KP-Lab System: A Collaborative Environment for Design, Realization and Examination of Different Knowledge Practices

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Abstract. This paper presents a collaborative working and learning environment called KP-Lab System. It provides a complex and multifunctional application built on principles of semantic web, exploiting also some web2.0 approaches as Google Apps or mashups. This system offers virtual user environment with different, necessary and advanced features for collaborative learning or working knowledge intensive activities. This paper briefly presents the whole system with special emphasis on its semantic-based aspects and analytical tools.

Keywords: collaborative system, practices, patterns, time-line, summative information.

1 Introduction

KP-Lab System provides modular, flexible and highly integrated system for collaborative realization of different knowledge practices, examination of previously realized practices and identification of potentially new interesting and useful knowledge. This system was designed and is still being developed within EU IST project called KP-Lab (web site: http://www.kp-lab.org/). KP-Lab is an ambitious project that focuses on developing theory, appropriate knowledge practices and a collaborative learning and working system aimed at facilitating innovative practices of sharing, creating and working with knowledge in education and workplaces.

The KP-Lab system can be compared with some other existing applications in mentioned domain, e.g. Moodle, BSCW, etc. This comparison is described in next section with some detailed information about offered functionalities.

The whole paper is organized in two main sections plus conclusion. This, introductory one contains general information about presented collaborative system KP-Lab and its comparison with other selected state-of-the art systems. The second chapter describes in detail architecture and main components of the KP-Lab system: platform and virtual user environment. The last chapter is devoted to some conclusions.

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1.1 State of the Art

Report on industry-led FP7 consultations [4] summarizes the characteristics of the current CWE (Collaborative Working Environment) as follows. CWE are not integrated and interoperational, they support mainly point to point and not multipoint conferencing, they are defined mainly for structured environment providing static shared objects and they do not support the unstructured orchestration of activities using collaboration aware objects. Finally they focus primarily on peer communication and not flexible team interaction.

KP-Lab system with its integrated functionalities represents step forward in the long process of achieving specified goals to provide interoperational system with possibility to make dynamic changes in realized processes or different types of shared objects, to provide different types of communication, primary synchronous as chat or virtual meeting tool with automatic creation of discussion maps; ubiquitous access through mobile devices, etc.

We provide comparison with selected representatives that belong to broader adopted systems as Moodle, BSCW and Claroline:

- Moodle[1] is typical representative of Course Management System (CMS) strongly oriented on the idea of integrated modules. Users have possibilities to create their own courses in different conditions but e.g. feature to analyse user's practices/activities is weakly developed. It is possible to explore performed activities based on relevant course or user with some basic information.
- BSCW[2] represents a strong commercial system that provides advanced functionalities as tagging, communities, templates, search on different indexing services, while editing tags or the indexes are not so well supported, also collaborative and idea generation tools are not available. In addition, it provides simple storage for performed activities and some basic statistics describing users' behaviour. The important fact is that this system is based on different technologies behind, i.e. processes are modelled through workflows, and data storage is implemented by transactional database.
- Claroline[3] is organized around the concept of space associated to a course or a pedagogical activity. It provides basic functionalities for e-platform and some advanced as possibility to creating complete sequences of learning activities; statistical information about access to the platform, tools or documents usage, forum contributions; but hardly addresses the management and flexible modification of processes.

2 KP-Lab System

The previous comparison shows that each system provides the basic functionalities for collaborative systems and some advanced based on its purposes. The main difference between them and KP-Lab System is its orientation on semantic technologies. It

[1] http://moodle.org/
[2] http://public.bscw.de/
[3] http://www.claroline.net/

is built on principles of semantic web, e.g. ontologies are used as common communication framework in whole systems [3]; shared objects consist of two parts: content and metadata that are stored into semantic repository based on RDF standard, strongly exploitation of stored semantic information for tagging, semantic annotation, search, creation of different visual models (conceptual), description of shared objects and performed activities, etc. The other strong point of presented system is its operability and interactions with other existing solutions, i.e. access to different types of content repositories based on Java standards; possibility to import learning packaged from other collaborative systems within SCORM or IMS standard; integration with existing web2.0 applications as Google Calendar or Google Docs.

The KP-Lab System consists of two main parts: platform and virtual user environment. The KP-Lab platform provides storage and supporting functionalities for end-user layer in form of semantic middleware.

2.1 KP-Lab Platform

The KP-Lab platform (see Fig. 1) consists of several integrated groups of services that are combined in a flexible service-oriented architecture. This architecture represents a set of services that are based on heterogeneous technologies, but provides interoperability that is neither language nor platform dependent.

Technical services cover middleware support services for accessing the whole system based on predefined user's roles and access rights. This aspect is modeled through security ontology that is stored in knowledge repository.

Content management services manipulate with different types of content, e.g. document, video, sound files, pictures, etc. These services tightly interact with CTM on lower level in order to provide access to different types of repositories and with end user layer on upper level to offer features for uploading and versioning of content files.

The semantic middleware services provide storage (knowledge repository) and management services for semantic descriptions (metadata) of the shared objects created by the KP-Lab tools.

Functional services provide supporting functionalities for different end user tools, e.g. Help system that contains basic wiki pages with tutorials and manuals for individual tools, recommender for further user actions, search in help documents, etc. Search services are based on Solr search server[4] that provides API for indexing and faceted search. Knowledge analysis services provide middleware services for analytical tools above awareness repository.

Repositories contain three types of databases: knowledge, content and awareness:

- Knowledge repository is implemented within RDFSuite [1] that is based on RDF (Resource Description Framework[5]) standard. This standard enables the creation and exchange of resource metadata as normal Web data. RDFSuite is being developed at FORTH -ICS in Greece and comprises the Validating RDF Parser (VRP), the Schema-Specific Data Base (RSSDB) and interpreters for the RDF Query Language (RQL) and RDF Update Language (RUL).

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[4] http://wiki.apache.org/solr

[5] http://www.w3.org/RDF/

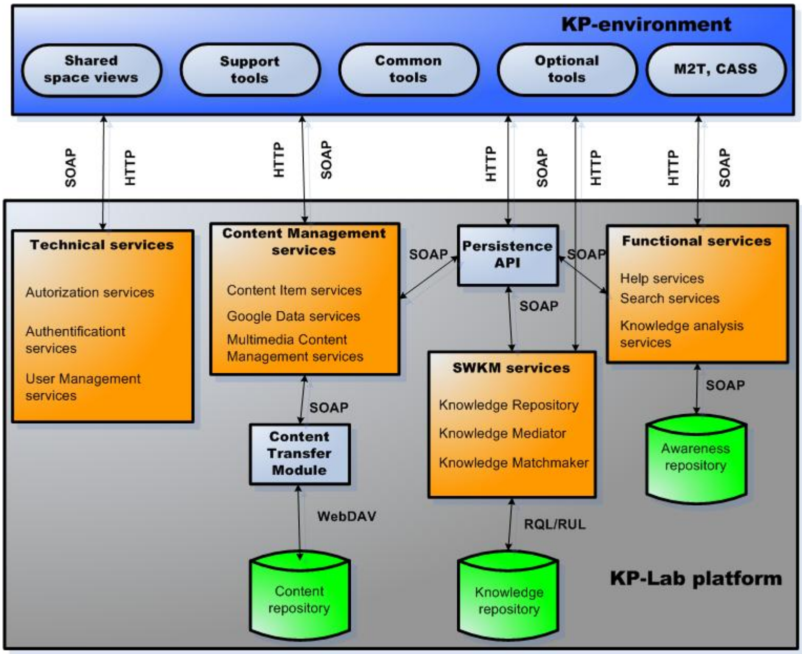

Fig. 1. Architecture of the whole KP-Lab System

- KP-Lab Content repository is implemented through Jackrabbit[6] engine for the compatibility with the JSR-170 standard
- Awareness repository is implemented within MySQL database and provides source data for notification and analytical services. Source data cover logs of events that represent all users' activities and changes within various shared objects in KP-environment [2].

Persistence-API is a Java client library, which provides the generic RDF persistence framework. It allows serialization and de-serialization of the Java objects into RDF repositories (based on the RQL and RUL). One of its main purposes is to separate business logic from RDF. By simple annotations, user can connect the Java Bean class with RDFSuite, without having any knowledge about RQL/RUL [5].

Content Transfer Module (CTM) is dedicated to creation and management of regular content (documents in various formats) used in shared objects (content described by metadata), either towards KP-Lab's own content repositories or external content repositories.

2.2 KP-Environment

KP-environment (KPE) represents user virtual environment with various integrated end-user tools divided into several groups (see Fig. 1):

[6] http://jackrabbit.apache.org/

Shared Space views represents basic user environment of a learning system aimed at facilitating innovative practices of sharing, creating and working with knowledge in education or workplaces. Users have possibilities to realize collaborative activities or practices around different types of shared objects organized in flexible manner based on user preferences, i.e. Content view for shared objects and relations between them, Process view for creation and realization of process models to represent practices or activities, Community view for identification of interesting relations and communication channels between different users and Tailored view as personal space for individual user purposes.

Support tools provide supporting functionalities for effective collaborative work or learning within virtual space, i.e. awareness (on-line notifications about changes in environment); search (free or semantic based on existing metadata); help system and possibility to define user personal preferences and settings.

A group called Common tools refers to a large set of tools that are tightly integrated into KP-environment, i.e. commenting or tagging (tags based on predefined vocabularies, or own tags), chat (individual or group), simple note editor and sketch pad, possibility to import or export data in form of packages based on IMS [6] or SCORM[7] standard, support for personal work within to-do list, integrated semantic wiki.

Optional tools are loosely integrated applications with main user environment accessible based on user preferences or expectations and they use directly KPE graphical user interface or own browser window. These applications provide advanced functionalities for: analyses of performed activities or practices based on monitored and saved data in Awareness repository (e.g. visualization of whole shared object building process based on defined time-line with identification of key persons, their contributions and relations between them; see next chapter for further details); possibility to export data from existing repositories in expected format for further analyses in third party tool as SPSS; exploitation of Google Calendar or Google Docs through open Google API; analyses of multimedia video clips through tagging features, management of tag vocabularies represented as ontologies in knowledge repository; possibility to create and manage visual conceptual models and own visual modeling languages.

CASS represents Java-application implemented on 3G mobile devices and provides access to the KPE through wireless connection. M2T offers conferencing features for management of virtual sessions or meeting with possibility to create discussion maps and analyses of finished discussions based on stored historical data.

2.3 Analytical Tools

The KP-Lab analytical tools represent very important part of described system as they provide interactive framework for different types of analyses based on user requirements or expectations. We provide two basic possible approaches.

The extraction of summarized information about performed activities or practices in KPE based on information stored in knowledge and awareness repositories. These information are obtained based on defined users' queries and cover various aggregations of available data, e.g. number of participants involved and number of actions performed by each of them; number of content items used / changes made / versions

[7] http://www.scormsoft.com/scorm/cam/contentPackages

produced; number of annotations defined / assigned / changed; number of comments added; number of to-do items created / fulfilled or not fulfilled; number of chats, meetings, links, etc. in given time interval, within given group or with other constraints posed by the user in the analysis phase.

The second approach is to consider the activities or practices in KPE as a series of different actions in a chronological order (time-line), possibly with different levels of granularity, where some subsets of them may have crucial importance (see Fig. 2). Such carefully (manually) selected subsets of actions can be called *critical patterns*. These patterns usually lead to some critical moments in a whole activity, which can mean, for example, a significant progress, discovery of new knowledge/approach, or on the other hand they may indicate un-success of a particular activity or its early finish.

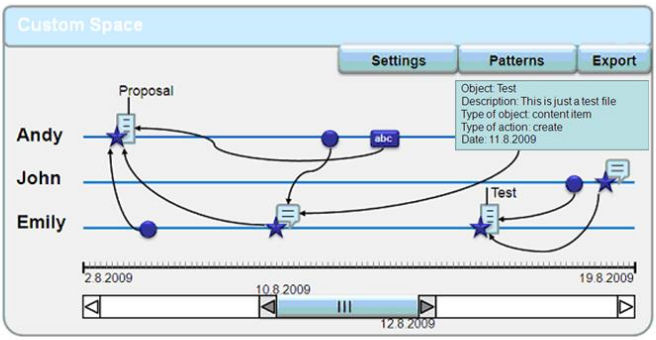

Fig. 2. TLBA visualization

Time-line based analysis (TLBA) provides a complex view of performed events and gives the possibility to focus on potentially interesting facts. This is an interesting way to reflect on the existing practices and following their transformation into innovative ones. Sequences of performed events with relevant elements in chronological order are visualized via defined (one or more parallel) time-line(s), see Fig. 2. Users have possibility to filter/customize the list of properties shown in the timeline based on their preferences. The important functionality of this tool is possibility to define and store interesting patterns from the timeline. Basic time-line visualization consists of automatically-collected events that are performed in KPE. In some situations, it is necessary to include elements called external events (performed outside KPE) that are relevant to analyzed process and this operation is performed manually by the user.

3 Conclusion

KP-Lab System represents interesting and promising initiative in the domain of collaborative systems in order to provide complex solution with various integrated end-user functionalities in one place to meet user expectations within design, management and analyses of different collaborative activities and practices in education or working conditions. KP-Lab System can be compared with existing widely adopted systems to identify positive advances, e.g. support of semantic principles, cooperation with web2.0 technologies, intuitive and interactive user environment, simple extensibility and replacement of previous system based on possibility to import data in standard packages, advanced analytical features to offer different perspectives on performed events, etc.

Public version of our system is available on http://2d.mobile.evtek.fi/shared-space.

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