Personalizing the online video intake in an ubiquitous language learning scenario

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Preface

The international conference on User Modeling, Adaptation and Personalization (UMAP) is a forum for researchers and practitioners who are investigating techniques for adapting systems to the demands of individual users or groups of users. The UMAP 2011 adjunct proceedings bundle demonstrations of innovative UMAP-based systems (including research prototypes) and poster papers that present novel research ideas, projects and scientific findings.

We thank the members of the Program Committee of UMAP 2011* for their support and reviews. Furthermore, we are grateful to all authors who submitted articles to the UMAP Poster and Demo track and contributed with their works to the UMAP adjunct proceedings.

Fabian Abel
Silvia M. Baldiris
Nicola Henze
Chairs of the UMAP Poster and Demo track, June 2011

An incremental visualization model for activity awareness information

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1 Activity awareness visualization

In the research on groupware and CSCW, [1] defines *activity awareness* as "the awareness of project work that supports group performance in complex tasks". Activity awareness support involves informing the user about the state of the her/his personal and shared activities, helping her/him to keep up to date with their evolution and to synchronize with collaborators; see [2].

Awareness information, delivered as notifications or presented in awareness spaces, concerns different types of events which might overload the user, challenging the resumption of the state of her/his activity contexts. In order to address this issue, we propose a presentation model supporting the incremental access to information. Our model visualizes a summary of the state of the user's collaborations, focused on the recent past, from which details about the occurred events can be easily accessed.

Fig. 1. Awareness cloud of a user of a collaboration environment (in Italian).

As shown in Figure 1, we propose to visualize the recent activity awareness information for a user U as a tag cloud representing an abstract view on the events occurred in U's activity contexts. The cloud enriches the awareness space of the collaboration environment (which presents complete information about the user's activity contexts) with a projection on the recent past.

Each node of the Awareness Cloud is either associated to an activity context (e.g., LAVORO A), or to a collaborator (e.g., CLAUDIO) and provides the user with a direct access point to the related awareness events (i.e., events occurred in an activity context

or generated by the actions of a user). The size of nodes depends on how many awareness events have been collected in the time interval considered for the generation of the cloud. In principle, visualization could refer to a long event history; however, this would not help understanding what happened in the recent past, which is relevant for handling multiple parallel collaborations. Thus, the cloud can be configured specifying the starting and end times to be considered.

Our visualization model assumes that awareness events are classified in the user's activity contexts. We applied it to the framework described in [2]; however, a different environment could be exploited as long as it provides the same functionality.

2 User feedback and discussion

We conducted an experiment to evaluate the impact of the introduction of the Awareness Cloud on users' experience.

Hypothesis (Ha): The introduction of a custom tag cloud to enhance a context-dependent activity awareness space (i.e., an awareness space structured on the basis of the users activity contexts) will improve users performance on an awareness information seeking task, in terms of execution times and number of errors.

Sixteen volunteers participated in this experiment (10 men and 6 women, all students or university staff members), with a median age of 26. The experiment had a single-factor, between-subjects design. Two treatments were applied: the experimental treatment consisted of an activity awareness space enhanced with an Awareness Cloud; the basecase was a context-dependent awareness space, structured on the basis of the user's activity contexts. Each treatment condition was considered as an independent variable. Participants' performance was considered as a dependent variable and was calculated considering two objective measures: number of committed errors and time needed to complete the task. Participants were divided in two groups of eight people and each group received one single treatment.

A questionnaire proposed to users before the task showed that there was no significant difference in the level of practice each user had with collaborative applications. The experimental task lasted about 15 minutes and was designed as an information recovering and comprehension one, simulating a typical, asynchronous reception of awareness information in a collaboration environment. Users in both groups participated in three different collaboration groups and received awareness information (13 events) regarding other users' activities in such collaborations. Users were then asked to answer six questions, whose answers could be found by navigating the various events.

We used an unpaired Welch's t-test to analyze collected data. An alpha level of 0.05 was used to make decisions of significance. We found a significant effect both for the number of errors (exp. mean: 0, ctrl. mean: 0,625, $t = -2.38$, $p = 0.049 < 0.05$) and for execution times (exp. mean: 542, ctrl. mean: 694,875, $t = -3.15$, $p = 0.011$), that lead us to reject null hypothesis of no difference between the treatments, and to accept our hypothesis: the introduction of the Awareness Cloud improved users' performance.

In a post-test questionnaire each user was asked to choose between 7 levels of satisfaction (from 0 to 6). Both groups expressed a median value of 5 for their respective

User Interfaces; st.dev for Experimental Group was 0,55 and st.dev for Control Group was 1,02; no significative difference was encountered.

The results of the experiment revealed that our visualization model represents an added value to a context-dependent awareness space: it significantly improved users' performance, in terms of times of execution and number of errors, while the control group did not perform as good. First-hand observations of participant behavior lead us to grasp two aspects that may explain these results: first, the Awareness Cloud was easy to understand and to use, and showed a good level of integration with the awareness space. Indeed, the users of the experimental group could choose whether to adopt it or not, but they all opted for its use since the first question. Second, the Awareness Cloud allowed users to express fast and precise queries by clicking on nodes, with a User Interface that was valued as "practical, good and interesting". Navigating into the awareness space in isolation did not prove itself as immediate and error-proof as the Cloud: users of the control group who did not commit errors spent more time doing their tasks, probably due to the need of verifying their choices.

Users complained that the Awareness Cloud made it hard to spot nodes with a very low density of events. As a possible solution, we want to enable the user to configure the Awareness Cloud by specifying which elements (s)he wants to monitor. When the cloud is generated, such elements will then be displayed with a different color.

3 Conclusions and future work

We presented a visualization model supporting the incremental access to activity awareness information in a collaboration environment. Information is presented at different levels of detail in order to provide the user with a general view on what has recently happened in her/his collaborations, supporting an easy retrieval of specific information.

Our proposal is the first step towards the development of an adaptive awareness support service providing a personalized access to awareness information. Personalized awareness clouds could be generated by enabling the user to select "high-priority" contexts, or by tracking the user's interests across activity spaces (e.g., see [3]) and by refocusing the Cloud accordingly. In our future work, we also plan to extend our awareness model to manage adaptive workspaces which tailor their services to the dynamics of the collaboration activities carried out by users; e.g., see [4].

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An Acceptance Model of Recommender Systems Based on a Large-Scale Internet Survey

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Abstract. Recommendation services capture and exploit personal information such as demographic attributes, preferences, and user behaviors on the internet. It is known that some users feel uneasiness regarding such information acquisition by systems and have concern over their online privacy. Investigating the structure of the uneasiness and evaluating the effect to user acceptance of the recommender systems is an important issue to develop user-accepting services. In this study, we developed an acceptance model of recommender systems based on a large-scale internet survey using 60 kinds of pseudo-services.

Keywords: acceptance model, recommender systems, privacy

1 Introduction

Recommender systems (RS) are widely accepted by the internet service users as convenient and indispensable tools. To build well-tuned recommendations for a specific user, the system must acquire personal information about the target user, including demographic attributes (age, sex etc.), their preferences, and behavior with the target services. It is known that some users feel uneasiness with such information acquisition by systems and have concerns regarding their online privacy [1]. Investigating and understanding the structure of the uneasiness to the acceptability of RS, how to reduce the uneasiness, and how to enhance privacy are important research issues to make RS more user-accepting.

Recent research is providing user acceptance model for various internet services including personalized ones such as RS [4]. Chellappa and Sin [3] revealed a tradeoff between usefulness of personalization and users' concern over privacy. Yet, Vijayasarathy [5] reported that customers' privacy concerns are not a significant factor for predicting user intentions to use on-line shopping services. As RS become more popular, more extensive research on user acceptance is needed to design user-accepting recommendation services.

In this paper, we construct a user acceptance model of RS including privacy related factors based on a part of the data collected through an internet survey. The unique contributions of our study are in 1) using large amount of data acquired from over 4,000 subjects and 2) using pseudo-service to fill the gap

between declarative and behavioral acceptance. In the survey, to enable subjects to experience recommendation services with specific characteristics, we implemented various kinds of online pseudo-services in three service areas (e-shopping, healthcare, and navigation). The number of the service types is 60 and two of them were randomly allocated to each subject.

2 Large-Scale Internet Survey Using Pseudo-Services

In the beginning of 2010, we conducted a large-scale internet survey on disclosure and usage of online personal information and acceptance of RS using the personal information. First we extracted important factors which can affect users' acceptance of recommendation services through literature review, small-scale user interview (12 subjects), and large-scale preparatory internet survey (105,176 subjects invited and 20,001 subjects responded).

In the main survey, two types of pseudo-services were randomly chosen from 60 types and allocated to each subject. The subject first experienced one of them, that is, he was asked to execute three tasks (registration, get recommendation, control personal information used in the service). Then he answered to queries (46 queries about user characteristics, 22 about users' perception/impression of the experienced recommendation service, 1 about users' intention to use the service). The process was repeated two times per subject. We invited 6,000 subjects and got answers from 4,422.

3 Results and Future Work

Using a part of the survey data, we examined the relationship between users' impression/perception and intention to use RS with the structural equation modeling (SEM). The hypotheses which we focus in this paper are as follows:

Hypothesis 1 Perceived usefulness of a RS will positively affect users' intentions to use the system.

Hypothesis 2 Perceived ease of use of a RS will positively affect users' intentions to use the system.

Hypothesis 3 Perceived risk over privacy for a RS will negatively affect users' intentions to use the system.

Hypothesis 4 Perceived reliability of a company which provides RS will positively affect users' intentions to use the system.

We used 5-point scale measurement queries (from strongly agree to strongly disagree) in the survey. In this analysis, we used three queries for evaluating perceived usefulness, three for perceived risk, one for perceived reliability, ease of use, and intention to use the recommendation service.

Fig. 1 shows the result of the SEM analysis using Amos [2]. Standardized coefficients are shown on the arcs corresponding the above hypotheses. As is demonstrated in the figure, all hypotheses are confirmed to be significant at $p <$

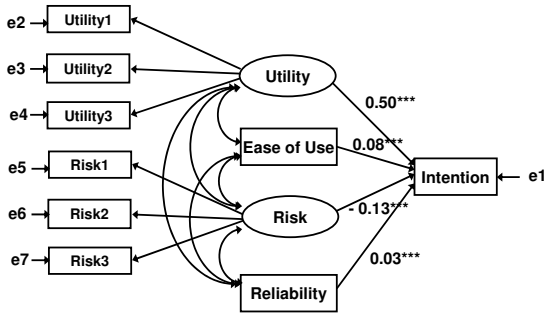

Fig. 1. Result of the analysis with SEM (Acceptance model of RS)

0.001 level. The values of the goodness of fit statistics, GFI=0.997, AGFI=0.993, CFI=0.997, RMR=0.009 and RMSEA=0.023 show that the model explains the variance structure of data well. This result clearly shows that the uses' perceived risk is an important factor for acceptance of RS as in [3]. It also demonstrates that the high reliability of the service provider can increase the acceptance of the services.

In this paper, only a part of user characteristics (risk sensitivity) and service characteristics (reliability of service provider) were used in the analysis. Because our survey is very large-scale, we can analyze many other aspects of user acceptance in future. Other than acceptance of recommendation, users' intention to disclose personal information, and permission of the secondary use of the information, will be analyzed to gain a deeper understanding of users' attitude to online personalized services.

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PeWeProxy: A Platform for Ubiquitous Personalization of the "Wild" Web

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Abstract. In this demo, we present PeWeProxy, a specialized proxy server which shifts personalization layer from the server side towards client and changes any web site of the "wild" Web into a personalized and social one. Such a platform is highly valued by both users and researchers. Users see the benefits of enhanced web surfing while researchers are provided not only with precious web usage data but also by means how to quickly evaluate their methods in real world scenarios.

1 Introduction

Most of nowadays Web adaptation methods are able to work only

- in specially tailored web-based systems with a well-defined and known domain (thus closed information space)
- require special devices on the user side, such as custom web browser
- force user to radically change her surfing habits (e.g., use a different search engine, which can significantly affect the evaluation of proposed methods).

Problem of closed information space is that information provided by one site (even in a personalized way) can hardly compete with the vast information potential of the whole Web. Even if this problem can be partially solved by techniques of open corpus user modeling, the two remaining problems (custom web client, custom search engine) still represent a barrier in transferring methods and results of research into practice, to a wider audience.

In this demo we present PeWeProxy (`http://peweproxy.fiit.stuba.sk`), a solution to overcome aforementioned problems. It is an enhanced proxy server able to deliver ubiquitous personalized Web experience to its users. It comes with a service layer which allows for any possible processing of HTTP requests and responses flowing through the proxy, including an on-the-fly creation of lightweight keyword-based user model. Its main goal is to take personalization and adaptation techniques based on ideas of the Social Web and apply them on the "wild" Web of websites, which are created using "one-size-fits-all" paradigm.

PeWeProxy brings advantage to both users and researchers: users get the browsing enhancement that make the Web social and easy to use, while the researchers can collect precious data on the Web usage and perform experiments in real-life scenarios. We have already used PeWeProxy to evaluate novel approaches to search personalization [2] and social website navigation [1].

2 PeWeProxy

PeWeProxy is based on a fast and reliable proxy server Rabbit written in JAVA. We added an infrastructure, for capturing, processing and altering requests flowing from users to web servers and vice versa. The whole architecture is pluggable, where all the processing is done via plugins performing operations on the top of HTTP messages, making it extremely easy to incorporate new functionality. Although there were previous attempts to realize adaptive layer within a proxy server, such as IBM WBI (`http://www.almaden.ibm.com/cs/wbi/`), they lack high level infrastructure required for consistent user modeling (e.g., user identification, feedback collection). A difference is also that our solution is fully distributed (Fig. 1), eliminating a single point of failure and lowering latencies.

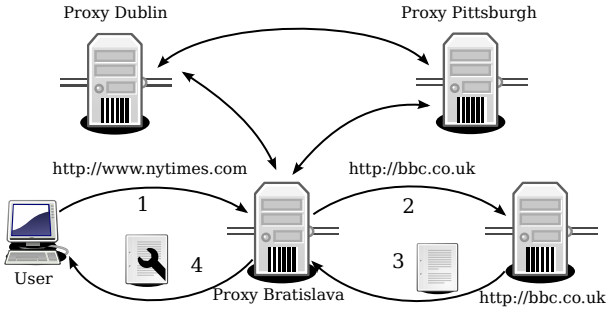

Fig. 1. Overview of distributed proxy deployment. Multiple proxy servers synchronize their databases and share user models.

PeWeProxy user model. PeWeProxy comes with a set of core plugins realizing user modeling across the "wild" Web. First, it assigns each HTTP request to a user by storing a persistent cookie holding an anonymous identifier. For the actual user modeling, we opted for keyword-based approach, where keywords and other metadata are extracted from web pages using various third-party services (e.g., OpenCalais). In addition PeWeProxy injects a tracking JavaScript into pages, which reports implicit feedback indicators such as time spent on page.

Web surfing enhancements PeWeProxy supports two types of web surfing enhancements: *(i)* site-specific, augmenting navigation or functionality of a particular web site (Fig. 2) and *(ii)* social-based, which can be applied to any web-site as they are based on generic principles of wisdom of crowds, such as visualization of footprints of visitors, which are similar to current user.

3 Conclusions

Our specialized proxy server provides pluggable and distributed architecture acting upon the communication between user's browser and the Web. It has

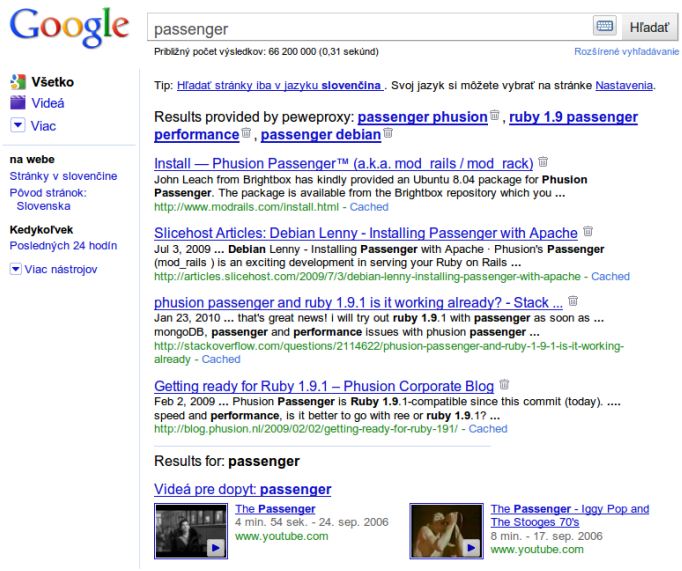

Fig. 2. An example of a site-specific augmentation: PeWeProxy disambiguate and expands queries to Google search engine and provides personalized search.

a great potential for researchers in the field of user modeling and personalized systems, allowing them to quickly deploy and evaluate their ideas in cooperation with real users in real-life scenarios.

It is simple to build a plugin, which was confirmed by participants of PeWe workshop (`http://pewe.fiit.stuba.sk/ontoparty-2010-2011-spring`) who created interesting web enhancements in just four hours, without any prior experience with our proxy platform. Because PeWeProxy also automatically synchronizes its database and user models between multiple instances and can be easily deployed in multiple geographical locations, we believe that more research groups from UM community would join our initiative.

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INGRID: A web service tool for hierarchical open learner model visualization.

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Abstract. This paper presents a tool to visualize open learner models. The tool is domain independent and is freely available as a web service. It can be easily integrated with any existing web-based learning environment.

Keywords: Open learner model, visualization, web services

1 Introduction

The learner model is the core of any adaptable educational system. The internal representation of the learner knowledge is used to adapt the behavior of the system. In the last decade, it has been claimed that the information about the learner model should be accessible not only to the system, but also to the users. It has been proposed that the users should even participate in the refinement of the model by modifying the learner representation. Such a model is called an open learner model [2].

Many intelligent and adaptable systems have provided ways of visualizing and interacting with the learner model. [1][2][5][6][7][8]. However, the development of such components has been almost always deeply linked to the system, which means that heir reusability has been very limited as developing a new system requires a considerable amount of work and money.

This demo presents a tool called INGRID that has been designed for the visualization of open learner models. It was initially developed as a component of MEDEA architecture [3], but it has evolved as an independent application, based on web services. It has been implemented using the JavaScript InfoVis Toolkit. (See http://blog.thejit.org/). As an example, the integration between INGRID and SIETTE [4] is shown in fig. 1.

2 Open learner model visualization

The new 2.4 version of INGRID includes three types of representations of the learner model: A dynamic tree, see Fig.1 (top), that displays the knowledge level based on a color scale. This is a partial view, where users can collapse or expand nodes to explore the whole contents. The sunburst, see Fig.1 (bottom), that presents the whole

learner model in concentric sectors. The third view presents a table with the details of the knowledge level distribution for all concepts and its evolution in time, if available.

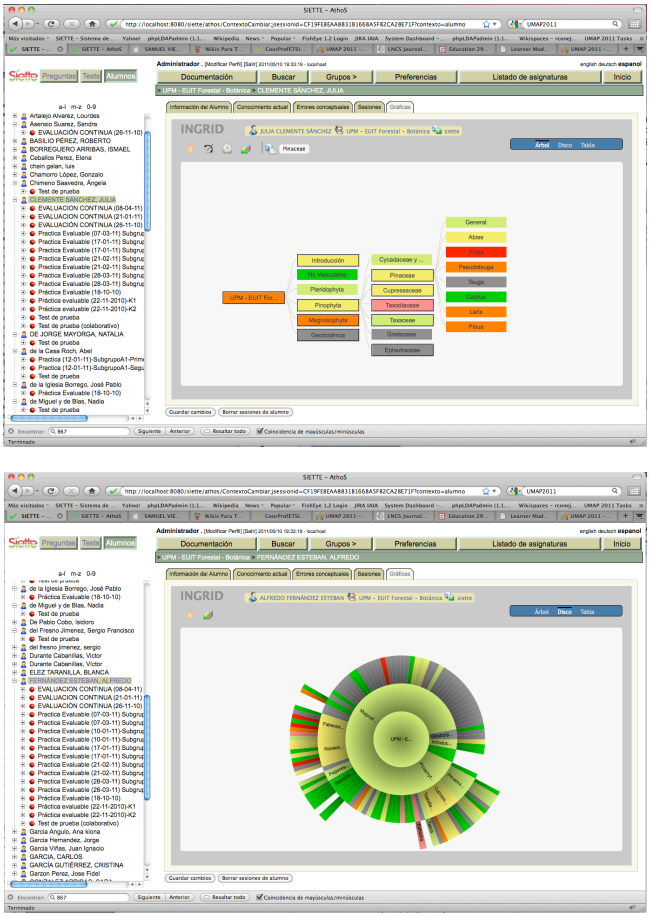

Fig. 1. The tree and sunburst views of the hierarchical learner model integrated with SIETTE.

All of these views are interactive, which means that the user can click on any concept representation to obtain a detailed description of the sources that support its current value. Alternatively, the user can select any of the possible actions associated with a particular node, which allow him to manually edit the current value, and/or access other sections of the learning environment related to the desired concept. To call the visualization web service, the learning environment should construct three XML objects: the ontology of concepts with at least the "part-of" relationship, the *(concept, knowledge level distribution)* set; and the *(concept-actions)* set. The learner's name and context are also passed, but there is no need of authentication, since the visualization tool does not store information about the user. It only

represents what its client sends. Actions are web links that, when clicked, redirect the user usually to the same learning environment that has called the visualization tool. For instance, in the integration with SIETTE, action links are knowledge assessments that are available and/or recommended to the user. Other systems can add links to specific sections of their content. Before calling the visualization tool, the learning environment composes those links so the visualization tool only has to display them.

The main advantage of this approach is the fact that the visualization of the student model is a completely independent and reusable module that can be integrated anywhere in a web intelligent learning environment, based on the classical overlay hierarchical learner model. The main integration effort is to create the XML format of the domain model and the learner model. Actions are optional. Moreover, future improvement on the visualization tools would be automatically available for clients.

Current limitations of the visualization tools include the visual representation of the uncertainty of the system about the knowledge level of a particular concept (the information can be passed but it is only displayed as a distribution in the table view); and the representation of misconceptions. The current version of INGRID is available at http://urano.lcc.uma.es/ingrid, and SIETTE at http://www.siette.org

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Personalizing the online video intake in an ubiquitous language learning scenario

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Abstract. This research explores the possibilities of video elements as an autonomous resource for language learning. We are working on the development of a platform that enables ubiquitous access to educational video content from different devices, emphasizing mobility. A key goal of the project is the delivery of audio-visual material specifically recommended to the student based on explicit learning goals, activity logs in the platform and the properties of the specific context of the student (device being used, user location or connectivity details). The aim of using this system is to understand and improve the patterns and habits of students learning languages whilst mobile.

Keywords: Online Video Platform, Interactive Video, Ubiquitous Learning, User Modelling, Recommendation Engine.

1 Introduction

Nowadays, video is a recurrent resource in learning initiatives. Thanks to technologies like the Internet, Web 2.0, core languages like Flash or HTML5 and fourth-generation mobile devices, video is becoming an element of direct and quick consumption, abundant in the net and ubiquitous in its intake.

In addition, new devices such as smartphones, tablets or interactive television systems exploit the use of information from the Internet efficiently to manage common tasks like the real-time communication of users and also the remote consumption of multimedia material such as pictures, music or video [1]. Current device market trends confirm the relevance of these practises, by investing in the development of applications that are able to adapt in shape and content to different screen sizes and interaction systems. The acquisition of knowledge is undoubtedly one possible target for these applications, as today there are many different lines of research such as mLearning that exploit ubiquitous learning [2].

Specifically, in language learning, there are many formative experiences using video in mobility, but most of them involve a fixed structure operated by a real teacher, tailored lists based on predefined learning paths, or they just leave the student with the task of choosing which content to consume through search tools [3].

2 Steps towards personalized video training

The main objective of this research is to use an educational video platform to bring fluid learning into ubiquity, making the material always readily accessible. To do this we established a set of goals in order to develop functional research. We focus on language learning, specially using video material for the maintenance and reinforcement of language skills as a means to complement lifelong learning.

We will define a semantic tree for language learning so we can completely structure elements from this area of knowledge. We are studying the categorization of items such as the specific language itself, the level, or the skills involved, along with already functional ontologies for language learning like LLOM+[4], and of course adding the necessary data for a complete design that meets the needs of this mobile learning context, allowing modifications if needed.

Our system will behave as a learning object library, registering all the metadata and statistics on our servers, but allowing the usage of both local video and other universities/partners educational repositories [5], even including general video content websites to centralize access and improve the intake of videos. We use a recommendation engine that serves user-personalized content based on our semantic structure video annotations, making them evolve according to the "interesting/not interesting" feedback given from the students and its impact in their profile goals.

Finally, we will analyse the usage and experience satisfaction from users and also review our predictions using the systems logs on usual practices according to device.

3 System structure and delivery design

We have designed an architecture scheme that supports the platform functionality, including the adaptation and recommendation processes (Figure 1).

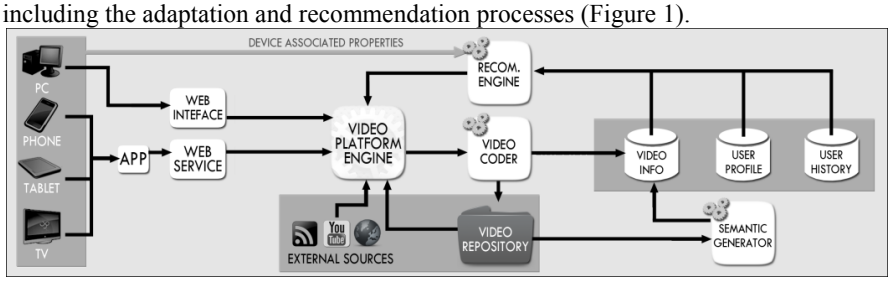

Fig.1. Ubiquitous educational video platform high level architecture

In figure 1 all the general system processes can be observed. First, it provides access to the video platform engine through a Web interface or a specific application relying on web services for the supported devices [6]. The video library is composed of a collection of references to audiovisual educational material, where in the case of own-repository content the system prepares different versions of each video by means of a video coder server, to support different qualities and formats to suit each device and screen size configuration (thus improving user experience). Finally, another two important processes are identified in the chart, a semantic labelling helper based on data extraction from the media key frames, and the video recommendation engine.

Video access and its delivery to students is a critical point of the system. While a guest user can access any indexed material, our attention is primarily set to registered users, since otherwise we could not manage information on their profile and history, and therefore make an effective recommendation [7]. For each user we will maintain a profile with stored information regarding their preferences and language learning goals on the platform (chosen from the developed ontology, such as 'Business English' or 'B1 level') along with their history and evolution in the system (including bookmarked videos) [8], goals that will be reviewed and questioned by the system periodically so the student moves in the right direction. These goals correlate with the semantic labelling on each video, so the user can state whether a specific media has been positive or not for their learning, re-factoring the weight of each video label by contrasting it with the user profile. Finally the engine will filter results according to extra factors such as the user location, format and video quality supported or other context-related restrictions, allowing the student to receive new appropriate content for that specific situation whether he is at home, at the University, on the bus, etc.

4 Discussion

In this paper we have presented our research on the possibilities of video elements and their use in language learning, creating a distribution and consumption system based on semantic recommendations which take into account not only the content but also the user context. The project is in a stage where it combines the completion of the formal design with the development of prototypes of each module from the system that help us work towards the results we expect for the final experiences.

We believe the final video platform experiences will provide feedback with meaningful data on the different usage learning patterns for each device and the strengths and weaknesses of context-based recommendation engines for learning.

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Aligning Subjective User Feedback for Reputation Computation in Virtual Reality

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1 Introduction

Virtual Reality (VR) is defined as an artificial environment experienced through sensory stimuli provided by a computer. Current research on VR aims to develop a simulated reality that is realistic enough to satisfy human senses. As this technology is getting mature, its new application areas emerge, such as virtual marketplaces. Previous research has concerned about adopting virtual reality into constructing e-commerce, and validated whether and how virtual reality can influence trust and thus impact user decision making in advance [1]. Besides, there are inherited trust problems in virtual marketplaces. For instance, some sellers may be dishonest (*e.g.*, fail to deliver items as what they promised), or some sellers may have different competency (*e.g.*, provide only low quality products). In order to address the trust problem in virtual marketplaces, a five-sense oriented feedback provision approach has been proposed in our previous work [3]. The basic idea is to allow buyers to share their past experience about sellers in their feedback based on human buyers' five senses, namely, *vision*, *sound*, *touch*, *taste* and *smell*. Then, the reputation of sellers can be modeled based on the shared feedback. Information about five senses is synthesized by virtual reality simulators. As reported by Luca et al. [4], virtual objects can be created by copying the real products, such as using the 3D scanner to record *visual information* and using the haptic device to collect *tactile information*. With the aid of special equipments (*e.g.*, haptic gloves), users can also sense the virtual copies similar to the real objects, and can have the similar perceptions towards the attributes (*e.g.*, *softness*) of objects as in the real life. Thus, buyers can sense virtual products without time and space limitation compared to shopping markets in reality. However, this property of virtual marketplaces also brings several problems. For example, some sellers may cheat on the quality of products. They can always provide virtual objects copied from high quality products to attract buyers, but deliver lower quality real products. This further demonstrates the importance of reputation mechanism.

However, feedback in human users' five senses may involve users' own subjectivity by using the various subjective terms. For example, a simple concept like "soft" has different semantics for different users. The "adequately soft" perception of the user A may be interpreted as "inadequately soft" by another user B in some situations. Thus, if user B receives user A's feedback of "adequately soft", user B cannot use it directly. Instead, user B should interpret the feedback to "inadequately soft" according to B's own subjectivity. In this view, the step to firstly align the subjectivity involved in user feedback before computing reputation of sellers is indispensable and of great importance in assuring effective decision making for buyers. To effectively solve the above mentioned subjectivity problem in user feedback, we propose a subjectivity alignment approach by

adopting virtual reality tools with the information available in human users' five senses. To do so, the agent of each user maps the subjective terms in its user's vocabulary onto objective sensory data in the form of fuzzy membership functions and shares these learned metrics with the agents of other users. Thus, for each buyer, collected feedback towards a target seller can be aligned according to his own subjectivity, and then the aligned feedback is used to compute the reputation value of the target seller.

2 Approach

Specifically, in our approach, each user in virtual marketplaces is assisted by a software agent and equipped with virtual reality simulators. A *concept learner engine* module is attached to the agent, by which it can well learn the semantics of its user's subjective terms in a shared vocabulary [2]. The agent learns the semantics of these subjective terms over time by exploiting the correlation between the subjective product evaluation provided by its user and the sensory data, simulated by virtual reality tools (*e.g.*, haptic tools) for products avatars. The semantic metrics are specified in the form of fuzzy membership functions and shared with the agents of other users. Thus, the feedback communicated among agents are composed of only objective semantic metrics. This allows the agent to clearly interpret the subjective feedback provided by other users and transform it into its own user's subjective terms (*i.e.*, perceptions). Based on the aligned feedback, the agent automatically evaluates the satisfactory degrees of past transactions conducted by other users according to its user's preference. In summary, through the subjectivity alignment approach, buyers can more accurately model sellers' reputation. In the next sections, we will describe our subjectivity alignment approach in more details and explain how we can use the aligned results to compute reputation of sellers.

2.1 Subjectivity Alignment

The agent of a user is responsible for modeling semantics of the subjective terms in its user's vocabulary. Here, using virtual reality simulators, the subjective terms of buyers are learned and mapped onto corresponding values of objective sensory data that are numeric in our system. Note that, the learning is an iterative process that requires sufficient interactions data between the agent and its user in order to obtain relatively precise mapping metrics. A basic learning unit is as follows, the agent provides a sensory stimuli to its user, and the user percepts the stimuli and provides to the agent a corresponding subjective term (*e.g.*, too soft) that best presents his perception in his vocabulary to the agent. Besides, the learning is also a continuous procedure because the perception of a user may change over time. For example, a user may become less sensitive to *tactile stimulus* as he gets older. Thus, the learned metrics should be updated every time after a certain time interval. Furthermore, in reality, it is common that human users cannot present their perceptions consistently towards some values of objective sensory data. That is, more than two different subjective terms may be provided by the same user as he has some fuzzy sensory zones. Hence, to more precisely specify the mapping metrics, we introduce the *trapezoidal membership function* with pseudo partitioning, ranging in the unit interval $[0, 1]$, to represent the degree of truth for the subjective terms. Here, 1 indicates the full membership of a given subjective term, referring that a user is completely confident about his perception. If the degree of truth $\rho \in (0, 1)$, it means that the user might sometimes describe his perception using this subjective term, and at other times use other terms in his vocabulary due to the perception sensitivity. After learning semantic metrics, each agent can align other users'

feedback according to its own user's subjectivity. For example, both user A and user B use two subjective terms, *i.e.*, "inadequately soft" and "adequately soft", to describe their touching experience. When user A provides a feedback of "adequately soft", the agent of user B should firstly collects the user A's semantic metric of "adequately soft", S_1. Then, it computes the similarity value between S_1 with user B's two semantic metrics respectively. The subjective term with higher similarity value is considered to be B's perception according to user A's feedback of "adequately soft". Thus, the feedback from user A is aligned according to B's own subjectivity.

2.2 Reputation Computation

The main flow for the buyer B's actions to compute the reputation value of the seller S is illustrated as the following four steps: 1) The agent of the buyer B requests and collects a set of feedback about the seller S, where subjective terms are translated to objective semantic metrics represented as fuzzy membership functions; 2) Semantic metrics in the collected feedback are transformed into B's own semantic metrics; 3) Based on B's own preferences for different attributes and the aligned feedback of each past transaction, degrees of satisfaction are computed for the transactions; 4) The reputation of seller S is computed as the average degree of satisfaction.

3 Conclusion

This paper proposes a novel approach to align subjective feedback for reputation computation. It takes advantages of various virtual reality simulators in human users' five sense. We demonstrate how sensory data in virtual reality can be exploited in virtual marketplaces to handle subjectivity in user feedback and how the aligned feedback can be used in seller reputation computation. More specifically, the agent of each user is responsible for learning the subjective terms in its user's vocabulary, by mapping each subjective term into corresponding objective semantic metric. The semantic metrics are specified in the form of the trapezoidal membership function. This work represents an important initial step for constructing trust and reputation mechanism in virtual marketplaces. For future work, we will conduct experiments to validate that the subjectivity alignment approach can greatly improve the efficiency and robustness of existing trust and reputation mechanisms.

4 Acknowledgement

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Generating Personalized Destination Suggestions for Automotive Navigation Systems under Uncertainty

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Abstract. Programming a car's navigation system manually takes time and is error-prone. When the address is not handy, a cumbersome search may start. Changing the destination while driving is even more problematic. Given a modern car's role as an information hub, we argue that an intelligent system could in many cases infer the right destination or have it among the top N suggestions. In this work, we propose a personalized navigation system that is built from three main ingredients: strong user models, knowledge source fusion, and reasoning under uncertainty. We focus on emails as one particular knowledge source, exploring the uncertainties involved when extracting empirical data of email appointments.

Keywords: Knowledge Fusion, Uncertainty Reasoning, Information Extraction

1 Personalizing Destination Suggestions

If you take the car today and need directions, the destination must be entered manually into the navigation system. Even if one is familiar with the route, the use of such a system is beneficial as it provides current traffic information. But no matter what kind of input device one uses, the process takes some time and is error-prone. If one feels confident to remember the route, things can even become dangerous when the navigation system is programmed later while driving. Existing knowledge sources can be exploited to suggest an accurate set of personalized, situated navigational destinations to the driver in order to reduce the necessary interaction and avoid distractions from the traffic. Possible knowledge sources that contain clues about the destination are calendars and address books, usually stored on mobile devices or services in the cloud. Additional sources include email communication and GPS sensor logs, even though they are less structured and inherently unreliable. Our main claims are: 1) Extracting appointment information (in order to derive possible destinations) from emails is subject to uncertainties. 2) Taking into account probabilistic models allows for an accurate ranking of destination suggestions with uncertain and potentially conflicting destination information obtained from these extractions.

The proposed system is therefore designed to maximize the accuracy of personalized destination suggestions by dealing with uncertainties, using a combination of rule-based reasoning and probabilistic ranking.

Aggregating user information in a common knowledge base (see [2]) provides an ideal set-up for further reasoning tasks, which in turn enables personalization. However, much of the collected information is not known for certain, therefore care must be taken when drawing conclusions from it. The reasons are manifold, and include accuracy of information extraction (IE) systems, quality of pattern recognition models, precision of hardware sensors, human errors, etc. Using emails (as a mostly unstructured source for extracting appointment data) requires IE methods that deal with the automatic discovery of information in text. We have performed a human analysis of appointment specifications on an email corpus. 350 mails were considered for this study, where 29% of these mails contained a total of 143 appointments. The messages were manually annotated according to a fixed scheme. Incomplete time, place, and attendee information was given in 12%, 64%, and 21% of the events, respectively. Data was however in a straightforward, standard parsable format in only 36%, 9%, and 27% of the cases. Overall, the study confirms two things: 1) In many cases, emails contain the relevant time, location, and attendee information for meetings. 2) In a few cases, the information can be easily extracted, but in the majority of cases, a more sophisticated approach (e.g., using NLP techniques) is needed, which introduces uncertainties.

2 URDF Reasoning Framework

The URDF reasoning framework [5] we use as our reasoning backend provides a SPARQL-compliant query model for knowledge bases captured in RDF/S. In addition to constraints expressible in RDF/S, URDF supports Datalog-style *soft rules* which are grounded against the base facts provided by the RDF knowledge base. Via these soft inference rules, URDF can also derive new facts which were not initially present in the knowledge base itself. Moreover, as soft rules may be noisy as well, *hard rules* can be employed to enforce consistency constraints over both base and derived facts. The initial grounding phase of URDF is followed by a subsequent *consistency reasoning* phase, where probabilistic inference techniques are applied to calculate the confidence of derived facts. Confidence computations are based on the lineage (i.e., the derivation structure) of facts inferred from rules, which captures the logical dependencies of the derived facts back to the base facts that were used for grounding. Moreover, lineage also provides a convenient means for *explaining* how these answers were derived [4].

Inference Rules. While queries in URDF are conjunctions over subject-predicate-object (SPO) patterns just like in SPARQL, the presence of rules drastically impacts how these queries are evaluated, and how potential conflicts are resolved. Soft rules have the form of implications (Horn clauses), with exactly one positive head literal, while the body of the rule is a conjunction of positive literals. As an example, suppose we have the following knowledge base, consisting of a number

of base facts extracted from various email correspondences, as well as an inference rule about the possible destinations `?eloc` of a user `?x`, given the current time `?ctime` and location `?cloc`.

```
hasEvent(Mike, E1) [0.7].
eventTime(E1, 24.01/10:00) [0.6].
eventLoc(E1, DFKI-KL) [0.8].

hasDestination(?x, ?eloc, ?ctime, ?cloc) :-
       hasEvent(?x, ?e) ∧ eventTime(?e, ?etime) ∧
       difference(?etime - ?ctime) ≤ 60 ∧ eventLoc(?e, ?eloc) ∧
       distance(?eloc - ?cloc) ≤ 80 [0.9].
```

When issuing the following query

```
hasDestination(Mike, ?dest, 24.01/09:00, DFKI-SB)
```

thus looking for the place where Mike might want to go at 9:00am starting from the location DFKI-SB, the engine infers that Mike is associated with an event E1 at the location DFKI-KL, which is about to take place in one hour. Since the distance to this location is less than 80 kilometers, which can typically be reached within less than 1 hour, DFKI-KL is a likely destination of Mike on this morning. Hence, we obtain the derived fact

```
hasDestination(Mike, DFKI-KL, 24.01/09:00, DFKI-SB) [0.3].
```

as the only possible answer to our query with a confidence of 0.3024 (which can be obtained by multiplying all input confidences in this simple example).

Lineage & Confidence Computation. URDF employs SLD resolution, which is also the default grounding technique used in Datalog. In analogy to uncertain and probabilistic databases [1], we represent lineage of a derived fact as a Boolean formula (see also [3] for details on the semantics of these operations). The lineage formula is expanded recursively when grounding a query against the rules. That is, whenever we expand a rule, the head literal is replaced by the literals in the body of the rule, such that only variables related to base facts (and first-order soft rules) are contained in the final Boolean lineage formula.

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A new dimension for user modeling based on the use of sensory vocabulary

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Abstract. In our research, we investigate the use of sensory vocabulary in forum texts as a source for implicit information on the user. Therefore, a corpus with more than 1,000,000 forum posts was analyzed for the occurrence of expressions that are directly linked to a sensory system. We found that users differ significantly in their use of sensory expressions and that most users have preferred patterns for the use of sensory expressions.
Keywords: User Modeling, Perception, Language use

1 Introduction

Digital media permits to present information in manifold ways. An adequate mode of information presentation helps the user with information processing, e.g. some users prefer to read new information, some prefer listening to it. Research shows that information can be more easily understood if its presentation is adapted to the cognitive style of the target user [2]. One aspect of cognitive preference consists in the preferred mode of perception [2;3]. Such information might be of interest for every user model used in a setting where the user's interest needs to be captured or the user's process of information perception and organization shall be supported [4].

But how can such a preference be elicited? We propose to use existing text, written by the target user and published in the internet, as a source of information about the user's perceptual preference. We follow the tradition of lexicon based approaches [6;8] such as used in opinion and sentiment mining when we look for expressions with a link to a sensory system, e.g., "green" or "see" as visual, and "loud" as auditory words.

2 Method

Our work proposes an extension to existing user models. We present a modeling technique that implicitly acquires sensory vocabulary data by analyzing forum text.

Sensory lexicon We based our lexicon of sensory vocabulary on the list of stems of sensory vocabulary collected by [5]. The list of sensory stems may be divided into 4 disjoint sets, namely the lexicon of visual vocabulary L_V, of auditory vocabulary L_A, of kinesthetic vocabulary L_K, and of olfactory and gustatory vocabulary $L_{\{OG\}}$.

Measures The use of sensory vocabulary in a document p is expressed as a four-dimensional vector *vprofile(p) = [p.V, p.A, p.K, p.OG]* based on the frequency of sensory vocabulary per sensory system. Thus, the visual component of the vector (the other components are calculated analogously) is defined as

$$p.V = \frac{|\{ t \in p' \mid v(t) = 1\}|}{|\{t \in p' | v(t) = 1 \text{ or } a(t) = 1 \text{ or } k(t) = 1 \text{ or } og(t) = 1\}|} \quad (1)$$

where *t* are the terms in *p'*, which is *p* modeled as a bag of words, and *v(t)* (etc.) are the sensory indicators of the term:

$$\text{indicator level } s(t) = 1 \text{ if stem(t) is in the lexicon of sensory vocabulary} \quad (2)$$
$$= 0 \text{ in all other cases.}$$

VAKOG profiles *vprofile(p)* were not only calculated for each document, but also for each author by concatenating all posts of this author to one new pseudo-document and calculating its profile as described in Equation (1). The similarity *vsim(p1,p2)* between two posts was measured as the cosine similarity of their profiles.

Hypothesis Every user has a preference profile for sensory modalities, expressed as a profile of usage of sensory vocabulary. Hence, the similarity *vsim(p1,p2)* of posts written by one author should be higher than to posts written by somebody else.

$$avg_{p1,\, p2 \in P,\, p1.author=p2.author}\ vsim(p1,p2) > avg_{p1,\, p2 \in P,\, p1.author \neq p2.author}\ vsim(p1,p2) \quad (3)$$

where the *pi* are posts, *P* is the set of all posts, *pi.author* is the post's author, and *vsim* is the similarity between the VAKOG profiles of its two arguments. We decided to control for content similarity by treating the full-text similarity of two posts as a covariate. The hypothesis then is refined to "if two pairs of posts each have the same full-text similarity, the pair of the same author will have higher VAKOG similarity than the unrelated pair". Full-text similarity was operationalized as the cosine similarity between the two posts modeled as bags of words (BOW) by the WEKA[1] StringToWordVector filter, weighted by TF.IDF [1].

Data To test the hypotheses, we chose Richling's forum corpus [7]. It is a corpus built on posts from discussion forums on the car type BMW E30, published in the years 2000 until 2007. This very narrow topic helps to minimize result variation due to discussion of different topics. The corpus is monolingual and consists of more than one billion posts in German, each post text accompanied by information on the author, the header, the reference post, and the date.

3 Results: The use of sensory vocabulary in forums

The E30 forum corpus consists of 1,053,841 posts, written by 30,021 different authors. A detailed distribution can be found in Table 1.

Concerning our hypothesis, we applied two methods of testing. (1) Comparison of distributions with Mann-Whitney's U test: Significance testing against the null hypothesis of equal distribution was calculated separately for BOW and for VAKOG similarity, comparing the hypothesis set with the set of all post pairs. (2) To combine the similarities BOW and VAKOG, we used loglinear modeling for 3-way contingency tables. The values of the three dimensions were: (i) pairwise full-text similarity, (ii) pairwise VAKOG similarity, and (iii) the 2 categorical values of the variable of interest (*author-* vs. *non-author-post-relation*). All results were

[1] http://www.cs.waikato.ac.nz/ml/weka

statistically significant with a p-value <.0001. The hypotheses testing on the E30 forum corpus shows a significantly higher VAKOG similarity within the hypotheses subsets than within the set of all post pairs. These results were consistent both for the comparison of means and the combined BOW and VAKOG similarities. This confirms our hypothesis and leads to the following conclusion: Authors of forum posts have a tendency to use sensory expressions in similar distributions over time. Hence, that distribution can be considered as an interesting extension to user descriptions for user modeling.

Table 1. The distribution of sensory expression in the E30 corpus.

Posts	1,053,841
Original posts	223,973
Answer posts	829,868
Not-empty posts (neP)	646,455
Av. nr of terms per neP	40.69
Authors	30,021
Av. nr of posts per author	35.10
E30 Dictionary*	
Different terms	474,264
Different visual terms	6,798
Different auditory terms	5,047
Different kinesthetic terms	7,518
Different olfactory+ gustatory terms	1,674
Sensory terms	785,303
Visual terms	318,305
Auditory terms	248,896
Kinesthetic terms	192,566
Olfactory+gustatory terms	25,536

*Terms are handled as different as soon as they differ in one letter, including typos versions

4 Conclusions and outlook

In our research, we have proposed a new dimension for user modeling based on the use of sensory expressions. Based on findings from cognitive information processing and learning styles, we investigated the potential of the idea to analyze the use of sensory expression as an individual preference that might indicate sensory preference.

We opted for an implicit approach to data acquisition concerning the use of sensory vocabulary by means of analyzing forum text. We found that authors tend to use sensory expressions in similar distributions when writing new posts.

The obtained results are quite encouraging: Our next steps are to enlarge the corpus of sensory expression, investigate the relation between preferred sensory system(s) and the use of sensory expression by combining forum text analysis with user tests on sensory preference, and examine the influence of topic on the use of sensory expression.

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Designing Transparent and Controllable Adaptation to Social Context

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Abstract. Design of adaptation in transparent and controllable way preserves user trust, keeps high interaction comfort, and gives the user the feeling of control. This paper presents the design of an adaptive multi-display system that automatically adapts to the social context in order to protect private data from observation. The user-centered creation process informed the design of transparency and controllability of the adaptation.

Keywords: Adaptation, public displays, social context.

1 Introduction

Adaptation on public displays is often based on implicit interaction. Besides certain advantages, such implicit adaptation also comes with some risks. The lack of transparency and controllability over the adaptation can cause frustrations and the loss of user trust. This paper presents an adaptive public display system which takes into account user needs in transparency and control. We report on the design, sensing mechanisms, and the preliminary evaluation.

2 Design of the Adaptive Public Display

Existing research on adaptive systems identifies the importance of transparency and controllability as essential design factors improving user trust to the system [1, 2, 3]. If private data is involved in the adaptation, transparency and control gain even a greater importance. Langheinrich claims that systems should explicitly inform users of aspects that relate to their privacy [4].

The guidelines for transparency and control informed the design of an adaptive application, called Friend Finder. Friend Finder visualizes social networks of the users on a large public display. The display shows the pictures and names of the friends overlaid over the local map (see Fig. 1, left). The users can select friends to get more information, e.g. current availability or the path to the friend's destination. The system can be used by multiple users (see Fig.1, right); in this case the social networks can be differentiated by colors.

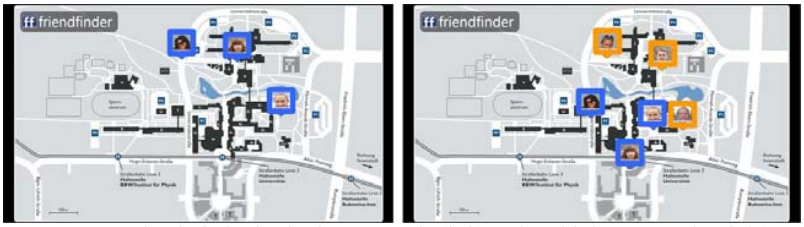

Fig. 1. Friend Finder in single user mode (left) and multiple user mode (right).

The display can be operated with a mobile phone which enables the browsing by means of a wheel control, inspired by the iPod wheel. The users run with the finger over the wheel clockwise or counter clockwise and highlight friends one by one on the public map (see Fig. 2, left).

Fig. 2. Selecting friends on public screen: in opened mode (left) and in protected mode (right)

Privacy Protection. According to an earlier conducted study [5], pictures and locations of the friends were perceived by students as privacy-critical data. Therefore, a privacy protecting adaptation was built into Friend Finder. The adaptation is based on the sensing of the social context: once another person is detected in the proximity of the display, the friends' pictures and names become masked on the public screen; they migrate to the mobile display. The users can select friends by means of the mobile display, by direct clicking on corresponding portrait (see Fig. 2, right).

Sensing of the social context. Privacy protecting adaptation relies on the face detection and noise level detection. Both mechanisms were implemented using SSI framework [6]. Face detection was facilitated by Shore software[1]. The camera mounted at the the large display senses the area near-by the display and thus detects the people who can potentially observe the display. The camera detects static and moving faces in the range of up to 5-6 meters radius (see Fig. 3). In order to detect people in the areas outside camera coverage, we introduced the noise level detection. The increase of the noise level over a certain volume threshold triggers the adaptation.

Designing transparency and control. Intermediate evaluations showed that decent visual alerts, i.e. the visual change of the public screen (masked pictures), suffices to notify the user about the adaptation fact. Control over the adaptation was required any time, but not in an obtrusive form. Therefore, the mode button on the mobile display enabled the users to change the performed adaptation. The button could switch the mode from masked to unmasked, and thus to correct the wrong system interpretation of the necessity to protect the data.

[1] Shore Software, http://www.iis.fraunhofer.de/en/bf/bv/ks/gpe/demo/

Fig. 3. Camera detects the faces in the proximity of the display.

3 Future Work Directions

The preliminary evaluation revealed the fact that the need in manual correction of adaptation strongly depends on the personal relations between the user and the observers. Therefore, the further improvements of Friend Finder are aimed at a more flexible user model behind the adaptation. The model will be based on the recognized personality of the approaching person. According to the personality the specific adaptation strategy will be applied.

Acknowledgements

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Mining the Browsing Context: Discovering Interaction Profiles via Behavioral Clustering

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Abstract. Web clustering usually groups semantically related pages, often including browsing usage information from server logs. However, this is rather limited when it comes to getting deep information about user behavior. Here we explore a different perspective. Behavioral clustering is about modeling the website, that is, finding interaction profiles according to how users behave while browsing. By using a client-side logging tool, we gathered interaction data on three websites. Then we applied a partitional clustering algorithm with interaction-based features as input vectors. We describe our approach, reporting preliminary results, and envision some applications for further research. Behavioral clustering helps to find common interaction profiles as well as to easily identify outliers.

Keywords: unsupervised learning, user profiling, implicit modeling

1 Limitations of Server-side Logs for User Modeling

Modeling the users has long been identified as the key factor of every adaptive hypermedia system. The usual approach is resorting to automatic analysis tools and Machine Learning (ML) techniques, since "manual" work (e.g., preparing usability tests or filling in online questionnaires) is certainly not scalable on the long term due to the highly dynamic nature of user interests and preferences.

Web clustering is a ML technique that aims to group web pages by similarity, by mining features that are document- or transaction-centered (i.e., based on text, link, and usage analysis). Grouped data are then used to make inferences about what users have read, are interested in, etc. Unfortunately, web clustering has been traditionally limited from the user interaction's point of view. Apart from the above mentioned dynamism of users' interests and preferences, websites are constantly updated, and newer paradigms (e.g., caching, Ajax) have substantially altered the traditional *client-request* $\leftrightarrow$ *server-response* model. Thus, the web server provides limited knowledge when it comes to getting deep information about the user behavior.

We claim that the browsing context should be added to better contribute to such behavior understanding; that is, we need to move to the client side. Also, mining the browsing context may enhance, complement, and strengthen current approaches to user modeling, adaptation, and personalization (cf. [2]).

2 Contributions

Our proposal has been entitled *behavioral clustering* because its main aim is to cluster websites by *how* users behave, *what* do they do, and *when* they access and leave a site. In the same way as browsing gives information about what is interesting (or not), behavioral clustering can be used to corroborate the coherence of a website from the user interactions' point of view. In addition, mining the browsing context could be used to augment known web clustering techniques, such as page ranking or relevance classification [1]. It also may add a new vision to describe web pages, e.g., *"document A is handled in the same way as document B, where users usually hesitate over the site logo and then click on the first link of the aside menu."* Finally, another contribution of this paper is the empirical validation of the proposed approach through a field study, which also replicates as well as extends previous work in the field [4].

3 Methodology

We collected usage data remotely on three *informational* websites (tendenciashabitat.es, lakq.es, sivaris.eu) for approximately a month, by using an Open Source tracking tool [3]. Such a tracking tool logged user interactions via DOM events (e.g., `mousemove`, `click`, `blur`, or `resize`). It also reported other useful information about interaction, such as scrolling, motion frequency, etc.

Users were chosen by random sampling, which means that only a fraction of all visitors (with equal probability of selection) was collected. Each interaction log was stored in a MySQL database and then exported in XML format, and are available upon request. We used Octave[1] to process all logs (11636 files, see Table 1), which were modeled as normalized interaction-based feature vectors. (For an overview of the chosen features as well as a previous pilot study one may consult [4].) We then applied the well-known K-means algorithm to group them in an unsupervised way, using random convex combination as initialization method. The optimal number of clusters was determined as the less distorted grouping in terms of the intra-cluster variance. Finally, we looked at the features that logs assigned to each cluster had in common.

4 Experimental Results

As observed in Table 1, we found some clusters that were clear outliers. This fact reinforced the idea of using behavioral clustering for isolating sub-populations. Looking at these outliers we found that logs belonging to those clusters had extremely unusual behaviors (e.g., browsing time greater than ten hours in the same page, almost no mouse motion, etc.). On the other hand, though, the remaining clusters showed more consistent behaviors. Looking at these groupings we could identify which pages were clubbing active users (e.g., rapid mouse

[1] http://www.gnu.org/software/octave/

movements, slight scroll reach, few clicks, etc.) or which ones caused people to hesitate most (e.g., repeated patterns of 'move-stop-move'). These results led us to conclude that each user sample we tracked was in fact a mixture of populations. This evidence encourages to be cautious in using logging tools or intuitions that assume a normal distribution for all users.

Table 1: Clustering results for the evaluated datasets.

Corpus (+ size)	OTH (4803 logs)						NM (5601 logs)					LAKQ (1232 logs)				
Cluster No.	1	2	3	4	5	6	1	2	3	4	5	1	2	3	4	5
Population (%)	0	46	15	0	0	37	25	0	16	27	29	43	7	14	20	13
Distortion	0	0.1	0.72	0	0	0.17	0.15	0.31	0.28	0.14	0.9	0.21	0.16	0.16	0.18	0.27

5 Summary, Conclusions, and Future Work

We have introduced the behavioral clustering methodology, which was evaluated on three real-world datasets, to discover "hidden" profiles on websites. This technique can be used as a measure of similarity between web pages or to evaluate their design. It is also suitable for discovering outliers or "wild-shots". Although we have used only behavior data generated by browser events, we have demonstrated that ours is a useful approach to organize and describe websites from the user interactions' point of view.

As observed, mining the browsing context from user behavior may serve as a complement to current web mining techniques. Future work includes verifying if behavioral clustering results are indeed better than traditional web clustering (i.e., based on clickthrough data only). Further suitability of this work relates to any system that taps knowledge about the user, e.g.: Information Retrieval, Relevance Feedback, Document Organization, or Usage Inference, just to name a few. We believe that we have barely scratched the surface of potentially novel research on user modeling and related applications.

Acknowledgements. Work supported by MIPRCV project (CSD2007-00018).

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Towards Personalized Pervasive Theragames in Smart Wheelchairs

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Abstract. Therapeutic serious gaming enables a more active rehabilitation process through an engaging learning. A patient can execute specific exercises while playing a game, involved in the story and trying to accomplish its activities and levels. This paper presents a proposal towards personalized and adaptive therapeutic serious games for pervasive assistive healthcare environments. Particularly, we are designing games for smart wheelchairs and to be used in the rehabilitation of both cognitive and motor deficits. The movement and the location of the patient's wheelchair are used as input for the gameplay. Furthermore, the work's research is investigating how a personalization model can be generally defined for these kind of systems in order to improve their effectiveness.

Keywords: Pervasive healthcare, personalization, adaptive therapeutic games.

1 Motivation

Currently, therapeutic serious games (theragames) are receiving a lot of interest by the healthcare community [1]. Using them, a patient can train specific skills and receive persuasive warnings or important information, being motivated and not perceiving them as repetitive rehabilitation exercises. They can engage patients and present even more success if taking into account the patient's capabilities, needs and goals.

Pervasive Healthcare is nowadays another hot topic [2], and the combination of pervasive healthcare assistive environments with theragames results in more effective tools for therapeutics assisting and monitoring. The context-aware nature of these pervasive theragames offers dynamic adaptation of content and interaction according to the patient's current condition, general capabilities and recent performance. As a main principle, a pervasive environment should proactively respond and adapt to individuals who inhabit it, meeting their specific needs and wants. The success of new healthcare proposals depends decisively on this principle of user-centered design. Personalized healthcare provides medical services that are truly effective "for me" instead of the today's general healthcare paradigm of "one size fits all" [3].

Motivated by the aforementioned, next Section presents a design proposal of personalized theragames for a Pervasive Assistive Environment (PAE) already presented in [4]. Finally, conclusions are presented and future work is addressed.

2 Personalized Theragames for an Assistive Environment

The PAE we are implementing integrates smart wheelchairs with embedded sensors to measure physiological parameters and mechanical quantities (e.g., acceleration). RFID technology is used to identify the patients on the wheelchairs and to locate the latter within the indoor space of application. An android-based tablet PC is attached to the wheelchair as a device for information presentation and user interaction.

The theragames will be used for the rehabilitation of both cognitive and motor deficits, with stroke patients (mostly elderly) being the main target population. The movement and the location of the patient's wheelchair are used as input for the gameplay. The main game is still in development and is based on Pervasive Computing and Augmented Reality (AR). Therapies based on AR offer immersive experiences to the patients, turning out to be more engaging and rewarding for them.

Basically, the game's main mode presents an indoor map in the wheelchair's tablet and is designed for three gameplay scenarios: 1) the patient sees virtual objects at specific positions of the map, which have to be "caught" through the physical movement of the wheelchair passing on their corresponding physical positions (patients have to "pick-up" the objects associated with a category, such as family or cooking); 2) different physical circuits must be completed within time limits; and 3) patients have to move in the wheelchair to certain positions/zones where adaptive sub-games are launched as activities. RFID tags on the floor are used to mark the paths, the virtual objects' positions, and the activities spots. The wheelchair's LF RFID reader tracks and identifies the floor's tags.

An additional interface of the game will be designed for ambient displays. This ambient interface can be used for multi-patient therapy with collaboration and competition settings. For instance, while a patient sees her presence in the tablet's map, it will be possible to follow all the wheelchairs through the general map in the ambient display. This is mainly a tool for the therapist that is monitoring the exercises and game action, but other functionalities can be added.

We already have a first theragame prototype related with cognitive rehabilitation. The game combines elements of both memory and mahjong kind of games. It permits therapeutic intervention when semantic categorization and auditory and reading comprehension are impaired in aphasia and alexia, the most common speech and language disturbance in stroke and head trauma. It is integrated as a sub-game of the third scenario of the main game, but it can be independently used by patients.

Personalization is essential to pervasive healthcare environments, which aims to provide adaptive context-based services to the users. However, obtaining and choosing the relevant information and interfaces for user interaction in these environments is still a critical issue [5]. An essential input for every personalization technique is the user model [6]. Our starting point for user modeling integrates the following items: demographics, preferences, properties, roles and health knowledge. Initial data is collected from life logging sensors, healthcare systems' records and even personal devices. Additionally, the usage of the physiological sensors enables the capture of patients' physical and physiological data as biosignals input to the personalization process. Combined with the patients' current performance scoring (and therapeutic scoring history) and goals, they are used for setting up levels and activities (e.g., adaptation of GUI and information) and for difficulty adaptation (e.g.,

game flow such as maps design and selection, time limits, tips presentation). Moreover, patient's actions, such as responding times and wrong chosen paths, are recorded and analyzed to dynamically change predefined game elements, maintaining an adequate therapeutic level of challenge and helping the patient to combat possible frustration. Thus, the games are personalized according to the mentioned points, but also taking into account results of questionnaires posed to the therapists and patients.

3 Conclusions and Future Work

The paper presents a new vision for the design of theragames that take advantage of the smart healthcare supporting objects and devices. The personalization of pervasive theragames can enable: dynamically adaptation of therapeutics according to patient's health condition and performance; appropriate therapeutic performance feedback and progress monitoring; more engaging and rewarding therapeutics for patients; and better in-home rehabilitation procedures and remotely analysis. Our research is being used to investigate how a personalization model can be generally defined, processed and distributed among devices, and the benefits it adds to human computer interaction in pervasive healthcare environments.

As we still do not have end-users evaluation results, we drew on the therapists' knowledge to evaluate the current prototypes design in terms of diverse parameters. Since the project incorporates research from diverse areas, our research team presents expertise in areas such as physiotherapy, speech therapy, biology, pervasive computing and game design. Future research is important in the design of evaluation methods for testing the prototype in real environments, such as clinics and homes for the elderly.

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An Evaluation Framework for End-user Experience in Adaptive Systems

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Abstract.
The evaluation of adaptive and personalised systems is a difficult, complicated and very demanding endeavour due to the complex nature of these systems and the usability issues encountered. This demonstration introduces a web-based framework to support the evaluation of end-user experience in adaptive and personalised systems. This framework has been developed based upon advice from domain experts and a review of evaluation approaches, methodologies and techniques adopted by existing adaptive systems. The benefits of the framework include: i) the provision of an interactive reference and recommendation tool to encourage the evaluation of adaptive systems; ii) the collaborative nature of the framework facilitates the sharing of evaluation information among researchers from diverse communities; iii) the identification of pitfalls in the planning process as well as in data analysis; and iv) the translation of presented information into users language of choice.

Keywords: Evaluation, Adaptivity, Personalisation, Translation, Recommender.

I Introduction

The research field of adaptive systems has grown rapidly over the past 15 years and this has resulted in terms, models, methodologies, and a plethora of new systems. Adaptive systems are becoming more popular as tools for user-driven access to information [1]. This has led to the challenge of catering to a wide variety of users in differing environments and user trust issues. Therefore the effective and thorough evaluation of adaptive systems is of utmost importance. It is essential to not only evaluate but also to ensure that the evaluation uses the correct methods since an incorrect method can lead to wrong conclusions [2-3]. This demonstration introduces an interactive web-based framework for evaluating end-user experience in adaptive systems.

2 Demonstration System: An Evaluation Framework For End-user Experience in Adaptive Systems(EFEx)

2.1 Aim and Functions of EFEx

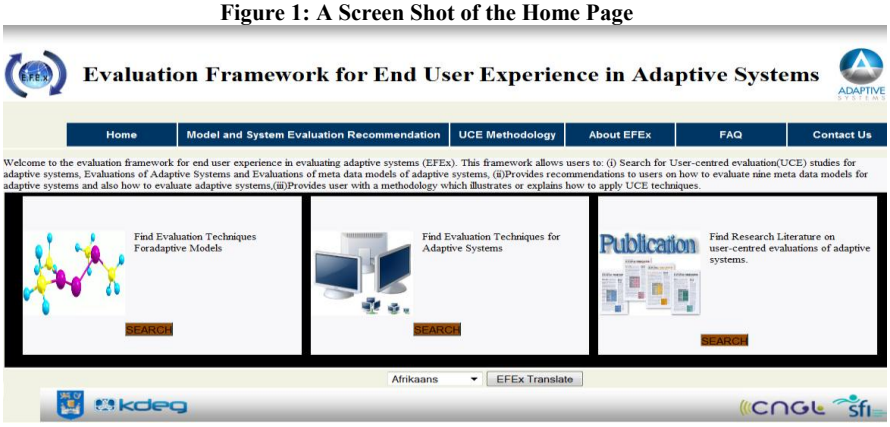
EFEx is designed as a web-based user interface which allows users to collaborate and supports the user to: i) search for related research material such as, user-centred evaluation (UCE) studies and papers detailing the evaluation of similar adaptive systems; ii) get recommendations on how to best combine different evaluation methods, metrics and measurement criteria in order to most effectively evaluate their

system; iii) identifying a UCE methodology which details how to apply existing UCE techniques; vi) translate the whole user interface into their native language. EFEx supports 49 different languages. When searching for related research material or evaluation recommendations, the following characteristics of the system must be provided by the user: (system name, developer, evaluation approach used, evaluation purpose, system description, application area, evaluation methods(techniques) used, evaluation metrics, evaluation criteria, year the evaluation was conducted and what was improved by the adaptation).

2.2 Technical Implementation

EFEx is designed as a typical 3-tier architecture which consists of: *i) the presentation layer, ii) The business logic layer* which is pulled out from the presentation tier ,it controls the EFEx functionality by performing detailed processing and *iii) the data persistence layer* which keeps data neutral and independent from application servers or business logic. It is implemented by integrating (i.e., NetBeans 6.9 Apache lucene, Apache_OpenJPA, Apache-Tomcat, Myfaces-core, MySql-win32, MySql-connector-java, Json**,** and Google Translate).

Figure 1: A Screen Shot of the Home Page



2.3 Target Audience

The end-users of the EFEx framework can be classified into two groups: i) people developing adaptive technologies/systems who wish to test out the effect of the adaptive technologies/systems on end-users; ii) people who are developing the adaptive experiences using the adaptive technologies/systems

2.4 Use-Case Scenario

A user who has developed an adaptive system wants to use EFEx framework(Figure 1) to find out: i) how to combine and apply existing evaluation methods (techniques), metrics and measurement criteria in order to evaluate the adaptive system and the metadata models (i.e. user, domain, strategy, task, content, device, system, navigation and presentation models) used by this system; ii)recommendations on how to evaluate adaptive systems and the models; iii) any

evaluations of similar adaptive systems, models and authoring tools which have been published between 2000 and today; iv) any studies describing user-centred evaluation approaches which have been published between 2000 and today. Finally, suppose this user only speaks French and cannot read English content. The EFEx framework provides Personalised information to suit the user's requirements based upon their interests and preferences.

2.5 Potential Educational and Industrial Benefits of EFEx Framework

The authors acknowledge that the evaluation of adaptive systems is a difficult task. For example, one major problem is to understand the adaptation mechanism of the system. More specifically, what is improved by the adaptation and what might have been the situation had a different adaptation occurred. Furthermore, several researchers have emphasized the difficulties caused by the complexity of such systems and the usability issues they raise [4-7]. EFEx has been developed as part of PhD research which proposes a user-centred evaluation approach to adaptive systems.

The EFEx framework provides users with: i) a centralised repository which stores current UCE studies of these systems, models and authoring adaptive technologies. Currently it is very difficult for evaluators and researchers to find this information in a central place and reporting of these studies seems to be "sloppy"[8]; ii) Users also get personalised recommendations. These recommendations reduce the time spent and the cost incurred while evaluating these systems, models and technologies. Researchers can collaborate while globally distributed and learn faster.

3 Technical Requirements and Acknowledgement

For demonstration of the EFEx framework, the author's personal laptop will be used. Access to the Internet will be required. This research is based upon works supported by Science Foundation Ireland (Grant Number: 07/CE/I1142) as part of the Centre for Next Generation Localisation (www.cngl.ie).

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SERUM: Collecting Semantic User Behavior for Improved News Recommendations.

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Abstract. We present our recent work on recommending personalized news articles to users based on implicit collected feedback and large scale semantic datasets. Our personalized recommendation application SERUM exploits the fact that semantically linked and structured information becomes more and more available driven by a strong research community. Our solution combines these semantic, encyclopedic knowledge sources with a large news article dataset and collected implicit user feedback using an RDFa based Web application. In a first step, we compute semantically related entities of interest, such as similar artists or genres, based on a user behavior model using graph-based algorithms. In a second step, we utilize these interest entities for computing news article recommendations. An RDFa schema has been designed that enables standard annotations in any XHTML Web page, thus making structured data available for the adaptation process, but also for any service or tool that supports the RDFa standard.

Keywords: user behavior, semantic recommendation, graph based recommender, news personalization.

1 Introduction

Consuming information on the Internet becomes harder and harder as the number of information sources explodes. Several services, commercial or research based, try to support users in finding the right information. In our system, SERUM (Semantic Recommendations based on large unstructured datasets), we incorporate semantic information on the clients side, namely RDFa, and a semantic knowledge base in the back end, to learn and understand a user's interest in news topics to recommend news matching the users interest. Our proposed news system supports users in finding interesting and up-to-date news articles about their favorite topics, currently focusing on entertainment news. The knowledge base of the recommender system is a dataset obtained from Freebase[1] consisting of ≈ 400,000 artists, ≈ 4,600,000 tracks and albums, and ≈ 2,000 genres,

[1] http://www.freebase.com

connected by ≈ 1,5 million edges. This information is linked to a news corpus, provided by Neofonie GmbH, currently containing 7,200,000 news articles with 40,000 articles added on average each day. Both datasets are linked together by extracting entities from news articles using named entity recognition methods. The recognized entities are then linked to the entertainment dataset building a large knowledge graph, modeled as an ontology. Recommendations are computed in a user-centric way combining a user model, obtained from the tracked user behavior, with the knowledge graph.

2 User Behavior and Personalization

SERUM is a Web-based application where users can log in and read news from different news sources. While reading, we implicitly collect the users reading behavior to deduce interest in topics or entities. In the current system we focus on four behavior tracking use cases: (1) User clicks on an article: The news and all related entities are marked as interesting. (2) User clicks on an article in a list: The clicked article and all related entities are marked as interesting for the user, while all other surrounding articles are marked as less interesting. (3) User clicks on recognized entities in an article and (4) triggered mouse-over events: Entities clicked by the user or marked by the mouse pointer are given a higher interest rating.

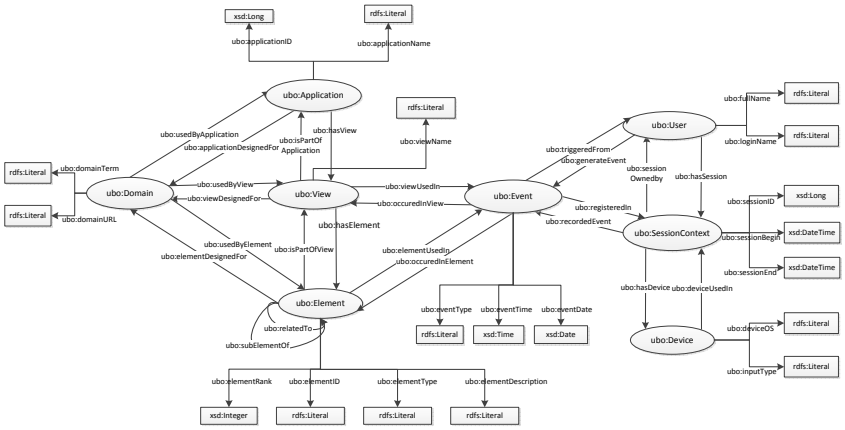

Fig. 1. UBO: User Behavior Ontology – A ontology for user behavior collection

This (implicit and explicit) user feedback is collected using an RDFa based tracker incorporated in a Web application. The data is stored on the server side in an RDF store using a self-developed User Behavior Ontology (UBO), see Fig.

1. This User Behavior Ontology describes all events relevant for modeling the user behavior such as user clicks or mouse-over events. Events, triggered by the user (e.g. clicks) are linked to news articles and named entities (e.g. artists in the news article) the user interacted with. Based on a statistic analysis the user behavior events are aggregated to identify named entities (e.g. musicians and genres) the user is interested in. In this step, we deploy domain knowledge to enrich potentially relevant named entities in order prevent sparsity problems. Thus, musician recognized to be interesting to the user are expanded with data about produced albums and collaborating artists, computing strongly related entities in the domain ontology.

The named entities computed to be interesting to the user are used as input for a graph based news-article recommender. The article recommendation strategy is based on the recentness of the news as well as the correlation of computed interests and their occurrence in the news. The recommendation algorithm is explained in detail in [1].

3 Conclusions

In our demo, we will show, that the usage of semantic information on both ends of the SERUM system, RDFa on the client side and Linked Open Data on the backend, improve the recommendation quality and user satisfaction. The use of Linked Data allows us to extend the system's knowledge about a user. For example, if the user only entered "Madonna" as an interest, we can add genre information (e.g. pop) and information about collaborations with other artists. Therefore, significantly less information about the music taste of the user is needed to be able to recommend appropriate news. The collection of user behavior using RDFa allows tracking not only information the user directly interacted with but also information that is related to an interaction. Thus we have more information about the user and can compute more precise interests.

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IDIUMS: sharing user models through application attributes

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Abstract. IDIUMS is a framework for sharing data between user models in adaptive applications which use different attributes to record the user's interactions. This paper and the accompanying demonstration illustrates the architecture of IDIUMS, a prototype reference implementation and the experimental setup constructed to test the underlying hypothesis: using rules to map attributes between different types of application allows those applications to make better adaptations.

Keywords: shared user model, adaptive game, adaptive hypermedia, adaptive assessment, attribute, overlay model

1 Introduction

In 2009, we presented early investigations into sharing user model data between two different systems with adaptive elements: hypermedia and computer games [3]. Since this work, the scope of the project has been generalised, to cope with a variety of applications.

The overlay user model [2][5] consists of a graph of the concepts within the application's domain. Attached to each concept are one or more attributes, and to these attributes the user is assigned values. These attributes give the value meaning. If the attribute layer were left out, the value could be assigned to a concept, but would it mean the user likes that concept, has knowledge of the concept or simply viewed it?

With this understanding of the role of attributes, it becomes clear that even if they share a concept graph (there are examples of mapping between concept graphs [4]), each application reasons on different attributes. An adaptive hypermedia tracks the number of page views a user has made. An adaptive game records the number of levels played and the player's success levels. An adaptive assessment stores the number of questions attempted and the number of correct answers. A recommender system registers interest. On their own, these systems cannot share their user model values because they adapt on different attributes.

IDIUMS is a framework to solve this problem, and the reference implementation is described in this paper. Currently, an experiment is being set up to test the hypothesis that using rules to map between the attributes in different types of adaptive application results in improved adaptations within those applications, over starting with no data about the user.

2 IDIUMS: the Interactionally-Diverse Intermediary User Model System

A prototype reference model of IDIUMS has been written in Java and packaged as a JAR for ease of deployment.

IDIUMS requires a rule engine to enable translations of values. It uses a computer algebra system called Jasymca [1], which allows symbolic algebra to be used to represent the rules. In addition to evaluating the rules between two applications, IDIUMS traverses the graph of all rules connecting applications within the system, so that if there is no rule directly connecting two applications, a translation between the attributes may be performed via rules connecting a third, intermediary application.

New and existing adaptive applications may integrate with IDIUMS by utilising the simple REST interface. The query string identifies which user, application, concept and attribute is being accessed, the HTTP GET method used for retrieval and POST used for setting a value (with the value in the request body) and the return format is determined by the file extension (.xml or .json).

3 Experimental System

The underlying hypothesis behind IDIUMS is that user model data can be converted at an attribute level: that is, assuming the data is about the same concept (or has been mapped appropriately), then values unique to one application can be translated to those in another. To test this hypothesis, an experimental framework and methodology have been developed, which are described below.

3.1 Applications

Three adaptive applications, which record different attributes, have been selected to test the effectiveness of translating attributes: an adaptive game, an adaptive hypertext and an adaptive assessment. The domain of these applications is similar, to remove that as a variable in the experiment. This common topic is learning looping in the Java programming language.

The adaptive hypertext is a digital textbook, built in the GRAPPLE Adaptive Learning Environment (GALE), which provides adaptive navigation within the textbook, so the learner can choose the most appropriate thing to read next.

The adaptive game is inspired by a learning object [1], in which the learner studies some Java code consisting of a loop and attempts to predict what will happen. The next screen displays a submarine which moves as per the commands in the code. The adaptive game implements this learning object, but allows the learner to write, compile and run real Java code to control the animation. The learner can play with the code until they have solved the puzzle. The game presents multiple scenarios to test the player's knowledge of all the concepts.

[1] http://webuser.hs-furtwangen.de/ dersch/jasymca2/indexEN.html

The adaptive assessment consists of a database of questions encoded in the QTI XML format. The engine selects an appropriate question, based on the state of the user model, and uses the QTIengine [2] REST interface to render the question.

3.2 Methodology

The participants of the experiment will be led through using each of the applications in turn. At the start, and then following the use of each application, the participants will be asked to complete a questionnaire asking them to self-assess their knowledge of various aspects of Java loops, and to rate whether the level of challenge in the application was appropriate for them. By having IDIUMS provide translations of their user model data, it is hoped they will rate the adaptations as more appropriate compared to the control group who will start each application with no initial user model data.

4 Conclusion

IDIUMS is an intermediary user model system with a REST-like interface for interrogating and modifying the data. It provides a method for sharing a user's data between applications that are interactionally-diverse, by maintaining a graph of rules between the attributes in different applications.

It will be demonstrated in the context of an experiment to test the hypothesis that sharing data at an attribute level improves adaptations. Conducting this experiment is the next stage of this work.

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[2] http://www.qtitools.org/landingPages/QTIEngine/

A Comparison of How Demographic Data Affects Recommendation

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Abstract. Recommender systems attempt to find relevant data for their users. As the amount of data available on the Web grows, this task becomes increasingly harder. In this paper we present a comparison of recommendation results when using different demographic features (age, location and gender) commonly available in online communities. We assume that demographic data holds implicit information about users' taste and interests, and present results of a simple method that extends standard collaborative filtering algorithms to include one or several of these features. We evaluate our assumption in a movie recommendation scenario and compare results from different features to standard collaborative filtering.

Keywords: recommender systems, experimentation, human factors, demographics

1 Introduction

During the last 20 years, the amount of time that recommender systems have been researched, the de facto standard has been *Collaborative Filtering* (CF). However, current systems contain much more information about users than their counterparts twenty years ago did. One type of information commonly available in current systems is the *age*, *gender* and *location* of the users. Research has shown that these and similar features are of importance when attempting to increase the quality of recommenders [2,3]. In this paper, we apply the implicit relation brought by these features in a movie recommendation scenario by a simple extension to the k-Nearest Neighbor algorithm and show that even a very simple approach utilizing this sort of data brings significant improvements in terms of recommendation quality.

It has been previously shown that demographic data increases the quality of different information retrieval tasks. Weber and Castillo [3] used demographic information like average income, race, etc. to find difference between groups in a search engine scenario. Said et al. [2] showed that different social groups have difference in taste when it comes to movies as well.

In our work, we use a model that employs these features to create higher similarity scores between users from the same demographic groups. We present early

stage results of experiments performed on a dataset containing demographic data.

The main contribution of this paper is a comparison of basic demographic features and their effect on recommendation quality in a Collaborative Filtering-based system.

2 Dataset and Experiments

In this paper we use a dataset provided by Moviepilot[1], which is Germany's largest online movie recommendation community. The snapshot used in our experiments contains the ratings of $10,000$ randomly selected users who have rated at least one movie. In addition to the ratings, the dataset also contains the age for $1,292$ users, gender for $6,583$ users and city for $4,400$ users. Table 1a shows the percentage of ratings performed by the users for which we have demographic data. The total number of ratings in our subset is $1,539,393$ spread over four years (2006 to 2010). This corresponds to roughly 20% of the full dataset.

2.1 Experimental Setup

For the experiments, 50 training and evaluation sets each for every demographic feature were created. The evaluation sets consisted of 5000 ratings for 500 randomly selected users. The selected users had to have rated at least 30 movies. Out of these, 10 movies having been rated with a value above the user's average rating value were extracted (i.e. the set of true positive recommendations). The rest of the data was used for training. Users were assumed to belong to the same demographic group if they a) lived in the same city, b) were of the same gender, or c) were born in the same decade. For each of the demographic features, our recommender was run once with the similarity of users within the same demographic group multiplied by a factor set to $10,000$, which is the the same as the number of users in our dataset, in order to significantly heighten the similarities. The recommendation algorithm used in our experiments was a slightly modified version of the *K-Nearest Neighbor* using the Pearson Correlation Coefficient as the neighbor similarity measure. Additionally, for comparison the recommender was run once for each training and test set without multiplying the similarities, i.e. the assigned similarities were solely based on the users' rating behavior. The results presented are the averages of all runs for each demographic group.

2.2 Results

We evaluate the results with Mean Average Precision (MAP) and Precision at 10. These measures were chosen since they are well-known and widely used in the field of Recommender Systems and Information Retrieval, providing a statistically sound estimate of the recommendation quality [1].

[1] http://moviepilot.de

	Number	%
City	991,845	64%
Age	1,144,761	74%
Sex	1,398,732	91%

(a) The number and percentages of ratings assigned by users who have stated either the city they live in , their age or their gender.

	$P@10^{10K}$	P@10	%
City	$2.79E-4$	$2.66E-4$	4.7%
Age	$2.45E-4$	$2.45E-4$	0.0%
Sex	$2.86E-4$	$2.33E-4$	22.9%

(b) The Precision@10 values for the demographic-aware recommender and a regular CF one.

	MAP^{10K}	MAP	%
City	$3.89E-3$	$3.81E-3$	2.2%
Age	$3.93E-e$	$3.93E-3$	0.0%
Sex	$4.22E-3$	$3.82E-3$	10.4%

(c) The Mean Average Precision values for the demographic-aware recommender and a regular CF one.

Table 1: Data statistics and results

The initial tests showed that our assumption, "demographic data has an impact on CF", is true. Gender, especially, seems to have a large impact with a resulting increase of 10% for MAP (and 22% Precision at 10). Age seems, however, not to have a very high impact. This could be due to the way we define age, i.e. born in the 60's, 70s, 80s, etc. We intend to treat age with a more dynamic approach using time slices, e.g. a sliding window of +/- a number of years.

3 Conclusion and Future Work

Our early stage results show that demographic data does matter even in a movie recommendation scenario. We expect that finer grained data, similar to that used by Weber and Castillo [3] will most likely affect the quality of a recommender system even more, especially if used in a more elaborate way than this simple CF extension. Our current work focuses on collecting and connecting this data to what we already have, as well as finding subgroups based on several features, e.g. age and city combined.

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Online Adaptive Language Learning

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Abstract. Training programs and technologies have evolved in relation to students' demands to learn languages through Information and Communication Technologies (ICT). In the context of online education, digital platforms like Moodle play a leading role as these management systems include applications and tools which allow us to create and evaluate language content efficiently. However, there is an aspect which could be revised and improved to allow course teachers to adapt learning systems to students' profiles, needs and preferences. Therefore our proposal aims to present an outline of a Moodle-based language learning system that adapts level, preferences and context to students' general profile.

Keywords: Language learning, personalized learning, adaptive LMS.

1 Introduction

Technology is evolving rapidly and Internet access has become common and routine and allows access to information anywhere and anytime. In addition online applications have evolved to the current Web 2.0 with communication and presentation of multimedia content tools. This evolution has also had an impact on education, enabling online learning systems to develop constructive and collaborative learning opportunities for students [1].

Moreover, current teaching programs based on the active involvement of students, allow students to select their learning and choose different paths according to their previous knowledge [2]. This leads to the construction of customized learning systems that adapt to the needs of each student. To achieve this customization, we apply the benefits of Adaptive Hypermedia Systems (AHS) [3] through adaptation techniques and dimensions [4, 5]. The aim of AHS in education is to adapt the course contents or subject for each student, so they can reduce the time needed to complete the course.

Due to the emergence of cultural, training and work mobility there is a greater need to learn languages [6]. Bearing this in mind, education should adapt to students' different needs and preferences to develop language learning systems using existing technology (AHS).

This work is aimed at designing a Moodle-based online language learning system which adapts to the student's profile to improve his/her learning process. However Moodle does not offer personalized learning. Therefore, we aim to explore the ways of improving its functionality by including a feature which enables customization within the platform. Our goal is to include personalized learning combining the set of tools for language learning and assessment contained within the platform [7] and the

advantages of AHS. Specifically we focus on the way the system adapts to the students through content-based information such as their knowledge levels, learning and task preferences; and context-based information such as environmental characteristics and time [8].

2 Designing the system

First, we have to establish how we want the system to operate, later we will develop the design according to the way we want it to operate. Our system will contain a set of stored activities; some of these activities will be selected for each student according to their needs (characteristics and preferences also stored in the system) (Figure 1).

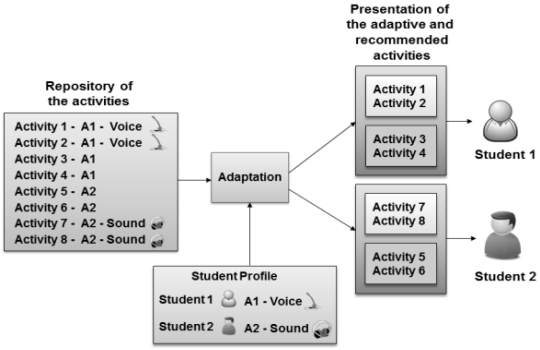

Fig. 1. Adaptive system diagram

In Fig1, we can see an example using 2 students and 8 activities. Student 1 has A1 level and he can/wants to carry out activities involving voice recording, student 2 has A2 level and he can/wants to carry out listening activities. Then, activities 1, 2, 3 and 4 will be adapted and recommended to student 1 and activities 5, 6, 7 and 8 will be adapted and recommended to student 2.

We have already seen how the system will operate; now, we will consider how we will adapt activities to students based on their different learning needs. We will choose some relevant elements to customize our system to:

- Content-based information:
  - Level of knowledge: The student will do one or more tests developed by subject specialists to assess their prior knowledge. Once this is established the student begins a course and may progress to the next level.
  - Learning Preferences: the student can choose to practise their preferred skills (grammar, listening, writing, reading, speaking or vocabulary) and the system will recommend more tasks of that type, however, the system will also show tasks for other types of skills, which they will also have to complete.
  - Task Preferences: a student may prefer using resources or doing exercises.
- Context-based information:
  - Environmental characteristics: these characteristics are based on the suitability of the location of the student for listening or speaking activities.
  - Time: the time which a student has available to interact with the system.

These elements will make up the parameters of the student profile in Moodle and indicate the activities will be chosen for the students accordingly.

Also, the system architecture allows particular contents to be revealed to each student in the system at any given moment, using information from the student profile and will be based on three phases:

1. Content-based adaptation: assuming each student has an assigned profile, at this phase we obtain content-based information of student profile and, through the rules of the system, select the items that are adapted to the particular student profile.
2. Recommendation by inferences: once we have selected the items to be displayed to the students, we analyze the student's previous behavior in the system, to anticipate his/her context-based information and recommend items accordingly.
3. Context-based recommendation: items are selected and recommended for the student but the student can change his/her context-based information anytime, in that case the system would recommend different items.

After these phases, adapted and recommended activities are presented to the students by displaying or hiding of Moodle tasks.

3 Discussion

This work focuses on the characteristics and preferences of students, especially their different levels and objectives in language learning, to determine their educational needs in the acquisition of second languages. Our proposal includes adaptation within an *open-source* platform like Moodle to improve student learning, offering personalized and adapted learning through content-based and context-based information. We think it is possible to achieve personalized and effective learning within the Moodle platform with the design outlined in this paper.

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