An Adaptive E-Advertising User Model: The AEADS Approach

Alaa A. Qaffas and Alexandra I. Cristea

Department of Computer Science, The University of Warwick, Coventry, CV4 7AL, U.K.

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Abstract: By customising advertising campaigns based on the attributes of the user, the efficacy and success of the campaign is likely to be enhanced. The most challenging yet interesting part to model is the user (or customer). This paper focuses on an automated, simple, lightweight user model, easy to integrate into an existing system (storage and operation). Accordingly, the arbitrary commercial website can acquire the ability to retrieve general data of the user and monitor the behaviour of the user during navigation session on the website. It also presents a study that assesses the effectiveness of a tool based on this model, via a trial run of a model prototype with users.

1 INTRODUCTION

Technological advancements have led to a significant increase in web-based promotions and online marketing, as target audiences can now be accessed regardless of time or location. The adaptation of advertising adds significant benefits to customer satisfaction and business profits (InternetAdvertisingBureau, 2012). Availability and the easiest way to manage the adaptation of advertising with minimal effort on any commercial site has become a key demand for businesses. Many models exist, e.g., the Dexter model (Halasz et al., 1994), AHAM (De Bra et al., 1999), and LAOS (Cristea and de Mooij, 2003), but they are proposed mainly for personalising the educational experience. Lessons learned from them may be applied here, to some extent. Moreover, these models do not feature the lightweight integration of adaptive features on any website as their main purpose. Therefore, a new model - the *Layered Adaptive Advertising Integration* – has been proposed, based on prior ones, in order to introduce an easier approach to integrating adaptation features into any commercial website. Some of its components differ from those in traditional models. In particular, the user modelling in the proposed model is separated into storage and delivery parts, the latter is not covered in this paper, as it has not been implemented yet. This separation can potentially enhance the generalisation, portability and efficiency of the user model and delivery model. The storage part is encapsulated and manipulated via XML representation, to allow the system to be integrated into any website easily and with only minor changes to the original database of the website. In addition to the separation, the storage of the user model and its operation is added to the delivery model, in order to facilitate the integration process on any website. This separation also allows the new model to be easily expanded.

Our research aims to address the following main research question:

How can we support website owners in the creation of adaptive advertising?

This main research question can be addressed by answering the following sub-research questions:

A. *What type of tools do website owners need, to be able to efficiently add adaptive advertising in a lightweight manner (as an add-on) to their website?*

B. *What kind of support do website owners need, to be able to use these tools?*

To answer these questions, we recommend a collection of tools, Adaptive E-Advertising Delivery System (AEADS), which facilitate the creation of adaptive e-advertising. This paper in particular focuses on one of the vital components in any adaptive systems, the *User Model (UM)*. In this paper, we propose a lightweight UM, with a set of features and attributes that we consider essential to adaptive advertising, and which can be easily added to any static commercial website. Furthermore, this model is implemented and evaluated with real Internet users and customers.

The following sections discuss the related research, the user model tool and its evaluation, and finally provide a conclusion.

2 RELATED RESEARCH

Adaptive hypermedia systems allow for personalisation, thus improving the efficiency and accuracy of information distribution (Brusilovsky, 1996). This process consists of three major types of tasks: acquisition, representation and secondary inference, and production (Kobsa et al., 2001). The *acquisition tasks* identify information regarding users' characteristics, computer usage and environment, in order to construct an initial model of the user. The *representation and secondary inference tasks* inference and express the content of the user model and makes assumptions about them, such as their behaviours and the environment. The *production tasks* generate the adaptation of the contents and structure of the system to meet the users' needs. We use the classification of the data in a user model by user, usage, environment, hardware, software, and location. According to (Brusilovsky and Millán, 2007), an adaptive model considers user's characteristics in developing a user model and the data captured can be categorised as knowledge, interests, goals and tasks, background, individual traits, and context of work.

A user model is a basic component in any personalised system and is a representation of user data stored for any adaptive changes to the system's behaviour. All adaptive hypermedia frameworks and models have a user model as one of their components. For instance, in AHAM (De Bra et al., 1999), the user model contains concepts with attributes storing user preferences, while in LAOS (Cristea and de Mooij, 2003) the user model is even more complex.

There have been many systems proposed to facilitate adaptation, including AHA! (Bra and Calvi, 1998, Stash et al., 2008), GALE (Smits and De Bra, 2011), ADE (Scotton et al., 2011), and WHURLE (Brailsford et al., 2001). A generic user model based on variable-value pairs that facilitate required adaptations form the basis of ADE, AHA! and GALE and this is suitable for online advertising purposes as well. In particular, according to (Mérida et al., 2002) a model is suggested for the delivery of hypermedia content that considers the types of users, the devices used by customers to gain access, the types of access, the state of the network and the current load on the server. Nonetheless, these are all standalone systems, which cannot be integrated into existing ones in a lightweight manner. XML-based pipelining, as used by WHURLE for applying lightweight solutions and standards, is efficient for adding minor modifications to existing systems, and is, therefore, utilised in our approach. However, user modelling in WHURLE is not as extended.

AdSense (GoogleAdSense, Davis, 2006), unlike our approach, cannot provide advertisements to clients directly, it just lets advertisers in the Google Network deliver advertisements to the content site to be presented to users automatically. It specialises in banner advertisements and uses location to personalise content (WebTechnologySurveys, December 2014). However, this process does not utilise any form of user-based modelling, or the assimilation of user information for personalisation purposes. Among the potential approaches to selecting the best form of advertisement, adaptive hypermedia may be used to link the advertisement to the consumer's taste, via user modelling, and is a significant element within systems that adapt to the user (Kobsa, 2007).

Another example, AdROSA (Kazienko and Adamski, 2007), that makes automatic personalised web banners, depends mostly on specific browsing behaviours of a user. It is similar to AdSense, the portal model of advertising uses AdROSA to deliver the advertisements.

Social networks are good sources of user information (Faust, 2007), from which user behaviour and characteristics for personalising advertisements can be retrieved. Although the type of content posted on these websites varies, it is generally indicative of a user's preferences, attitudes and behaviours.

Facebook is one of the most popular social networking sites, with 1.35 billion monthly active users from around the world (TheStatisticsPortal, 2015). Users can create a personal profile, add friends, send messages, post status updates and comments to friends' "walls". They can chat together and upload photos and videos that their friends can comment on and "like" (Hof, 2011). For these reasons, Facebook has been used as the first social medial data-gathering source for the first version of the system described in this paper, follow-up versions look into other sources though.

Many existing semantic web-authoring systems can be used in conjunction with other delivery or authoring systems (Cristea, 2004, Wu, 2002). In our case, XML was selected to generate the user model tool's internal representation.

The modelling of user profiles involves acquisition, representation and secondary inference. Data acquisition can be performed using a variety of

different methods depending on class, including user data acquisition methods, usage data acquisition methods and environment data acquisition methods. This includes user-supplied information acquired through questions asked by the system, acquisition rules, stereotype reasoning, and plan recognition, a process which predicts future actions based on previous patterns (Schmidt, 2003). A simple method for making a first assessment of others is to classify them into groups sharing the same interests, according to a set of criteria – a stereotype (Benaki et al., 1997b). We use the stereotype technique, as it makes inferences based on limited observations.

3 AUTHORING ADAPTIVE E-ADVERTISING

The overall Authoring model of Adaptive E-Advertising, as informed by prior research and implementations, especially in the area of personalised e-learning, includes:

1. The *Domain Model* - used by businesses to organise, label and categorise advertisements. As it has been described elsewhere (Qaffas and Cristea, 2014b), it is not further detailed here.

2. The *Adaptation Model* (Qaffas and Cristea, 2014a) - enabling businesses to adapt the advertisements they have organised, using the domain model tool for their customers' needs.

3. The *User Model* - representing the personal data of an individual user, stored for any adaptive changes to system's behaviours. For example, it can be used to predict the most relevant items for the user, when they search for information, as described below. This is the focus of our paper.

Here, the social input data component has been added to the user model, and then some functions of this model were separated, (e.g., the inference function) to be used in the delivery engine to support the integration process.

The user (customer) modelling tool has been designed to be simple (to have few user model features), in order to be lightweight, and to integrate with any potential website user model. With this tool, we implement the first steps of the user modelling, including its acquisition data, and retrieve explicit and implicit data. We use the explicit data supplied by users, and retrieve data from social networks, by using the social networks authorisation, and authentication APIs. We also conduct implicit data

acquisition, by using several techniques, including *stereotype reasoning* (Benaki et al., 1997a), and *plan recognition* (Schmidt, 2003) to be used in the delivery Engine.

All of the data about users in the user model is stored in XML files. Storing all of the data in a lightweight fashion (XML) facilitates the integration into any commercial webpage, as XML allows for pipeline processing and independence to any other processing on the website. Users can login into the system via two methods: register (Figure 1), and Facebook login (Figure 2). By logging in via the latter, the user model can be automatically populated with the necessary information for the adaptation of advertisements. The user information is arranged in an XML file with attributes such as `id`, `name`, `password`, `email`, `age`, `gender`, `location`, `number of logins` to site, `total number of clicks` on each advertisement, `device` used, and `software` used. All users can update their information on their profile page. This data will be stored in the `users.xml` file (Figure 3). The social data from the social login allows us to retrieve sufficient information about users and to infer from specific to general cases.

Figure 1: User Registration.

Figure 2: User Login.

```
- <Users>
    - <User>
          <userId>1397838625271</userId>
          <userName>h</userName>
          <password>q</password>
          <email>h</email>
          <age>old</age>
          <gender>woman</gender>
          <loginNumber>23</loginNumber>
          <totalClick>8</totalClick>
          <hobbies>Traveling</hobbies>
          <educationLevel>postgraduate</educationLevel>
          <educationType>Agriculture</educationType>
          <bandWidth>4M</bandWidth>
          <softwareUsed>Windows 7</softwareUsed>
          <location>undefined</location>
          <deviceUsed>Computer</deviceUsed>
    </User>
```

Figure 3: User Model XML file sample.

The implementation of the user modelling is made by creating servlets to be used in JSP pages, adding data to the `user_item.xml` file, such as the number of clicks on advertisement for each user, and the number of times each advertisement is shown, for each user attribute (Figures 4 a, b and c). The number of clicks and shows will be utilised to apply plan recognition. Plan recognition refers to the task of inferring the plan of an intelligent agent (here, the human customer) from observing the agent's actions or their effects (Schmidt, 2003). In addition, this process will depend on the plan library that businesses create in the authoring part. The delivery engine checks the clicked items and the plan library to acquire a sequence of advertisements to be presented to the user. The latter process belongs to the delivery engine part and no further details are given here. Moreover, a new XML file named `users_items_sequence.xml` tracks each user's selection sequence of advertisements, albeit only the final ten selections will be stored in this file. The threshold of 10 selections was decided based on trial and error on the testing phase of the system. This file will be used to predict user actions for current and similar users.

Furthermore, for advertising adaptations, we used, as said, the stereotype technique, as it makes inferences based on limited observations. Each user is assigned to a group (stereotype), according to the types of advertisements on websites (a website owner arranges his advertisements into groups and subgroups). The system then determines the activation conditions for applying the stereotype to a user. For example, if the user model shows that the user is interested in computers and televisions, then the system activates the stereotype "technology". From the usage data, if, for instance, the user has bought at least two electronic items or computers, then the stereotype "technology" can be activated.

Adv Item

Item ID: LCD1393709718958

a: Show Item

Adv Item Details

Item ID: LCD1393709718958

Name:

Information:

HardiskName:

b: Item Details

```
- <UserItems>
    - <Item>
          <User_Id>1397838625271</User_Id>
          <Item_ID>LCD1393709718958</Item_ID>
          <NumberOfClicked>2</NumberOfClicked>
          <NumberOfShow>2</NumberOfShow>
    </Item>
    - <Item>
          <User_Id>1397838625271</User_Id>
          <Item_ID>AdvertRoot1393709791989</Item_ID>
          <NumberOfClicked>4</NumberOfClicked>
          <NumberOfShow>4</NumberOfShow>
    </Item>
    - <Item>
          <User_Id>1397838625271</User_Id>
          <Item_ID>LCD1393709721749</Item_ID>
          <NumberOfClicked>2</NumberOfClicked>
          <NumberOfShow>2</NumberOfShow>
    </Item>
    - <Item>
          <User_Id>1095288034</User_Id>
          <Item_ID>LCD1393709718958</Item_ID>
          <NumberOfClicked>1</NumberOfClicked>
          <NumberOfShow>1</NumberOfShow>
    </Item>
</UserItems>
```

c: User Item.XML file

Figure 4: Plan Recognition.

Stereotype Name	Stereotype Attributes	Manage
age	kids;adult;senior;old	Delete Modify
gender	Man;Woman	Delete Modify
BandWidth	2M;4M;8M;8M+	Delete Modify

Stereotype Name	BandWidth
Stereotype Values	2M; 4M; 8M; 8M+

Add/Modify

Figure 5: Stereotype.

The administrator can create and control (add- update - delete) stereotypes.xml from the stereotype page (Figure 5). Based on hypotheses H1 (described below), an initial minimal set of necessary dimensions for an advertising user model are defined, and include *age, gender, bandwidth, device type, number of clicks on advertisements, education level, education type,* and *hobbies*. Each dimension has its own attributes. In addition, action sequencing is used in this research to predict the future actions of the user, to recommend actions based on the action sequences of other users, or to perform some of these actions on behalf of the user.

4 SCENARIO

To better understand the usage of the user modelling tool and the application of the data it stores, we describe a usage scenario as follows:

When the login page is loaded, Ahmed, a 25-year-old man, and a customer of a given company, enters his username and password. He could click the login button or he can login using his Facebook account. In both cases, bandwidth, location, device type, and software used for Ahmed are automatically obtained by the system. Login with a Facebook account will simplify access to the website and allows systems to automatically obtain important data.

Ahmed is using a smart phone with bandwidth lower than 1M (as extracted by the system). If Ahmed logs into the website for the first time, then only the general rules will be applied. All of the advertisements that are not appropriate for Ahmed (based on general rules: e.g., advertisements targeted to women, to higher or lower ages, higher bandwidth, or another device type) will be excluded. All of the advertisements that are appropriate for Ahmed, and all of the advertisements that are not assigned any rules, will be placed in the queue, to be shown to Ahmed.

However, if Ahmed logs into the website more than once, the behaviour rules and some inference processes will be applied. In order to apply behaviour rules and inference processes, the system needs to store all of Ahmed's behaviour, the advertisements that are shown to him and not clicked, the numbers of his actions, as well as advertisements that were shown and clicked, and the number of times they were clicked. When Ahmed clicks on any advertisement link, or the advertisement is shown to him, the system stores all of this data in two fields (number of shows, and number of clicks for each advertisement). In

addition, the system stores the last ten clicks for Ahmed to be used to infer his actions.

Based on this data, the system applies the behaviour rules and places the advertisements that results from it into another queue; in addition, there is another queue for the inference process, based on Ahmed's history of actions. Finally, the system decides on an advertisement (or collection thereof) from these three queues to be shown on the page that Ahmed loaded.

5 CASE STUDY

5.1 Hypotheses

The following hypotheses have been defined to evaluate the user model tool:

H0a: The user model (UM) concept for advertising (as illustrated by the UM tool) is <u>useful</u> for constructing a user model for recommendation of advertisements.

H0b: The UM concept for advertising (as illustrated by the UM tool) is <u>easy to use</u> for constructing a user model for recommendation of advertisements.

H0x are the basic hypotheses, and the rest are derived from them:

H1: The attributes of the proposed UM are <u>useful</u> for recommending advertisements (username, password, email, age, gender, education level, education type, hobbies, bandwidth, location, device type and software used).

H2: The data in the user model is adequate for the advertisements delivery engine decision.

H3: Automatically generating user model data (location, device type, and software used) is useful.

H4: Social networks used as a source for user data are an appropriate data source for recommending advertisements.

H5: A user's advertisement preferences can be predicted, by tracking the user's behaviour sequence when they use the system.

H6a: The input and output mechanisms of the user model tool are useful.

H6b: The input and output mechanisms of the user model tool are easy to use.

H7: The stereotypes for users with respect to advertisements recommendation are useful and appropriate.

H8: *The stereotypes for users with respect to advertisements recommendation are easy to use.*

H9: *It is useful to integrate the user model creation tool in any JSP website.*

H10: *It is easy to integrate the user model creation tool in any JSP website.*

H11: *Any website administrator can understand, use, and update the stereotypes.*

These hypotheses were evaluated by surveying a sample group of Internet users and analysing their answers, as further described below.

5.2 Case Study Setup

The user model tool was evaluated from a functionality and ease of use perspective by students studying different subjects and modules (Introduction to Business, Principles of Marketing, Management Information System and E-Marketing) at King Abdul-Aziz University in Jeddah, Saudi Arabia. Students were deemed appropriate as a testing population because, first, all of them are Internet users, and regular online shoppers, who are familiar with the current online providers. The other reason was to get a large number of users. Note that, whilst our users were familiar with the Internet, their study of a variety of subjects ensured that they were not only Computer Science specialists, and that the tool was tested with a wide variety of backgrounds, knowledge and interests.

Consequently, a sample of 285 Internet users were asked to evaluate the user model tool. In assessing the tool, they were asked to do the following.

First, the respondents were introduced to the user model tool and given a general overview of adaptive advertising. Next, the participants were instructed to use the tool and assess its effectiveness. The three-part questionnaire was provided at this point, to guide the evaluation process. The first section collects data on the personal details of each user. The second part presents a series of Likert scale (McIver and Carmines, 1981) questions, to encourage the users to rate the effectiveness of the system in terms of functionality and application. The Likert scale offered each respondent a series of five options when evaluating the user model tool, with the first scale option being 'not at all useful' or 'very difficult' and the last scale option being 'very useful' or 'very easy to use', respectively. A series of qualitative questions were posed in the final section, for respondents to speak freely about their experiences using the user model tool.

Table 1: Authoring Tool Features.

A	Whole User model Tool	G	Saving Information in XML as Export Format
B	User Registration Process	H	Facebook User Profile Import
C	Login Process	I	Match User Characteristic with Stereotype
D	Facebook Login Process	J	Adding own Stereotype
E	Submitting Information	K	Modifying existing Stereotype
F	Updating User Profile	L	Deleting Stereotype

Table 2: User Model Attributes.

1	Location	10	Education Type
2	Device Type	11	Hobbies
3	Software Used on Device	12	Bandwidth
4	Username	13	Get Location Automatically
5	Passwords	14	Get Device Type Automatically
6	Email	15	Get Software Used Automatically
7	Age	16	Getting Number of Shows for Each User
8	Gender	17	Getting Number of Clicks for Each User
9	Education Level	18	Getting Last 10 Sequence of Clicks for Each User

5.3 Results

Out of the 285 questionnaires distributed, 114 were completed (as students were clearly told that providing the answers was optional and had no impact on any of their other university activities or outcomes). Half of the respondents were aged 18-24, while 43.9% of them were 25-34, as can be seen in Figure 6. The results show that two thirds of the respondents were male and 34.2% were female, as shown in Figure 7. In addition, the education level (Figure 8) for the most of the participants was bachelor's degree, while 5.3% were at postgraduate level. This may have skewed our data slightly in the sense of a preference for the younger and well-educated population. However, they represent the generation whose needs must be considered by web providers, as they are shaping the demand of the present and future.

The Likert scale (Figure 9) facilitated respondents assessment of the features and functions of the tool and the results indicate that all of key features (A-L,
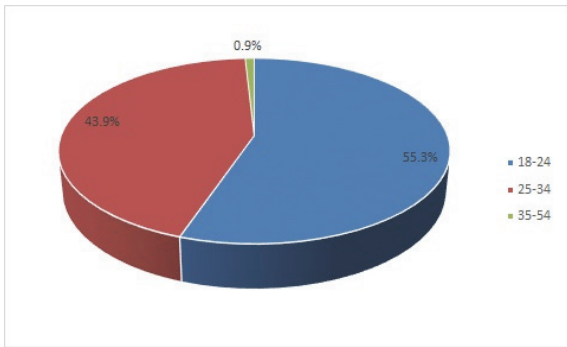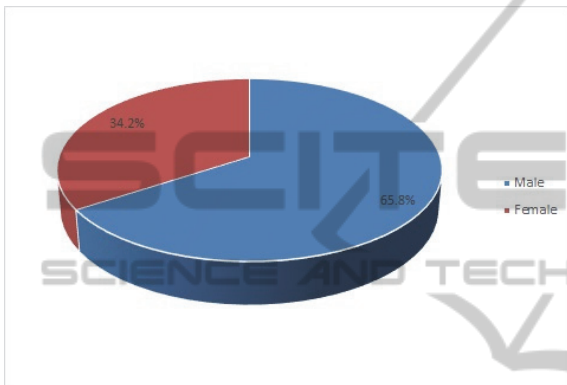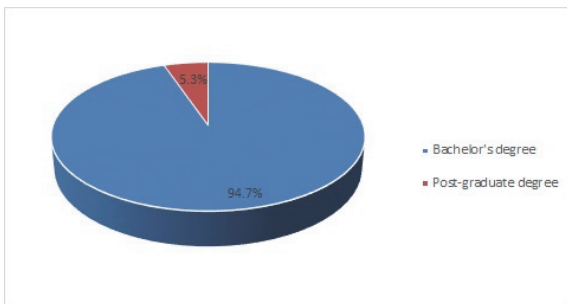
Figure 6: Age.

Figure 7: Gender.

Figure 8: Education Level.

defined in Table 1) were well-received. The tool's primary features were highly rated by users as each allocated a minimum score of four indicating that users found the tool's features are useful, and the standard deviation values of 0.47-0.50 were obtained. Therefore, as each score exceeded three, the user model tool can be deemed 'useful'. The most popular features of the tool were 'Saving Information in XML as Export Format', and 'User Registration Process' while the least popular features were (but still above four) were 'Match User Characteristic with Stereotype' and 'Modifying Existing Stereotype' while the slightly lower enthusiasm for these features may be caused by misunderstanding the purpose of

the stereotype. Therefore, some respondents may have felt that these features were less vital, when compared to others. Nonetheless, as each of these rules obtained a minimum score of four, they can still be regarded as useful. These results support hypotheses H6a and H7 indicating that the input and output mechanisms of the user model tool are useful, and the stereotypes for users with respect to advertisements recommendation are useful and appropriate.
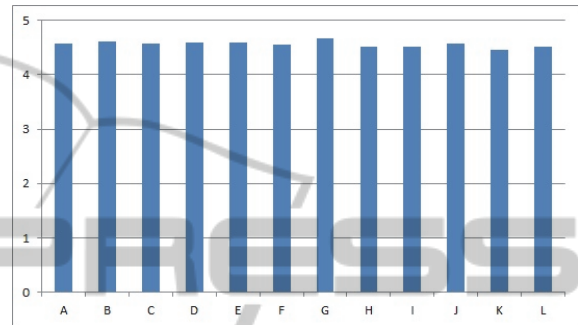

Figure 9: Usefulness (Ox axis detailed in Table 1).

The participants agreed that it is useful to collect all of the user model attributes to allow the selection of the appropriate advertisements, based on their profile and preferences. Figure 10 shows that user model attributes are useful or very useful, as the average score of 4.47-4.65, whereas the standard deviation values range between 0.48-0.50. Scoring highest in terms of usefulness for the user model attributes were "Education Level" and "Location". These results support hypotheses H1 and H3 to some extent, which said that the attributes of the proposed UM are useful for recommending advertisements, and automatically generating user model data is useful. The lowest scoring attributes were 'Get Software Used Automatically' and "Getting Last 10 Sequence of Clicks for Each User", although both elements scored above four. This may be due to a fear of their behaviour being tracked. Therefore, users felt that these attributes were useful, but not as vital. These outcomes support hypothesis H2 and H5 to some extent, as a user's advertisement preferences can be predicted, by tracking the user's behaviour sequence when they use the system and the data in the user model is adequate for the advertisements delivery engine decision.

All features were deemed to be easy or very easy to use, with average values of 4.46-4.61 and standard deviation values of 0.49-0.55. Consequent data analysis showed that users were particularly impressed with the 'Updating User Profile' and 'Facebook User Profile Import' features but not quite
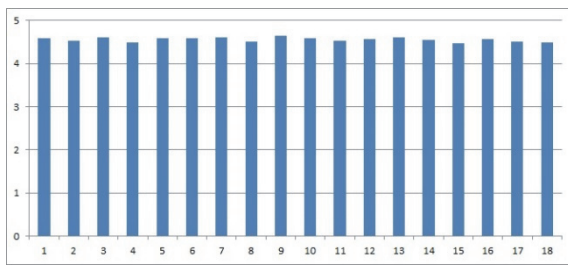
Figure 10: Usefulness (Ox axis detailed in Table 2).

as impressed with 'Saving Information in XML as Export Format' and 'Match User Characteristic with Stereotype' that support hypotheses H7 and H8, which indicate that the stereotypes for users with respect to advertisements recommendation are appropriate and easy to use. However, these components still received a minimum score of four, which implies that these components are easy to use. Generally, these investigation results indicate that the user model tool is easy to use (Figure 11).
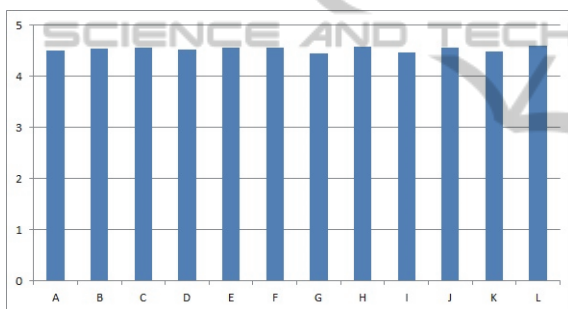

Figure 11: Ease of Use (Ox axis detailed in Table 1).

5.4 Qualitative Answers and Discussion

The last part of the questionnaire asked respondents to extend their feedback about the user model tool in order to highlight aspects that could be improved. This stage of research is fundamental, as it contributes towards enhancing modelling performance, by facilitating the efficient dealing with system issues, as they arose. Several respondents claimed that the tool should offer a more diverse range of hobbies as features, so that the scope of targeted campaigns could be extended, while others praised the Facebook login feature, which is now commonly offered by the majority of web-authoring applications. This feature is particularly useful, as the students were only required to remember one set of credentials to run different applications, it increases the integration of the user model with other web-based systems and increases overall functionality and ease of use. These results support to some extent hypothesis H4 which indicates that Social networks used as a source for

user data are an appropriate data source for recommending advertisements. One respondent also stated that the tool should refer to age in numbers rather than letters. Several respondents did not offer any specific suggestions on improving the tool, but acknowledged that it was an interesting topic of research, as online marketing systems and strategies become more and more advanced. Thus, the system should perhaps be promoted as a user-friendly tool, as opposed to a more advanced mechanism that requires specialist knowledge to run. Some also expressed confusion with regards to calculating bandwidth, so it may be necessary to take bandwidth limitations into consideration automatically, a modification that will increase usability in tracking these details on behalf of the user. Moreover, one respondent questioned why data was stored in XML as opposed to a database, so it may be necessary to explain how XML data can be transferred easily between different programmes. This support hypothesis H6a and b to some degree, in that the input and output mechanisms of the user model tool are useful and easy to use. In addition, regular users do not require such advanced knowledge of the system in order to use it effectively.

Another respondent suggested that additional demographical data should be collected, in order to create more in-depth user profiles and identify more specific target audiences. Similarly, another suggested the insertion of additional fields to diversify the tool, as more specific rules could be made in order to create more advanced marketing strategies. These are all useful suggestions, but need treated with care, as the main purpose was to obtain a light, flexible, easily transferable and applicable user model. Prior experience with adaptive hypermedia shows that adding a large number of features may only result in confusing the user. A way to deal with these various needs is to allow users some higher degree of customisation of the variables used - dependent however not only on their needs, but also on their knowledge of adaptive processes and systems, as was proposed in the context of adaptive education (De Bra et al., 2010). Moreover, the focus here is on developing a user model, and not the strategies that would be implied by it. Finally, in terms of interface and usability, one user stated that the system requires a more attractive UI, though this may not be a pertinent concern at this stage of the research process, the provision of a more attractive UI would undoubtedly improve usability and attract more users.

We believe that the system could increase the sales potential of businesses, by facilitating the accurate targeting of advertisements, based on a series of predefined demographic attributes and rules. This modified user model could offer more portability

to adaptive advertising systems and be integrated into any website, which support hypotheses H9 and H10 "It is useful and easy to integrate the user model creation tool in any JSP website". In addition, this model would facilitate the extension and expansion of existing systems and would offer a flexibility that we believe will help any business to personalise their advertisements, without the need to overhaul their existing business model. The website can call a method that resides on the same site in a specified location, using a code to manage all advertisements on that page, to alter them according to adaptation rules (Stash et al., 2007) and to keep records of those that have been displayed and clicked in the user model for current and future adaptation. These outcomes support hypothesis H11 to some extent, as any website administrator can understand, use, and update the stereotypes.

6 CONCLUSIONS AND FUTURE WORK

In this paper, a lightweight user modelling approach has been proposed. It could help Internet users to register to any web-based e-commerce system, and thus help companies' access their target audience more directly, by tailoring their marketing campaigns towards specific consumer demographics and focusing their advertisements on users who satisfy a predetermined range of criteria. Based on the outcome of theoretical and practical testing, a minimum set of user model dimensions have been validated. The evaluation results indicate that the initial functionality and usability of the small prototype system is promising. Further modifications are planned, based on the suggestions offered by survey respondents. The user modelling tool can be refined further, by taking into account user feedback and creating a lightweight adaptive system that is more customisable, and based on the needs and preferences of Internet users. As an immediate next step, in our follow-up studies, the delivery engine will be implemented, which is resident on the same website server, to deliver the advertisements to Internet users. This part parses the contents in the XML file and uses adaptation strategies to send the appropriate advertisements to the appropriate user, based on their user model.

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