UMAP'14 Workshop / UMAP Project Synergy Workshop (ProS 2014)

- Preface -

UMAP is the premier international conference for researchers and practitioners working on systems that adapt to their individual users, or to groups of users, and collect and represent information about users for this purpose. UMAP ProS workshop aims to bring together participants from several International projects to exchange ideas and experience relating to the approaches they are implementing or planning to implement, based on experiences in user modelling, adaptation and personalisation. This year's workshop invited overall 9 international projects related to the following themes of UMAP: UMAP in the social era, UMAP in the era of big data, UMAP in the era of pervasive computing, Infrastructures, architectures, and methodologies, Human factors and Models and Personal and Societal issues.

We thank all participants of the workshop for their contributions and the organizers of the UMAP 2014 conference for their support, especially Peter Dolog, Geert-Jan Houben (General co-chairs), Vania Dimitrova, Tsvi Kuflik (Program co-chairs) and Rosta Farzan and Robert Jäschke (Workshop co-chairs). We hope that you will find this program interesting and thought-provoking and that the workshop will provide you with a valuable opportunity to share ideas with other researchers and practitioners from institutions around the world. We are looking forward to a very exciting and interesting workshop.

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Program

1. *INTUITEL - Intelligent Tutorial Interface for Technology Enhanced Learning*
   Peter Henning, Florian Heberle, Kevin Fuchs, Christian Swertz, Alexander Schmölz, Alexandra Forstner, Andrea Zielinski

2. *Tourists' Dynamic Needs and Affects in Personalised Travel Route Recommendations*
   Aksenov, Astrid Kemperman, Theo Arentze

3. *Adaptive Interest Modeling Enables Proactive Content Services at the Network Edge*
   Hua Li, Ralph Costantini, David Anhalt, Rafael Alonso, Mark-Oliver Stehr, Carolyn Talcott, Minyoung Kim, Timothy McCarthy, Sam Wood

4. *The CHESS Project: Adaptive Personalized Storytelling Experiences in Museums*
   Maria Vayanou, Manos Karvounis, Akrivi Katifori, Marialena Kyriakidi, Maria Roussou, Yannis Ioannidis

5. *Pheme: Veracity in Digital Social Networks*
   Leon Derczynski, Kalina Bontcheva

6. *User-Item Reciprocity in Recommender Systems: Incentivizing the Crowd*
   Alan Said, Martha Larson, Domonkos Tikk, Paolo Cremonesi, Alexandros Karatzoglou, Frank Hopfgartner, Roberto Turrin, Joost Geurts

7. *PRISE : Adaptive Environment for Consolidated Management of Digitals Resources*
   Daouda Sawadogo, Ronan Champagnat, Pascal Estraillier

8. *Supporting Workplace Learning in Small Enterprises by Personal Learning Environments*
   Milos Kravcik, Kateryna Neulinger, Ralf Klamma

9. *Informal Learning at the Workplace via Adaptive Video*
   Milos Kravcik, Petru Nicolaescu, Ralf Klamma

INTUITEL - Intelligent Tutorial Interface for Technology Enhanced Learning

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Abstract. The EU FP7 project INTUITEL provides a novel adaptive learning environment, which is neither test-driven nor curriculum-based. Although based on ontologies, it extends these by an innovative concept of learning pathways and a subsequent ranking algorithm. The resulting environment is in line with pedagogical models and cognitive theories and will be integrated in five different market leading learning platforms.

1 INTUITEL Overview

Adaptive learning environments have reached a point where the underlying technologies and educational principles are mature enough to actually create a financial and didactic benefit on a larger scale. Although significant scientific progress has been made over the years [1–4], respective broad range solutions are just beginning to compete with established platforms. Existing systems for adaptive learning are either

- test-driven, i.e., making use of learner testing to identify knowledge gaps or learning styles, which are then used to create personalized learning pathways by hiding or adding sub-elements; or
- curriculum-based, i.e., relying on the a-priori availability of fixed, already heavily annotated course material, which makes it impractical for teachers to create new adaptive courses using their own material or material from other sources.

In contrast to these existing systems, INTUITEL[4] is controlled by (i) the learning behavior of its learners, therefore addressing and improving the learning experience and (ii) the intentions and educational experience of teachers, giving them the freedom to design their courses in different ways to customize them on their specific target audience. To this end, INTUITEL employs a layered set of ontologies:

- A Pedagogical Ontology (PO) as the broad pedagogical background knowledge and vocabulary to non-intrusively enhance learning material.

[4] INTUITEL = Intelligent Tutorial Interface for Technology Enhanced Learning, http://www.intuitel.eu, is funded in the 7th framework programme of the European Union (FP7-ICT-2011.8, Challenge 8.1) under grant no. 318496

- A second ontological layer, the Cognitive Map (CM), for a particular domain of knowledge. The versatility of this approach was shown by successfully creating four prototype realizations for the domains *General Didactics*, *Network Design*, *Computer Programming* and *Radar Basics* as well as a methodology for creating such maps.
- A third ontological layer, the Cognitive Content Map (CCM), which relates a particular learning content to the CM for this domain.
- A Learning Model Ontology (LMO), which defines additional attributes for the dynamic enhancement of CMs and CCMs with didactic aspects.
- As the foremost learner-specific layer, a Learner State Ontology (LSO), which is automatically generated from data gathered about the learner, reflecting his current state and behavior.

This hierarchy allows for a clean separation of a didactical model into macro and micro level learning pathways, differentiating between global strategies and local tactics [5]. Such a multi-level approach is also known in the GRAPPLE system [4], but there the ontological core consists of a user model.

2 Semantic Aspects of INTUITEL

The usage of ontologies for TEL has been suggested quite some time ago [6], most implementations use them to derive a partial ordering of Knowledge Objects (KO) along the simple sequencing specification of SCORM [7]. More advanced concepts of learning pathways have been discussed before, but concrete implementations so far are either prototypical or moving into the direction of a programmed learning environment [9]. INTUITEL moves beyond this, proposing an extension of the ontology based approach that takes into account more advanced characteristics of a learning pathway such as modular and/or nested composition [10].

We consider an *observed* learning pathway as a piecewise linear curve joining all subsequently reached cognitive positions in a multi-dimensional cognitive space[11]. Several different predefined learning pathways, each following a distinct didactical concept and described in the ontological hierarchy, are then compared to the observation. Deviations between the observed cognitive position and these predefined pathways may be used to provide metacognitive feedback to the learner. On this basis the INTUITEL system calculates a set of possible *next recommendable cognitive steps* along these various predefined learning pathways [12].

These are then ranked according to Didactic Factors (DFs), also defined in the ontological hierarchy to be (more or less) fulfilled by the knowledge objects presented to the learner We hereby distinguish hard criteria (like e.g. language, which must be spoken by the learner) and soft criteria (like e.g. media preference) to attribute a rank to each of these next recommendable cognitive steps [13].

3 Pedagogical Aspects of INTUITEL

INTUITEL provides a concise and clear recommendation to the learner within his ordinary LMS, but he may still decide to follow this recommendation or not. Depending

on the situation, even a natural language dialog with the learner is carried out. While still following the AHAM meta-architecture [2], the system therefore deviates from a simple sequencing approach rather dramatically, opening a larger didactical space to learner and teacher and leading to a much higher flexibility of concepts [14]. Following our approach one may e.g. re-use the same course material for a course following the Inquiry Based Science Education (IBSE) paradigm [15] as well as for more traditional approaches.

The *freedom of choice* is considered one of the major advantages of self-paced TEL by the younger generation. In preserving this freedom, INTUITEL is targeted at increasing the acceptance of TEL on a broad scale. The teacher (or course engineer) hereby acquires a rather non-intrusive role, where he may anticipate learners of completely different type moving through the content. The system therefore is a novel application of the Theory of Planned Behavior [16] to man-machine interaction.

Moreover the integration of learner and computer actually may bee seen as a hybrid actor of the Actor Network Theory (ANT), partially deriving its skills from the learner and partly from the computer [17].

4 Innovation from INTUITEL

INTUITEL does not constitute a novel LMS, but is introduced via a flexible and openly specified interface into five different leading eLearning platforms (eXact LCMS[5], Clix[6], Crayons[7], ILIAS[8] and Moodle[9]) and already now has a huge potential user basis.

A newly developed SLOM format for the association of metadata with learning content allows to perform the semantic enhancement without impairing the usage of this content in non-INTUITEL systems. To this end, INTUITEL also provides a tool suite for editing and import from other formats into SLOM.

The metadata concept of INTUITEL also provides the basis for an innovative treatment of learning resources: Learning resources anywhere on the internet may either be linked together without touching them, or be imported into a SLOM file. It is therefore possible to create personalized courses in a *global* virtual repository, no need exists for collecting and assembling learning resources into a single real repository [18].

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[5] cf. http://www.exact-learning.com/

[6] cf. http://www.im-c.de/en/

[7] cf. http://www.iosb.fraunhofer.de/servlet/is/4525/#

[8] cf. http://www.ilias.de/

[9] cf. http://moodle.com/

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Tourists' Dynamic Needs and Affects in Personalised Travel Route Recommendations

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Abstract. The FP7 project cSpace unites the notion of augmented reality, micro-projection technology, near real-time 3D-video reconstruction and cultural tourism into a single experience that aims to unleash users' inventiveness and creativity. The goal of "smart cultural routing" within cSpace is to enrich tourists' experience by offering them very personalised travel route recommendations tailored to their dynamic user profiles. In particular, a special attention in the suggested approach is paid to changes to a tourist's dynamic needs and affects. As a result, the tourist's experience from visitation can be enriched by means of fine-tuning the route's program, schedule and routing, according to this tourist's individual dynamic requirements and affective state.

Keywords: Affective Computing, Recommender Systems, Tourism, User Preferences.

1 Motivation

The proliferation of smartphones/tablets and the mobile internet have made it easier to reach, share and exchange the vast amounts of information that are generated daily. On the other hand, in order to benefit from this information, a more sophisticated filtering approach is required that would yet better suit tourists' preferences in terms of what they want to visit, in which sequence, with which pace, for how long, and so on. A visiting plan for such a touristic route requires specification of activities on three levels: program (what to visit), schedule (in what sequence), and routing (which transport modes and routes to use for travelling between locations). One of the ideas the recently started FP7 project cSpace[1] rests on is to offer users an opportunity to utilise recent technological advancements in order to stimulate their creativity and increase their cultural touristic experience. The aim of the "smart cultural routing" sub-project within cSpace is to develop a recommender system that will generate advice that fits the tourist's profile on each of the three levels mentioned above.

Recent examples of daily travel recommendations, such as in iTour[2], have provided solutions that suggest different forms of transportation (i.e. routing) to users based on

[1] http://c-spaceproject.eu
[2] http://www.itourproject.com

their preferences and real-time information about various travel-related details such as the road, traffic, and weather conditions.

The support of activity programming and scheduling requires combining heterogeneous personal interests, preferences and constraints within an additional tourism-related level that may often be dynamic and affect-driven. Emotions are fundamental to largely any kind of user experience, so that understanding the influence of emotions on user preferences and decision making is important. So far, researchers have already demonstrated how the knowledge about emotions can be included into the recommendation process elsewhere – from recommending movies [1], to choosing a more satisfying learning activity [4], to including emotions into a recommender system in general [5]. Examples of the most recent results in the field (e.g., [6]) clearly indicate that interpreting an individual's emotions remains a topic in research on recommender systems that is still in its infancy. Therefore, in order to enhance tourists' experience from visitation, we plan to include a tourist's affective state and motivational considerations into the tourist's dynamic user profile. And a tourist's individual dynamic needs, preferences and affective state will then be used all together in recommending the most suitable tour in terms of program, schedule and travel options.

2 Approach

The overall aim of the smart routing system is to offer the best possible experience to tourists under the given dynamic constraints and needs. Reflecting on this dynamics involves several considerations to be taken on a tourist's individual level, as follows.

Tourists may differ in terms of the type of advice requested, ranging from having specific interests and initial ideas to having no pre-defined preferences. They may also seek for varying types of cultural experience, have different amounts of time and money, use different approaches to trade-off travel costs against the value of experiences, and so on. A tourist's user profile defined as a set of personal interests, preferences and constraints thus determines to an important extent how a particular cultural route for the day is experienced and evaluated. We arrange all information in the user profile into four categories: *long-term*, *mid-term*, *short-term*, and *ultra-short-term* information (see Table 1). As their names suggest, the categories obey a time-frame criterion, so that each category relates to a different time interval and thus represents a measure of dynamicity of the parameters it contains.

There is a separate dimension within Table 1's ultra-short-term category – *emotion E*. Utilising information about a tourist's current emotions and needs in generating advice on which activities are the most suitable is expected to stimulate this tourist's involvement and to contribute to the overall cultural touristic experience. Therefore we want to consider tourists' motivational and emotional states and situational dynamic preferences, and plan to take the results of this analysis into account when generating a trip suggestion. The following challenges are pursued:

– Which dimensions of emotions and basic needs can be distinguished and are relevant for cultural touristic experiences?

– How do particular activities, trips and environments influence affective states and, vice versa, how do emotions/needs influence preferences?

Table 1. Categories of a tourist's dynamic user profile.

Long-term (static)	- Demographics: age, gender, occupation, … - Mobility (M): vehicle types, driver licences, public transport cards, … - State profile: interests (I), needs (N), health-fitness-disabilities (F), …
Mid-term (trip)	- Mobility (M), State profile (I, N, F) - Accompanying persons (Y): number, relations, profiles (long-term), … - Available budget (B): time (trip length), money (rough indication), … - Program (P): wish list of things to do during trip
Short-term (day)	- History (H) - Mobility (M), State profile (I, N, F), Accompanying persons (Y) - Available budget (B): for the day - Program (P_v): **sites visited**; Program (P_w): wish list **for the day** - Route plan (R): program, schedule, travel routes, …
Ultra-short-term (moment)	- History (H), Mobility (M), Accompanying persons (Y), **updated** - Available budget (B): **remaining** for the day - State profile: I (**updated**), N (**updated**), **emotion E** - Route plan (R), **updated** - **Position: coord XY, current activity (position in route plan), …**

Potentially, the number of (combinations of) dimensions to be considered can be large. In order to identify the more important and relevant ones, we need to study and measure tourists' preferences under given conditions, and to further investigate the influence their emotions may have on the measured preferences. Although the study and modelling of consumers' preferences and choice behaviour has a long history in consumer, transportation and tourism research, the influence of emotions and needs on (dynamic) preferences for choice options has not received much attention. Recent results suggest that it is possible to model the relationships between perceived utilities of choice options and activated needs based on the concept of dynamic mental representations [2]. These mental representations underlying evaluations of choice options can be modelled as a causal network between decision options and needs (Fig. 1).

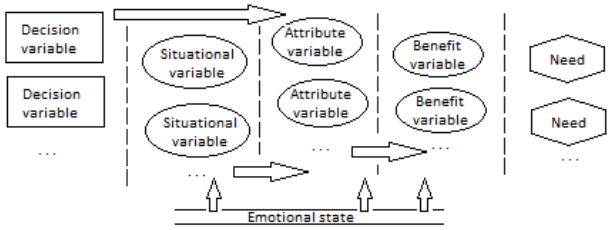

Fig. 1. Causal network and emotional layer in an integrated model of choice behaviour.

Such a model provides an integrated representation of the (dynamic) needs and preferences for choice options based on well-established cognitive and utility-based theo-

ries of choice behaviour. Dellaert et al. [3] argue that the approach has great potential for understanding tourism choice behaviour, so we plan to include a tourist's emotional state as an extra layer in the causal network and to apply the model to the case of our smart routing system.

3 Current State and Outlook

A preliminary survey of the potential of offering tourists the type of assistance the smart routing system intends to, conducted in Bologna, Italy revealed peoples' interest in using this kind of blending of technology and personalisation. Within the scope of cSpace, emotional information will be gathered from a number of sources, such as facial images and bio-signals, as well as by considering relevant context information. We are currently researching on the most appropriate emotion vocabularies that can be incorporated into the user profiles this way, in accordance with W3C's EmotionML specification (http://www.w3.org/TR/emotionml/) for describing the emotional state. Another primary direction of our ongoing work focuses on the inclusion of the affective state into the dynamic preferences and needs measurement phase, in accordance with the dynamic mental representations model. By doing so, we will be able to incorporate dynamic needs, preferences and emotions of a tourist into the recommendation process of selecting the most suitable and personally relevant program, schedule and route for the tour.

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Adaptive Interest Modeling Enables Proactive Content Services at the Network Edge

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Abstract—We have successfully applied user modeling in a networking project. The goal of the project was to develop the network services to enable efficient and transparent distribution of content in mobile ad-hoc network (MANET) environments often deployed in emergency and tactical situations. How to get the relevant content to the right user quickly, in the midst of network disruptions and resource constraints, is a key research challenge. To address this problem, we have developed adaptive interest modeling (AIM) to capture user interests and information needs and build an interest model (IM) for each node. One key contribution of our approach is to anchor AIM at the content-based network layer, which allows all upper level mobile applications to benefit without modification. This adaptive IM can enable many user-aware features including content prefetching and IM sharing. We have developed a unique type of prefetching that is based on recognizing user situations. IM sharing is a novel and efficient way of automatically keeping users up to date with each other. This is especially useful in tactical scenarios where it is important to have a common operational picture among users. Our network emulation experiments show that IM-enabled prefetching significantly reduces response time while increasing data availability at the same time. When combined with IM sharing, additional sizable reduction in response time is achieved.

Keywords—user modeling; context awareness; mobile device; interest; MANET; network layer; content availability; prefetch; sharing

1 Introduction

As mobile computing technology rapidly advances and mobile devices become increasingly popular, more and more content is being generated by mobile devices such as mobile phones, tablets, and laptops. In addition, mobile devices can be rapidly

deployed as a mobile ad-hoc network (MANET) at the network edge where fixed infrastructure is minimal or non-existent. With a large number of content-producing nodes, the edge network not only serves as communication medium, but becomes a distributed data store with each node as a potential content producer and consumer [5]. This type of content-based edge networking plays an increasingly important role in both tactical and emergency response operations [2].

Content-based edge networking requires efficient network services for disseminating, managing, and securing the distributed content. These content services can all benefit from the understanding and modeling of individual node's interests and information needs. Modeling of user interests at the network layer becomes feasible with recent advances in content-based networking architectures, which provide a host-to-content abstraction in the form of publish/subscribe primitives. In the ICEMAN (Information Centric Mobile Ad-hoc Networking) architecture, for example, both the subscription interests and publication metadata are uniformly represented as attribute-value pairs [5]. The queries express the user's explicit interests while the content metadata indicates the user's implicit information needs.

2 AIM Approach

Figure 1 shows a high-level view of AIM's modeling approach under the ICEMAN architecture. User and network events are continuously monitored at the network level. The events include user queries, subscriptions, publications, and shared information. These events are then processed by the adaptation algorithm, which infers user's interests and information needs and produces an IM, which consists of relevant and time-sensitive information elements such as terms and ontological entities (depicted as colored dots in the diagram). An information element represents one dimension of a user's interest. Once built, the IM can enable powerful applications including content prefetching and IM sharing. Given that the IM represents the user's latest interests, it is natural to use it to anticipate warfighter's near-term information needs and automatically prefetch relevant content on the user's behalf. In tactical scenarios, IM can also be shared among users to help create a common operational picture (COP), which improves user's situational awareness (SA). Content prefetching and IM sharing complement each other and together they bring faster query response, higher content availability, and better SA.

The AIM adaptation algorithm used for modeling the user's interests is an extension of the Reinforcement and Aging Modeling Algorithm (RAMA), which was developed in our previous research programs and was demonstrated to be effective in a formative evaluation study conducted by NIST [1],[3,4]. The adaptation algorithm monitors subscription and publication events. It then applies reinforcement and time-based information decay to build an adaptive IM for each node based on these events.

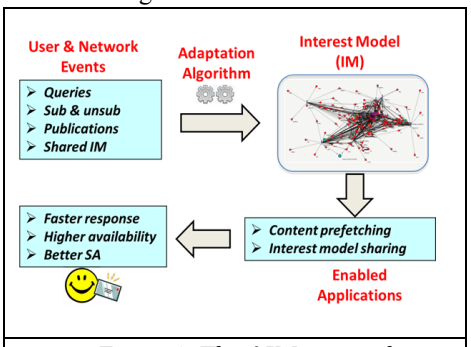

Figure 1. The AIM approach

3 Content Prefetching

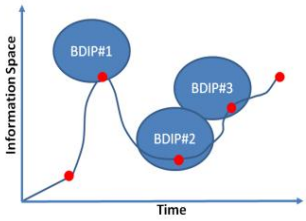

Figure 2. IM-enabled and profile-based prefetching

The adaptive IM can enable content prefetching in different ways. IM-enabled and profile-based prefetching (IPP) is a unique type of prefetching based on recognizing user tactical situations. The recognition is achieved by comparing IM and profiles that describe common operational situations such as battle drills, which are "a collective action, executed by a platoon or smaller element (http://usacac.army.mil/cac2/call/thesaurus/toc.asp ?id=4965)." A battle drill-derived information profile is referred to as a BDIP, which contains terms that describe the required information needs for a battle situation.

In IPP, we first manually create BDIPs (blue circles in the figure) for common military operations such as improvised explosive device (IED), cordon, and search (Figure 2). AIM then builds and continuously updates the IM (red dots) based on the user and network events. Whenever the current IM is updated, it is compared with the BDIPs to find the best match. As the IM continues to evolve over time, a matched profile may become dissimilar and a new profile may become more similar. This can happen when the situation on the ground changes. For example, cordon and search operations are interrupted by an IED explosion. In this case, the IM may initially match cordon and search profiles, but later switch to an IED profile. When a match is found, the information elements in the profile that are not covered by the IM will be used for prefetching. Content matching these elements is automatically fetched and cached when it becomes available and typically before it is requested by the user.

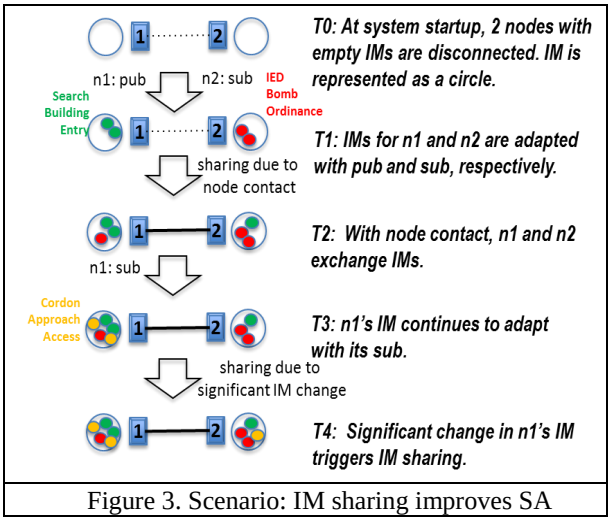

Figure 3. Scenario: IM sharing improves SA

4 IM Sharing

IM sharing is a mechanism for a node to automatically share its IM with other nodes on the network. There are two triggers for IM sharing: a) upon radio contact with a neighbor; and b) when the IM changes significantly. Once triggered, IM sharing is accomplished by sending a new data object encoded with IM elements to connected neighbors. Upon receiving neighbor's IM, the encoded information elements will be incorporated into the receiver's IM via the AIM adaptation algorithm.

IM sharing provides two benefits for the user. Firstly, it can work with AIM prefetching to impact the network performance. In particular, when IM is updated due

to receiving shared IMs from neighbors, IPP may be triggered to perform automatic prefetching. Another benefit is to help build a COP at the edge for better SA in a tactical situation. A notional scenario with two nodes shown in Figure 3 illustrates how AIM can improve SA.

5 Evaluation and Conclusion

We implemented AIM as well as the IM-enabled prefetching and IM sharing features in a content-based MANET prototype. We evaluated these features in a network emulation environment in two studies in a setup with 12 network nodes. Here we only present the results summary due to space limitation. IM-enabled prefetching significantly reduces response time (over 50%) while increasing data availability at the same time. When combined with IM sharing, additional sizable reduction in response time is achieved. Naturally there is a trade-off between these benefits and the associated cost in terms of increased bandwidth consumption.

In conclusion, we have developed the AIM capability for content-based mobile edge networking. It runs at the network layer in the ICEMAN prototype to enable proactive content services including prefetching and IM sharing. Of course, other applications of AIM would also be worthwhile to study in the future, such as the use of IM to influence ICEMAN's caching strategies (e.g., purging and replacement). There is also potential to make our approach more adaptive and focused so that the bandwidth overhead is reduced, e.g., avoid prefetching/IM sharing when the network is already over-utilized.

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The CHESS Project: Adaptive Personalized Storytelling Experiences in Museums

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Abstract. In this work, we describe the basic elements of an effort towards achieving personalized storytelling for museum visits in the context of the CHESS project, with a focus on the profiling techniques employed.

Keywords: Profiling, Adaptive Storytelling, User Modeling, Personalization

1 Introduction

CHESS (Cultural Heritage Experiences through Socio-personal interactions and Storytelling) is a research prototype that was developed under the CHESS project (http://www.chessexperience.eu/), aiming to enrich museum visits through personalized interactive *storytelling*. It uses a) personalized information about cultural artefacts to create customized stories that guide individuals or groups through a museum and b) aspires to (re-)inject the sense of discovery and wonder in the visitor experience. The CHESS system employs mixed reality and pervasive games techniques, ranging from narrations to augmented reality on smart phones. Two museums participated in the effort, each with a different scope and end user requirements: the Acropolis Museum in Greece, and the Cité de l'Espace in France.

There are two types of CHESS users, namely the visitors, who "consume" CHESS experience through their web or mobile terminals, and the authors, who design the experiences. CHESS is following a hybrid, plot-based approach with pre-defined content, where *story authors* (curators, museum staff, script writers) write stories around pre-selected museum themes.

2 Authoring CHESS Stories and Storytelling Model

Similarly to the making of a movie, the creation of CHESS stories includes four main phases, namely scripting, staging, producing and editing. During scripting, the author chooses the main story concepts, sketches the plot and writes the narrative text, i.e., the script. In staging, the author associates parts of the script with exhibits, paths and other spots in the museum environment. Then, a set of multimedia resources are

produced for the staged script, including audiovisual materials, games, quizzes, augmented reality applications, referred to as activities. Finally, the author does the montage, selecting and ordering the activities to realize the script.

In correspondence to the authoring phases, stories are represented as graphs in three different levels of abstraction, namely, the scripting, the staging, and the editing graphs, defining the succession of their atomic pieces and enabling conditional branching based on a variety of events or/and visitor characteristics, over all the three levels. The three graphs are interlinked, so the combined graph forms the story's Storytelling Graph. The overall CHESS Storytelling Graph (CSG) starts with a branching point which leads to all the CHESS stories authored so far.

All the CSG entities (i.e. their atomic pieces as well as the graph branches) are annotated with author selected features. Several features have been exploited so far, such as the topic, information type (real or fictional), script tone, connection to exhibits, required user role, duration, multimedia type, etc.

3 Personalized and Adaptive CHESS Visitor Experience

A typical CHESS experience starts as soon as the visitor enters the museum environment. The visitor goes to a specific web location with his tablet where he is required to log-in into the CHESS application and fill out a short quiz, to gather initial evidences regarding his/her preferences. Then the Adaptive Storytelling Engine (ASTE) starts traversing the CSG graph. Whenever a branching point is met, the ASTE performs two main steps: i) evaluates any hard constraints expressed on each branch to identify the valid ones (e.g. a branch may be unavailable for children) and ii) estimates the visitor's interest in the valid branches to rank them accordingly.

Aiming to reach the right balance between the mental load created to the visitor by the presentation of numerous questions and fully automated decision making, branching points are annotated by the authors as *mandatory*, *automatic* or *optional*. When a mandatory branching point is reached, the ASTE generates a menu where the available options are ranked according to the visitor's profile, while highlighting the first one. In automatic ones, the ASTE makes a decision without informing the visitor about the available options. Finally, when an optional one is reached, the ASTE decides whether a menu will be displayed or an automatic decision will take place. An automatic decision is taken if (a) there exists one option that is significantly better than the rest ones for the current visitor, and choosing it will not omit other story parts that the visitor may also like, or, (b) there exists only one option that the visitor will most probably like and the rest of the options will most probably be disliked.

Depending on the visitor's choice or the ASTE's decision, the CSG is traversed accordingly and the appropriate multimedia resources are fetched and presented to the visitor's terminal.

4 Matching CHESS Visitors to CHESS Content

The visitor's profile contains information about past actions and demographic data, as well as his preferences over the objects he has interacted with (i.e. the CSG entities),

referred to as *Interaction Objects*. Visitor's actions are interpreted and a preference value in [-1,1] is extracted. To estimate the visitor's interest in a set of *Candidate Objects*, we use the well-known k-nearest neighbor recommendation algorithm [1]. First, we calculate the similarity of each Candidate Object to each Interaction Object in the visitor's profile and for each Candidate Object we keep the k Interaction Objects with the largest similarities (we have used cosine similarity though any proper similarity metric may be employed). Given the Interaction Objects with the k largest similarities, we calculate the predicted preference value for the corresponding Candidate Object utilizing a weighted average.

In this way, visitor profiling and matching to CSG entities is not closely tied to the actual features' values used by the authors for annotation. Authors are enabled to have an open tag vocabulary, which they can specify upon their understanding of the current story; the only requirement is to use the same vocabulary throughout the story.

To achieve this we have used PAROS [2], a system that builds and maintains user profiles following a generic, graph-based user modeling framework.

5 Profile Initialization and Story Selection

To support the authoring process and address the personalization cold start problem, CHESS utilizes the notion of *personas*, a design tool from the marketing world. The system leverages persona definition to match visitors to personas, essentially aligning visitor preferences to the author's understanding of the museum visitors [3]. This approach has been applied in an evaluation study that took place in the Cité de l'Espace and it is described in [4]. We have also explored an alternative approach, interpreting visitors' answers to the initial quiz as evidences about their likes in fictional story parts, which are appropriately annotated. Initial story selection is then conducted by matching the visitor's profile to the corresponding stories' annotations. Results from a recent evaluation study with 24 participants in the Acropolis Museum showed that the adopted approach reached approximately 82% of correct decisions.

6 Profile Update under the CHESS Experience

The CHESS Profiler monitors the visitor's behaviour, interprets it as negative or positive feedback, adjusts the visitor's profile accordingly and uses the updated profile in the rest of the experience. The following visitor actions are exploited on that front: skipping (interpreted as high negative feedback on the corresponding activity), completion of activity (low positive feedback on the activity), menu selections (high positive feedback on the script branch) and non-selections in menus (low negative feedback on the corresponding script branches). Based on the visitor's actions on all the activities that comprise a script unit, the Profiler estimates the visitor's preference on the current script unit. Moving a step further, the script unit preferences are used together to infer the visitor's preferences on the whole script branch.

However, due to the big amount and diversity of entities included in the visitor's experience, which may last from 15 minutes to 1 hour, implicit feedback on its own may lead to inaccurate conclusions. For instance, evaluation results have shown that

skipping actions may actually occur due to the visitors' dislike in previous parts of the story, rather than on the ones that were actually skipped. Accounting for the main issues observed during the evaluation studies, we have also implemented a conditional explicit feedback approach. A feedback dialogue is dynamically injected into the user's experience through menus, when certain conditions are met, aiming to increase profiling accuracy.

For instance, if the visitor skips many activities in a short time then a menu is shown asking if he disliked the story part, if he is getting tired and would like to shorten the experience, or if he already knew the upcoming story part. Similarly, if the visitor skips a story part that his/her profile indicates he will like, a menu is shown asking if he is getting tired, if he disliked only the parts of the story he skipped but liked the rest, or if he disliked the whole story part. The main strength of this approach is that explicit feedback is requested only when needed, thus minimizing story interrupts and feedback overhead, while feedback requests occur as the system's response to the visitor's actions.

To further increase the accuracy of implicit feedback, we have also leveraged the visitor's location and movements, the time he spends at each story part, and the way he holds the tablet, examining the visitor's viewing angle. Due to the lack of precise location tracking these techniques have been implemented as a proof of concept and they are showcased with a Javascript demonstration running in the tablet.

7 Conclusions

The provision of personalized content for storytelling experiences in museums entails several profiling challenges. Explicit feedback needs to be maintained minimal to avoid fragmenting the story's plot. At the same time, visitor actions are the result of a guided, complicated interaction with the story's content, the terminal, the museum's space and exhibits, thus requiring for sophisticated and precise visitor monitoring techniques to detect visitor divergence and increase the accuracy of implicit profiling.

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PHEME: Veracity in Digital Social Networks

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Abstract. PHEME attempts to identify four kinds of false claim in social media and on the web, in real time: rumours, disinformation, misinformation and speculation. This brings challenges in modelling the behaviour of individual users, networks of users and information diffusion. This presentation proposal discusses the issues addressed by the project and the challenges it faces, in this emerging and rapidly-developing domain.

Keywords: social media, rumours, veracity, social network analysis

1 Introduction

Social networks are rife with lies and deception, half-truths and facts. The rapid spread of such information through social network sites and other online media can have immediate and serious consequences. For example, social sensors already inform live decision-making about incoming epidemics (such as West Nile Virus), fire engine dispatch (to handle fires in the Australian bush), and earthquakes in both Japan and the USA; in these cases, false information must be filtered quickly. To detect these rumours, large amounts of user-generated content need to be analysed quickly, yet it is not currently possible to carry out such complex analyses in real time. The PHEME project (http://www.pheme.eu) aims to model, identify, and verify claims annotated for truthfulness or deception as they spread across media, languages, and social networks.

Modelling user behaviour presents major challenges in this project. Individuals and groups send messages with different degrees of veracity, giving each author a different level of reliability. Further, people choose whether or not to propagate messages within their social network or to a new web venue. Capturing these behaviours, at both macro and micro levels, is a core part of PHEME.

2 Influence

Information diffusion plays a crucial role in a range of phenomena, including the spread of rumours over and between social networks.

Tracking information flow in implicit networks is a more challenging task because it involves: identifying identical information units; determining when this information was published; tracking the flow within this network; and inferring the implicit diffusion network.

Implicit networks created by dialogue can also be found over explicit social networks such as Twitter. For example, those contributing to a hashtag conversation are

not bound by explicit links such as follower or friend relations, but instead cause information to diffuse among those interested in that topic [1].

As a second stage, PHEME extends models to consider individual users and how they react to incoming rumours, critically seeking to characterise what types of incoming message are likely to be propagated. We model rumour spread using contact process models of epidemiology, whereby a disease is said to spread over a graph according to a Markov process. At each moment in time an ill individual (i.e. a user who currently believes a rumour) may infect a neighbour (i.e. share the rumour with them) or recover from the illness (i.e. realise they were mistaken due to new information), both with given probability.

In the context of the project, we will present models for influence, and models for the spread of changes over networks.

3 Influence and trust in social networks

Since PHEME deals with a wide variety of content, it is important to model trust as a mechanism for deciding which of a set of sources is the reliable one. Network models for trust are already used in information retrieval and have been adapted for Twitter. These typically take a PageRank-style score and propagate trust between nodes in the network.

With respect to influence, PHEME delivers methods for corroborating or refuting claims, leading to an estimate of a source's trust and reputation. This gives a means of capturing linguistic and network behavioural datasets [2] of users who trust / distrust sources.

The trustworthiness of a user/web site depends on the veracity of past content. The opposite is also true. It follows that veracity of a given message depends, amongst other things, on the trustworthiness of its author.

PHEME uses historical Twitter data dating back to 2009, the SWI, METER and APA news corpora, and the linked blogs, forums, and web content. These are searched for known false rumours, acquired from fact-checking websites, in order to create automatically large amounts of training data on past rumours and their spread. This in turn informs longitudinal user models.

We will present motivating examples of challenges in this scenario, and a summary of our existing research on longitudinal models over social networks.

4 Dynamic and transient information

PHEME addresses the spatio-temporal validity of claims, to find contradictions.

The temporal validity of facts needs to be taken into account when detecting contradictions and identifying rumours. It is possible to extract two truths that seem to contradict (e.g. "The president of the USA is George W Bush" and "The president of the USA is Barack Obama") but are in fact both accurate when the appropriate temporal information is added.

Similarly, claims have spatial constraints, especially when they pertain to elided contexts. For example, we may say "The president is Obama" and "The president is

Hollande"; without other knowledge, these are in conflict, but are in fact both true – just in distinct spatial regions.

PHEME seeks to develop tools for annotating and determining the temporal and spatial contexts of claims [3], and cross-referencing these to detect conflicting assertions, as a feature for detecting rumours, mis- and disinformation.

We will describe the anatomy of news articles, discuss existing approaches to temporal bounding, and the challenges in adapting these to social media texts.

5 Posts, networks and diffusion

PHEME involves the development of ontologies to model users, social posts and social network, as well contradictions, temporal bounding, and so on. The project involves building new and extended ontologies to model veracity, misinformation, social and information diffusion networks, rumours, disputed claims and temporal validity. It draws a distinction between content authors, receivers, and diffusers. This includes modelling the temporal validity of statements (e.g. Lenin was born in the Soviet Union vs. in Russia) and lexicalisations (e.g. Kaliningrad vs. Königsberg), based on work on adding temporal arguments to RDF triples.

We will give information on the ontological approach developed so far, accompanied by examples.

6 Representing dynamic flow in social graphs

The main challenge in browsing and visualisation of interlinked media and social network content is in providing a suitably aggregated, high-level overview. Timestamp-based list interfaces that show the entire, continuously updating stream (e.g. the Twitter timeline-based web interface) are often impractical, especially for analysing high-volume, bursty events.

The project incorporates visual analytics tools for collected veracity intelligence, including visualisations of geospatially and semantically referenced information, across news, media and social networks. Exploring the storytelling potential of big data visualization [4], the interactive components of PHEME are intended to increase the understanding of the complementary relationship between the explorative and communicative dimensions.

We will give examples illustrating the challenges in visualising this information and information regarding our planned approach.

7 Decision support

Modelling and reasoning with rumours is particularly challenging, due to the need to represent multiple possible truths (e.g. superfoods may cause vs. prevent cancer). The reasoning is parameterised further in accordance to the domains of the two use cases (healthcare and digital journalism).

PHEME addresses how the new veracity intelligence methods can be applied to a health-related use case, and how social media analysis can be integrated with public health monitoring and with analysis of the electronic patient record (EPR). Specific topics for demonstration are: Among other topics, PHEME will analyse the impact of public health concerns and health-related rumours, including issues of medications, trace elements and food additives (e.g. Alzheimer's, autism, Attention Deficit Hyperactivity Disorder).

The project also prototypes an open-source digital journalism tool, to support the cross-linking, verification, analysis, and visualisation of veracity, operating across media and languages. A real-time news platform, SwiftRiver, is to be used to test and develop rumour detection algorithms. Spatio-temporal knowledge plays also an important role. A key challenge is to identify the regionality of events (e.g., neighbourhood, city, or country level).

We will present these two motivating scenarios for rumour detection and discuss the potential impact and issues in each case.

8 Conclusion

PHEME addresses veracity in social networks, and attempts to identify rumour, misinformation, disinformation and speculation before it has a potentially harmful impact. The technologies required to do things come with big challenges, especially in the areas of user modelling, user interaction, and information diffusion. We describe a few of these specific challenges and present them in their context, as well as some of our proposed approaches.

9 Acknowledgments

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User-Item Reciprocity in Recommender Systems: Incentivizing the Crowd

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Abstract. Data consumption has changed significantly in the last 10 years. The digital revolution and the Internet has brought an abundance of information to users. Recommender systems are a popular means of finding content that is both relevant and personalized. However, today's users require better recommender systems, able of producing continuous data feeds keeping up with their instantaneous and mobile needs. The CrowdRec project addresses this demand by providing *context-aware*, *resource-combining*, *socially-informed*, *interactive* and *scalable* recommendations. The key insight of CrowdRec is that, in order to achieve the dense, high-quality, timely information required for such systems, it is necessary to move from passive user data collection, to more active techniques fostering user engagement. For this purpose, CrowdRec activates the crowd, soliciting input and feedback from the wider community

1 Introduction

The new generation of recommender systems find recommendations for their users in particular situations and at certain moments in time. As a result, the amount of information needed on an item increases dramatically since such systems deal not in single items, but rather in pairs, (i.e., recommend a *book* for a user to read at a specific *point in time*). The result can potentially exacerbate the data sparsity problem. To overcome this problem, rich and reliable sources of information on the items available for recommendation are necessary. This information needs to include not only views and ratings, but also contextual information on the user's situation, the device in use, etc. In particular, recommender systems focusing on user experience can exploit users' comments and reviews, the context of users and items, and other interaction data [5]. Conventional recommender systems are passive, i.e. they wait for users to start interacting with the system. However, if a recommender system could actively

Fig. 1. A recommender system actively interacting with the crowd. The arrows show reciprocal relationships between *a user interested in an item* and analogously *an item in need of user attention*. This type of relationships motivate user's to interact with items and actively contribute data that can be used to improve recommendation quality.

"request" more information for certain items, or certain item-context pairs (e.g. movie to watch during a flight), the sparse data problem could be addressed directly, and recommendation quality substantially improved. This is what the CrowdRec[8] project is focusing on.

Outsourcing micro-tasks to many users, i.e. crowdsourcing, is an unmined information resource; by actively collecting information from users on items, a richer and denser dataset is collected and can be used to improve recommendation quality. Crowdsourcing does however come with a drawback, i.e. users need to be remunerated for their contributions. We propose that recommender systems utilize their own users to contribute data. Instead of the traditional financial incentives common in crowdsourcing, we intend to motivate user contributions by matching users with the specific items that they find interesting enough to comment on, review or interact with at specific points in time. The result is a recommender system with *crowd activation*, as illustrated in Fig. 1.

The key factor in ensuring high quality of data is *user-item reciprocity*, i.e. if the recommended item is of interest to the user but does not invite interaction (e.g. tagging, reviewing, etc.), little or no data will be added by the user. However, if the user is likely to interact with the item (item-user reciprocity), more data will be generated. Consider this example: a new restaurant opens in a location that is off the beaten track. In the regular case, it would take considerable time for the restaurant to be discovered by the crowd. The system recommends this restaurant to a person familiar with that area, this person is also likely to write a review. Additionally, the person often frequents restaurants and is motivated by the fact that this particular review can make an important contribution to popularize the neighborhood she is living in. The result is a richer description of the restaurant in questions which results in better recommendations for everyone.

Analogously, in the case of user-generated video portals, conventional recommender systems tend to down-weight videos that receive little attention in the first few days after uploading [2]. With the proposed methodology niche content may also find audiences easier, thus potentially contributing to the diversity of recommendations.

[8] http://crowdrec.eu

2 Incentivizing Active Participation from the Crowd

Incentivization in the context of crowdsourcing is the act of motivating contributions from the crowd, and at the same time caring about the quality of these contributions. According to Antin and Shaw [1] and Kaufmann et al. [4], crowd member incentives can be divided into two basic categories; 1) *intrinsic motivation*, motivation arising from internal factors, e.g. enjoyment, identification with a community and need for social contact, and 2) *extrinsic motivation*, arising from external factors such as awards and external obligation. The CrowdRec vision of crowd activation for recommendation exploits both motivation types, with a specific focus on intrinsic motivation. This is attained by pairing users with items they likely are interested in, and in parallel targeting items which will benefit from user attention. The result being satisfied users engaging and contributing for the good of the community. The power of incentives in crowdsourcing has been demonstrated by real work applications, e.g. Podcastle (podcast transcripts) and Songle[9] (music annotation). Their creators report that the quality of contributed information exceeds that of commercial crowdsourcing platforms [3]. Our vision extends these approaches by pairing users with content, and vice versa. We anticipate reciprocal recommendations to actively match users to items not only based on interest, but also on need and likelihood of interaction.

3 User-Item Reciprocity

The vision of crowd activated recommender systems presented here aims to create a symbiosis between users and items. To realize this symbiosis, two factors must be taken into account: 1) users who are recommended to items should be interested in those items and have the potential to enrich them, and 2) it is necessary to create mechanisms enticing users to provide data on recommended items. The first consideration could be perceived as a traditional recommendation scope, the second will however require extending existing recommender system techniques in order to reach the goal. One direction for this extension is to build on existing work in reciprocal recommendation, creating matches between both the target item, and the target user. This technique, commonly used in dating recommendation, generates pairs of users with mutual preference [6]. In order to establish this symbiotic relationship, the concept of reciprocity in recommendation must be extended to scenarios where various constraints, e.g. duration of availability, novelty, interestingness, intrinsically limit the potential users an item can be recommended to. The ways in which reciprocal preference modeling can improve recommendation performance must be thoroughly analyzed before it can be understood. This includes the relation between the recommendations displayed and the response rate, the collection of critical amounts of feedback to better characterize media content, cutting the duration of cold-start for new

[9] http://en.podcastle.jp/ and http://songle.jp/

users and items, and optimization not only for users but also technical factors and business objectives.

4 Conclusions and Outlook

We presented a vision combining crowdsourcing and recommender systems. Our insight is that recommender systems can utilize their own user base as a crowd that can contribute the rich information needed to address the sparse data problem faced by recommender system. By using reciprocal recommendation to identify items that are suited to users, and additionally users that are suited to items, we propose that it is possible to incentivize users to contribute information on items. The resulting symbiotic user-item relationship will generate richer, high-quality information, resulting in better recommendations. We emphasized real-time and context-aware recommendation as contributing to the sparse data problem. Other factors could be important as well, e.g. in video recommendation it is interesting to recommend not only whole videos, but also time-points within specific videos. It is possible that rich information at the time-point level is only possible if recruited users are also interested in specific videos, making them interested in interacting with and tagging videos in their entire length. By activating the crowd, we can move beyond the problem of data sparsity to the problem of addressing low quality data. In addition to contributing, the crowd can also validate information that is used as a basis for recommendations.

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PRISE : Adaptive environment for consolidated management of digital resources

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Abstract. The increase in production of digital data, these last years, has raised several issues regarding the management of heterogeneous and multiple source data in the user's environment. In this proposal, we focus on user process management in order to assist him in the consolidated management of his digital resources in an interactive and adaptive system. We introduce PRISE (Personal Interactive research Smart Environment) to assist researches for managing their data effeciently. PRISE architecture is based on three essential parts of the system : the user model, the process model and the resource model. Our aim is to maintain a consistency in terms of interaction between the users and the digital resources. Experimental implementation which is carried out in our laboratory, is presented.

Keywords: User modelling, process management, profile management, trace-based system, digital resource consolidation

1 Introduction

In the recent years, the rapid growth in production of digital data raises new problems regarding data management issues [1][2]. Users of information systems face several major challenges in the organization of the data and retrieving quality information from data sources. They want to work in a consistent environment with reliable information despite the increasing number of data sources and their heterogeneities. The use of data must be relevant to their contexts and adapted to their profiles as illustrate in Fig. 1. It is shown that, users with different profiles might have access to multiple data sources. The data contained in these data sources are often heterogeneous. The main question that arises is : Can heterogeneous data from various data sources be adapted with the user? Otherwise, how to adapt these data to their users in a digitals resources management environment? We assume that it is very difficult or impossible for different users with different profiles and evolving in different context (context of use) to have the same usage needs on heterogeneous data. Indeed, we want to provide a digital resources management system that is best suited for each user.

The above questions have raised new requirements in the modelisation of process management. In [2] the authors argued that, it requires automated or

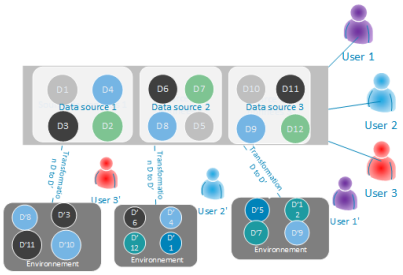

Fig. 1. Heteregenous and multiple data sources

Fig. 2. PRISE digital resources management interface

semi-automated analysis techniques to detect patterns, to identify anomalies, and to extract knowledge from different processes to produce an adaptive process management. This study consists of assisting user in handling digital resources based on a consolidated management of digital resources. The contributions of this proposal are as follows :

1. defining a new model of digital resource that provides the best use experience to users of a specific system (e.g. to meet the user's needs).
2. proposing an intelligent system to assist users in their resources management based on trace-based system, user profile modelling and adaptive process modelling.

2 Our Methods

The user's profile provides relevant information about the user. Therefore, we propose some mechanisms to assist the user in the consolidated management of resources and system environment based on these information.The profile should match the 3 facets of assistance as shown in Table 1.

The resource which is relevant to the profile of the user can be verified through the resource metadata. The proposed methods are related to three elements (the profile, the resources, the processes) that are very important when referring to consolidated management of digital resources. The methods in the proposed system are summarised as follows :

– firstly, we modelised and characterised the user's information and interaction with digital resources using the extension of IMS-LIP (IMS Learner Information Package). The digital resources in the system is also modelised by using LOM(Learning Object Metadata) application profile;
– secondly, each resources which are relevant to the user is characterised. TF-IDF [3] is used to measure the distance between the user profile information and the resource metadata;
– thirdly, the user process in the digital resource management system is characterised to adapt the digital resource manipulation process to the user model and the resource model.

Facets of user assistance	Characteristics to act on this facet
Resources management	Characterises digital resources in order to calculate the relevance of these resources for users in the systems
Process management	Characterises resources management rules and user's process management interaction to adapt the usage
Collaboration management	Criterions for building a user trust community [8], resource sharing and recommendation

Table 1. Facets of assistance in PRISE

The main objective on the relevance, we are interested, concerns the relevance based on the intention of the user[4] [5]. As The intention of the user is dynamic, the information cannot be stored in its profile. Therefore, we need to automatically identify user's intention to calculate the relevance of the digital resource for this user[6][7].

3 Architecture and Implementation

In the experimental work of this proposal, an environment system that allows a researcher to manage their digital resources have been developped. The system offers a set of tools allowing it to be more effective in the production of scientific results. Our research environment PRISE[1] includes several tools which are:

- digital resources management (implement with NoSQL database and JSON API to retrieve data);
- social networks including our model of the researcher's profile;
- events, tasks, teams, and members management.

Fig. 2 present resource management interface. Fig. 3 shows the functionalities that are required for implementation, Fig. 4 presents the system architecture and Fig. 5 shows an adaptive scenario model.

4 Conclusion and future work

The main contribution of the proposal is to be found in user digital resources relevance management, according to the user's profile information and the resource metadata. The first version of our prototype has been developed and we hope to improve it through some related works proposed in [9]. In our future work, we would need :

- to implement a better trace-based system which will be used to assist the user in his consolidated management of his digital resource;
- to build a resource run-time component which will be used to validate our resource model that will be more autonomous and interoperable;
- to implement the user's companion in the system.

[1] PeRsonal Interactive research Smart Environment

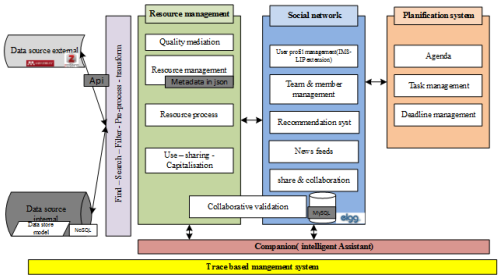

Fig. 3. PRISE system functionalities

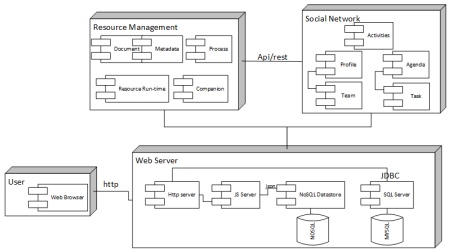

Fig. 4. PRISE system architecture

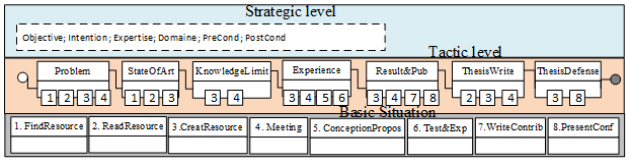

Fig. 5. PRISE Scenario

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Supporting Workplace Learning in Small Enterprises by Personal Learning Environments

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Abstract Small and micro enterprises have a decreasing participation in vocational education and training. There is a real need to engage them in developing a positive attitude towards training. The BOOST (Business perfOrmance imprOvement through individual employee Skills Training) project will integrate outcomes from two previous projects (BECOME and ROLE), in order to develop associated methodologies and tools. These will enable enterprises with less than 20 employees to identify their critical business needs and then also to find appropriate and customized learning resources to meet these needs. Our solution provides predefined Personal Learning Environments for 3 different roles. These environments are customizable and should be further developed towards personalization and adaptivity.

Keywords: Workplace Learning, Personal Learning Environments.

1 Introduction

In the BOOST project [1] we are aiming at facilitating informal learning at the workplace in small enterprises (up to 20 employees) by means of modern information and communication technologies. The project attempts to create a cross-border and cross-cultural approach to increase participation of micro and small enterprises (MSEs) in vocational education and training (VET). The aim is the transfer and integration of methodologies and tools from the previous BECOME [2] and ROLE [3] projects. The innovative methodologies identify the Business Goals (Business Critical Needs) of a MSE as well as the associated Learning Indicators. The Responsive Open Learning Environments provide customized learning and training solutions that enable to meet the specified Learning Indicators. The result will contribute towards increased engagement of MSEs in VET across the EU.

BOOST has the potential to address the clear needs of MSEs in terms of both the methodologies for engagement developed under BECOME, focusing on the real business needs and linking this seamlessly to learning solutions by using the ROLE platform and tools. It exploits tested but innovative solutions which already exist in other sectors of the economy. It is designed to raise competence levels in at risk sectors by providing responsive, flexible, comprehensive, inexpensive and `light' (Web. 2.0) e-Learning technologies.

The most important results will be the technical prototype and platform, which are based on an innovative methodology. At least 15 case studies are planned, in order to evaluate the prototype. More than 40 small enterprises will be involved and over 100 individual employees will test the tools, which will enable to identify their skill gaps and fulfill the business critical demands. At the end of the project (in September 2015) a conference for training providers, business networks, and policy makers will take place in Aachen. A suitable sustainability strategy for project outcomes will be developed too.

The developed system will integrate assessment of business critical needs with provision of training and learning solutions. The needs will be identified by methodologies from the BeCome project. The customized learning solutions will be provided via the ROLE project platform and tools. This project will take the key features and benefits of both and integrate them to meet the market need. The aim is to support employees in training activities and to facilitate their personal development.

2 Expected Impact on the VET System

In Germany a major aim is to increase the number of people who participate in lifelong learning (LLL). A new education policy target has been proposed by experts: increasing the participation of people between the ages of 25 and 64 in lifelong learning to 80% by 2015. Our solutions should support especially management of personal competence development.

As mostly small enterprises are unable to provide training, we are focusing on them. Our approach aims at integrating learning in their work processes, providing them with suitable instruments for business analytics and development of human resources. Our experience from previous projects has shown that in a business context, there are complex requirements and restrictions, like the contrasts between openness versus data security, different targets (the company versus the individual), or the implementation strategy. Nonetheless, the feedback from the evaluation remains very positive.

The German economy is based on skilled work, so companies require well qualified workers. But demographic change is leading to a shortage of these people, including scientific and engineering occupations. Therefore our target group consists of small IT firms, which can benefit from the proposed e-learning solutions. In addition, they should be able to overcome usual initial resistance and adopt new software systems more easily, as it is quite natural for them.

This proposal is a unique chance to disseminate the outcomes of recently successful projects and customize them for the special requirements of small enterprises. The provided solutions support personal competence development at the workplace in all phases, i.e. planning, learning, ad reflecting. They help to identify business critical needs and skill gaps of the employee. Then they can recommend learning resources from existing repositories as well as suitable peers in communities of practice. In addition, these tools also monitor progress and visualize relevant performance indicators, supporting self-reflection.

3 BOOST Technical Prototype

Our technical prototype should provide the following functionality:

1. Identification of the main challenges (competence gaps) for training (learning) in the company
2. Planning of training (learning) for individual employees (setting up learning objectives)
3. Providing suitable training (learning) opportunities for employees
4. Monitoring of (competence development) progress of the company and of individual employees

Based on the outcomes of previous projects, we have identified quite clearly the functional requirements for competence management:

1. Specification of relevant Business Goals (BGs – high level competences) and their priorities
2. Assignment of Learning Indicators (LIs – concrete competences) to each BG
3. Assignment of Learning Resources (LRs – e.g. documents, tools, peers) to LIs (facilitated by search functionality)
4. Assignment of relevant BGs and LIs to employees
5. Setting up target LI (proficiency) levels for the employee, considering also time scales
6. Assessment of the start and current LI (proficiency) levels for the employee
7. Monitoring the training progress in the company and also of each employee (considering also time scales)

On the other hand, the functional requirements for the learning support are still relatively vague, as they will be more domain dependent:

1. Community support – sharing experience, communication, collaboration
2. Domain specific support – training (learning) and assessment
3. Annotation (ranking) of learning resources assigned to LIs
4. Considering learning styles of individuals

These functional requirements imply a hierarchical data model consisting of:

1. Business Goals
2. Learning Indicators
3. Learning Resources

We distinguish 3 different user roles that have different characteristics and requirements: Manager (e.g. business manager, business advisor or consultant), Trainer (e.g. training manager, learning facilitator) and Employee.

Manager specifies BGs for the company, decides which BGs are urgent and which of them are relevant for which employee. Moreover, this role can also assess employees and monitors their learning progress.

Trainer describes LIs for selected BGs and the relevancy of LIs for individual employees, recommends LRs for the LIs, and chooses relevant Learning Repositories, where additional LRs can be found.

Employee gets an overview of BGs and LIs assigned to her, together with the recommended LRs. According to the descriptions of LIs she can search for additional LRs in the predefined Learning Repositories and add them to her portfolio. She can also access the selected LRs in order to learn. Finally, she can monitor her learning progress.

4 Conclusion and Future Work

The BOOST project started in October 2013 and in the first months the consortium tried to identify the common understanding of our requirements and propose a solution we want to realize. We have specified the first version of the technical prototype as described in this paper and implemented it. In the next phase we plan to select and interview several stakeholders, in order to find out the strengths and weaknesses of the current version. The outcomes of these interviews will be considered in the development of the next version of the technical prototype.

One of the requirements we already know about is the privacy. The current version is suitable for companies with open environments, where employees do not mind seeing each other's competences and learning progress. We believe this is a healthy environment. But not all companies want to follow this way and some of them emphasize more privacy. For them another version of the learning environment will be prepared, where each employee can see just her data. We are curious to see which of these 2 alternatives will prevail.

In additional, we intend to develop our prototype also towards personalized and adaptive learning. Our project partners have suggested learning styles as one type of user preference that might be considered. Here we want to benefit from our former projects, like WINDS [4], RAFT [5], PROLEARN [6], and TENCompetence [7].

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Informal Learning at the Workplace via Adaptive Video

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Abstract Learning at the workplace is to a large extent informal. Trainees often need consultations with more experienced colleagues who can answer their questions or demonstrate certain practice. This process is usually very time consuming for the more knowledgeable ones, who often need to repeat their explanations for various trainees. There is a high potential to make this process more efficient by means of technology, especially by using the power of multimedia. In this paper, we present a vision and work in progress for enhancing informal learning at the workplace by using video annotation and video adaptation techniques. This is part of the research and development in the Learning Layers project.

Keywords: Informal Learning, Workplace Learning, Video Annotation, Adaptive Video.

1 Introduction

The project Learning Layers aims to research the role of information technologies in informal learning at the workplace. The project has selected two very challenging application areas, the construction industry and the healthcare sector. Informal learning has traditionally played an important role in these sectors, but both have been hesitant to embrace learning technologies for different reasons. The emerging technologies are a key enabler to refocus efforts on informal learning, but few companies have taken these technologies up in a systematic way to include them into their learning strategy. The project is discovering whether technology can scale up the interactions in informal learning at the workplace.

Discussions with stakeholders revealed various requirements which can be solved by using multimedia in workplace scenarios. For instance, in the construction area young employees often ask their more experienced colleagues for advice and explanations. Moreover, when new techniques emerge (e.g. new devices/practice are introduced) people usually need assistance to understand how they function. In such situations an expert shares his knowledge with the peers, in order to boost the adoption of the new practice. However, if the process becomes repetitive, the resulting way of training is not very efficient. As such, a reasonable use of technology saves a lot of time and money.

In such workplace scenarios, mobile video recording and annotation make the training process efficient, maintaining in the same time important principles of education like engagement, demonstration and authenticity. Video is an intuitive and simple way to share an experience, as it captures many aspects of learning episodes. But because the information contained in the video is not explicit, a key feature for the easy identification of relevant parts of a video can be made by means of semantic annotations. These provide the basis for adaptation of the video according to the situational needs, selecting the relevant parts of it and presenting them in a suitable way. Thus, our solution considers mobile video recording and Web-based collaborative annotation of the resulting content. We explore if the collaboratively generated semantic annotations can represent a motivational aspect, by allowing learners to communicate and clarify issues among themselves. Furthermore, we explore if adaptive video presentations, based on the semantic annotations can further improve the efficiency of the informal learning.

2 Video Annotation

Domain knowledge of experts is often informal and ill-structured. This implies a danger of wrong representation and oversimplification when transformed into a linear form. However, for specific domains such as construction and healthcare an optimal balance between usability and the descriptive power of annotations has to be achieved. This is mainly because the vocabulary established in such working communities is of great importance for structuring and retrieving relevant information. If we consider videos as a medium of knowledge representation, further issues like segmentation and direct access to relevant parts have also to be addressed. A challenge is to provide an opportunity to easily select the scenes that are relevant in a particular context and to present them accordingly to learners. Semantic video annotation has been successfully used to categorize videos using metadata, both at a low (video frames) and abstract (semantics) levels. Development of new mechanisms to support individual and collaborative learning with videos or multimedia on the Web has been identified as an important direction of research [1].

SeViAnno is a semantic video annotation tool developed in the context of a cultural heritage scenario [2]. The tool enables plain text annotations, as well as several types of semantic annotations, i.e. *Place, Object, Agent, Concept, and Event* which are attached to specific video time points or video segments. Along with the annotation services, cloud upload, video transcoding and streaming and the use of shared media repositories are also supported for providing rich multimedia interaction capabilities. All these services are used from the various user clients, providing a flexible, extensible and modular approach to cope with video annotation use cases.

An improved widget-based prototype, which uses the customization and near real-time capabilities provided by the ROLE SDK[1] - SeViAnno 2.0[2] was further developed using the mentioned infrastructure. Apart from the collaborative features offered by the Web widget technologies, SeViAnno 2.0 also makes use of responsive

[1] http://sourceforge.net/projects/role-project/files/role-m10-sdk/
[2] http://role-sandbox.eu/spaces/sevianno2

learning spaces, targeting to be a tool for communities of practice [3]. As such, community members can join a shared space and collaborate on one or more videos. SeViAnno 2.0 contains several types of widgets used for different purposes: a video list widget, a video player widget, an annotation widget, a map (Google Maps API) widget, and a grid view widget for displaying the semantic annotations. As previously mentioned the semantic annotations can be added taking into account video time points and time interval information. The annotation services provide also the methods for searching videos or annotations. The metadata is stored using the MPEG-7[3] standard, which specifies a multimedia content description interface.

In the two Web versions, users can select a specific video and annotate it using the specified annotation types (i.e. plain text/keywords, semantic types). While the video is playing, the semantic annotations corresponding to the current video player position are being highlighted. Moreover, users can jump to a certain video position using the existing annotations (e.g. clicking on an annotation). The community awareness is given by the underlying ROLE space, consisting of a list with the members registered in a space (with presence information) and a multi-user chat.

In the Learning Layers project we have learned that an important requirement in the construction industry is the extreme limitation of available annotation vocabulary. Therefore a mobile version, called "Ach so!"[4], was developed in order to support informal learning in construction scenarios. Due to workplace constraints, Ach so! supports only simple text annotations, making it a usable tool for construction workers which work and need or capture information on-site. Nevertheless, such annotations can be further collaboratively developed into a more formal representation that may provide a better basis for useful end user services.

By using and further developing the semantic video annotation application, our approach supports communities of practice, especially regarding two main directions: 1. Support the user collaboration and seamless annotation capabilities across multiple platforms and devices (e.g. mobile, Web); 2. Make use of the mobile-Web interplay in order to collect contextual metadata, to further support both context detection and adaptation based on the gathered data by offering interplay of meaningful video fragments according to the needs of specific learners.

3 Adaptive Video Presentation

Our aim is to benefit from the annotated videos and provide an opportunity to adapt them according to the current situational demands. This should be based on the current preferences specified by a set of terms to extract just those parts of one or more videos that are relevant for these terms. In this way several long videos can be transferred into one relatively shorter, which may address the current learning goal and situational demands. Our adaptation approach is an incipient work. It is based on the FOSP method [4] that has been applied in the eQ system [5], which considers emotional intelligence in personalized adaptation. This acronym stands for Filter, Order, Select, Present. In the first step just the relevant components (segments) are

[3] http://mpeg.chiariglione.org/standards/mpeg-7
[4] https://play.google.com/store/apps/details?id=fi.aalto.legroup.achso

taken into account. In the second step these components are ordered according to certain rules. The third step includes selecting one of alternative representations of the component (e.g. the preferred media), in order to avoid redundancy. In the last step a suitable presentation strategy is chosen, e.g. how many components should be presented in parallel and how to arrange them on the end user device. These 4 basic operations are defined by functions specifying relations between various sets of attributes (metadata) from the domain, learner, and context models. For instance the weight of a component depends on its annotations and the current preferences of the learner. The order of the selected components may reflect certain logic or pattern. From alternative representation of an Object or Event the most suitable one is chosen, depending on the criteria. Various constraints can be considered, like the weight of the components or the total length of the adaptive video. In this way different adaptation strategies can be specified by different functions operating over the same data. One strategy can order the chosen components chronologically, another one according to their relevancy for the current context. Moreover, a strategy can limit the length of the adapted video too.

4 Conclusions

In this paper, we describe an informal learning approach based on collaborative video annotation, aiming to facilitate informal learning at the workplace. We intend to collect various types of annotations and use them to provide direct access to the relevant parts of them, which depend on the current context and situational demands.

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