is, in fact, in the vehicle?

Another important issue is related to the fact that usually passengers only validate their tickets/pass when entering the vehicles . This means that it may be difficult to determine who is, in fact, still inside the vehicle.

The simplest solution could consist of asking the users to re-validate their tickets/pass when leaving the bus. This solution is somehow simple to implement and is in fact implemented in some cities around the world. Our main concern is related to the fact that it may lead to confusion since the passengers want to exit as fast as possible.

Audience measurement

Audience measurement is especially related to determining the effectiveness of specific advertising campaigns. However, in this case it is also essential for the second step of the filtering process.

This can be achieved by direct means, like the use of cameras that track the users eyes to determine where the users are looking at, alternatively, by indirect means like the use of virtual coupons or displaying special URLs or QR codes.

Privacy

One of the main challenges concerns the users privacy. Therefore, the developed systems must warrant that the user profiles are completely anonymous, and that the gathered information will be used only for this purpose.

In May 2010, the Center for Democracy and Technology [9] released a report [17] including several recommendations about the security issues related with this new type of advertising techniques. The report is focused on the issues related to facial recognition, social networking, RFID tracking and so on.

4 Conclusions

With the present paper, we intended to present a study about a type of advertising that is beginning to get increasing attention from the advertising companies but also from the transportation companies that see it as an interesting source of revenue.

We have shown some of the different types of existing systems as well as some ideas on how to make them more effective.

Our central interest in this type of systems is particularly related to the process of determining which ads should be displayed at each moment. We think that focusing the process on the passengers instead of on the advertisers is one of the main aspects to dictate the success of these systems.

For this purpose, we have briefly presented our approach that uses the available information to display relevant, surprising and diverse ads to the passengers.

This system is being developed as part of a wider project involving universities, private companies and public institutions called TICE.Mobilidade [10].

The project will be deployed in various Portuguese cities, and will certainly give us a good opportunity to validate the proposed approach as well as identify possible improvements.

References

1. Wikipedia. http://en.wikipedia.org/wiki/Advertising. (accessed on 26/01/2011).
2. TRB. Audience Measurement for Transit Advertising project description. http://144.171.11.40/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2613 (accessed on 26/01/2011).

[9] http://www.cdt.org

[10] http://tice-mobilidade.clusters.ipn.pt/

3. Diane Williams: Moving Entertainment: Arbitron Evaluation of Transit TV Network - Los Angeles County MTA Buses Case Study. Research Report. (2006).
4. Florian Alt, Alireza Sahami Shirazi, Max Pfeiffer, Paul Holleis, Albrecht Schmidt: TaxiMedia: An Interactive Context-Aware Entertainment and Advertising System. GI Jahrestagung. 3933-3940. (2009).
5. Icomera. MoovManage. http://www.icomera.com/road/products/moovmanage/. (accessed on 26/01/2011).
6. Anind K. Dey: Understanding and Using Context. Journal of Personal and Ubiquitous Computing. Volume 5 - Issue 1, February. (2001)
7. Ross Shannon and Aaron Quigley. From intrusive to supportive: recommendations for pervasive advertising. In proc. of the first workshop on Pervasive Advertising at Pervasive 2009, May 1114, Nara, Japan. (2009).
8. Florian Alt, Moritz Balz, Stefanie Kristes, Alireza Shirazi, Julian Mennenh, Albrecht Schmidt, Hendrik Schrder, Michael Goedicke. Adaptive User Profiles in Pervasive Advertising Environments. In proc. of Ambient Intelligence 2009. pp. 276-286. (2009).
9. Jorg Muller and Antonio Kruger: User Profiling for Generating Bids in Digital Signage Advertising Auctions. Workshop on Ubiquitous and Decentralized User Modeling, User Modeling 2007, Corfu. (2007).
10. Antonio Di Ferdinando, Alberto Rosib, Ricardo Lenta, Antonio Manzalinic and Franco Zambonelli: MyAds: a System for Adaptive Pervasive Advertisements. Pervasive and Mobile Computing. Volume 5, Issue 5, Pages 385-401. (2009).
11. Ross Shannon, Matthew Stabeler, Aaron Quigley and Paddy Nixon Profiling and targeting opportunities in pervasive advertising. 1st Workshop on Pervasive Advertising, Pervasive 2009. Nara, Japan. (2009).
12. Nuno Gil Fonseca, Lus Rente, Carlos Bento: Selective Delivery of Points of Interest. AmI 2010: 295-299. (2010).
13. Luís Macedo and Amílcar Cardoso: Modeling Forms of Surprise in an Artificial Agent. Proceedings of the 23rd Annual Conference of the Cognitive Science Society,. Mahwah, NJ: Erlbaum, pp. 588-593. (2001).
14. Pedro Gago and Carlos Bento: A Metric for Selection of the Most Promising Rules, in Principles of Data Mining and Knowledge Discovery, Zytkow J. and Quafafou M. (Eds.), LNAI 1510, Springer, pp.19-27. (1998)
15. Jorg Muller and Antonio Kruger: How much to bid in Digital Signage Advertising Auctions? Adjunct proc. of Pervasive 2007, Toronto. (2007).
16. Alex Rogers, Esther David, Terry R. Payne and Nicholas R. Jennings: An Advanced Bidding Agent for Advertisement Selection on Public Displays. In: Sixth International Joint Conference on Autonomous Agents and Multiagent Systems (AAMAS-07), Honolulu, Hawaii, USA. pp. 251-258. (2007)
17. Center for Democracy and Technology. Building the Digital Out-Of-Home Privacy Infrastructure. Report. (2010).