A MULTI AGENT FRAMEWORK FOR EFFECTIVE CHANGE MANAGEMENT OF LEARNING CONTENTS IN SEMANTIC E-LEARNING

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Abstract

The inevitable changes in learning contents need to be tracked and managed seamlessly for knowledge repositories in order to facilitate the learners with up-to-date concepts. However, evaluation of suggested changes (in lessons, topics, sub-topics, learning objects etc) for incorporation into active knowledge base is of key importance identified through different factors such as content change type, change module, change priority, learning content change validity etc. A framework based on intelligent agents has been proposed for identifying/incorporating valid changes in the repositories of learning contents (and learning objects) on the basis of given parameters through different agents. These agents have been employed for different tasks such as Content Change Receptor Agent (CCRA)" to gather change specific parameters for use by "Learning Object Change Analyzer Agent (LOCAA), "Manage Learning Repository Agent (MLRA)" for handling the tasks specific to semantic repositories and "Learning Content Change Revision Agent (LCCRA)" to intelligently predict a change (through knowledge engineering techniques) if given parameters don't recognize the change in learning content(s). Moreover, these agents are intelligent enough to interoperate with latest generations of web i.e. web 3.0 (semantic web). This interoperation of agents is enabled through different baseline ontologies devised for modeling the learning contents in the form of lessons, topics, sub-topics their annotations and instances. In order to evaluate the proposed framework, a twofold approach has been exploited i.e. evaluation of ontological models and performance accuracy of system agents for catering the change in learning contents. Here, it is worth mentioning that initial implementation and evaluation parameters of proposed models are envisaged to be in controlled environments with evaluation in real time academic conditions over the years.

Keywords: E-Learning, Semantics, Multi-Agents, Knowledge Engineering, Learning Objects

1. INTRODUCTION

E-learning or Electronic learning [1,2] is the process of disbursing learning contents through electronic technology for educating learners with number of learning prevalent techniques i.e. slides or word/PDF documents in CDs, video conferencing, televised lectures, webinars (live online classes), message boards, social media, periodicals, journals, wikis and many more. There are number of underlying reasons for opting

E-learning over conventional study: it is swift, less costly, more interesting, and available at any time any place, manageable and update-able with convenience for large groups of learners. Moreover, it enables learners for not relying on the teacher and be independent with standardized process, consistency in the delivery of content and higher degree of satisfaction with web-enhanced teaching. However, our research is focused on updating the learning content repositories through intelligent agents; knowledge engineering techniques and compliance with web of semantics i.e. web 3.0.

A comprehensive mechanism of Learning Object (LO) [3] configuration management being an important part of LO development tracks the maneuvering of learning contents on one side and more importantly plays a vital role in maintenance by managing LO change requests. This phenomenon of change management, our focal point, facilitates kinds of learning contents from repositories maintained as ontologies [4].

One of the biggest challenges for successful E-Learning systems today and in the future will be to ensure the quality of LOs with efficient maintenance i.e. change management [5]. Similar phenomenon of managing the software change management can be applied for managing the change of LO in e-learning systems. The process of change management is illustrated in Fig.1 (provided by Microsoft) with a simplified view of the workflow for a change control process [6]. The figure demonstrates that not all change requests are accepted rather evaluation process is triggered with a change request to see if it is valid or has been fixed in prior version (Similar analogy is true for e-learning contents as well). Once validity of LO change request is affirmed, it is classified as a valid change or discard-change status based on priority of request made. In some cases, it might be deferred or simply rejected. Therefore, selecting and managing LO change is as important as actually making the changes in e-learning pedagogies and repositories. There will be scarce chances of delivering required learning content to learner by a specific date without establishing a plan and then monitoring LO changes during the entire learning cycle. So change management and change control, playing a vital role in controlling scope and effectiveness of learning outcomes with a far ranging effect on learning time, cost and quality.

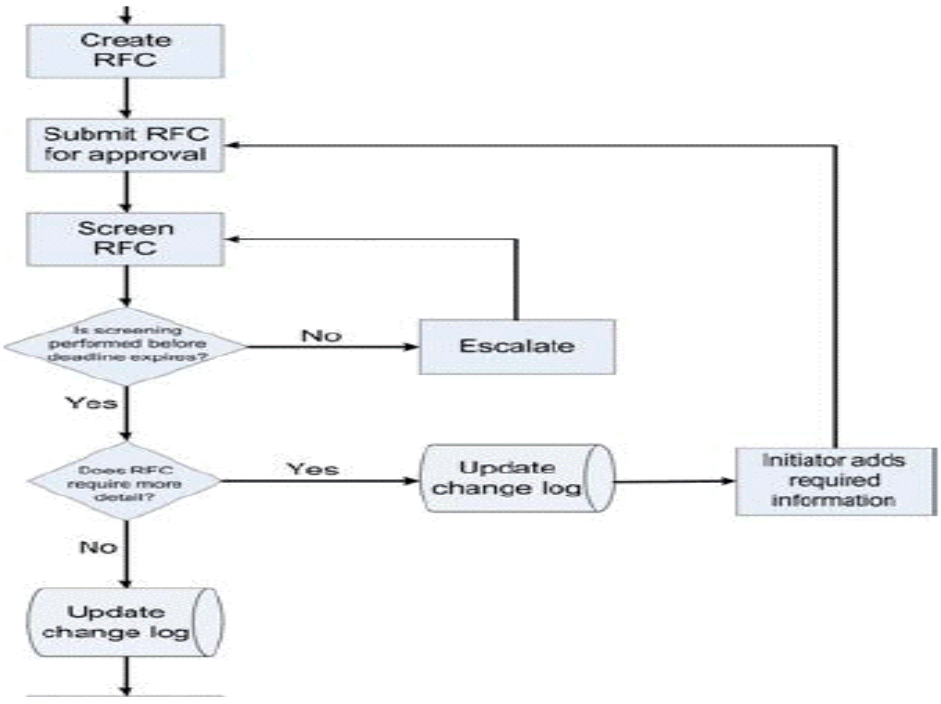

Fig.1 Life Cycle of Change Request in Software configuration and E-Learning

Keeping in view the importance of LO change management in e-learning, plenty of efforts have been made to automate the process of change management in all e-learning systems ranging from embedded systems to applications used for teaching the controlling of air traffic control, from an inventory management system to seismic analyzers to mention a few.

Numerous techniques can be observed to manage the software changes emanating from different domains in form of different artifacts with specific support systems for change management [6, 7, 8] Some places use

category theory to manage the change with ontological versioning. In this paper, we will be focusing on presenting a review of techniques in the realm of knowledge engineering for e-learning change management. Moreover, architecture based on a blend of AI techniques, agent systems and knowledge engineering entities i.e. ontology will be presented followed by the conclusion and future work.

2. LITERATURE SURVEY

A generic architecture based upon multi agents based E-learning system for learner/instructor in virtual environment is presented in [9]. Study focuses on representation of knowledge and pedagogical model (to add, delete, modify instructive concepts), learner model and interface model are focused in addition to instructor model (for providing knowledge about exercises to be performed). Veracity of conditions is evaluated by manipulating models contextualized for specific environments using M1-level knowledge based on learner-instructor relationship.

An approach based upon agents has been employed for managing the LO change in form of evolving learning requirements has been provided specific to biomedical domain in [10]. An RLR (Representation, Legitimation and Reproduction) framework has been proposed in this paper. This assists in managing the content updates (such as capturing, tracking, and managing LO changes) so that reproducible results can be produced.

In [11], Subversion an open-source version control system for learning management systems is presented for maintaining a LO repository versioning. LO and contents are maintained in the active directories

The paper [12] addresses issues in static educational material by considering the knowledge and capability with interactivity (responses & feedbacks based on assessments) for quality learning of learners. So an E-learning system employing Item Response Theory and machine learning techniques is presented. Learner is assessed after session of learning and assessments are made over tests (IRT based) and personalized recommendations (ANN based) entailing in personalized teaching environment are presented. There was one hidden layers in the network, ANN model was trained (over input, output and hidden layers) in MATLAB software environment.

For evaluation purpose 6 different responses were presented to the network collected for each test. The Learning Objects (LOs) recommended by ANN model were recorded in order to certify the contents suggested by domain expert. Performance of ANN model appeared similar to the desired outcome with an acceptable ration i.e. 25 of 30 tests (83.3%).

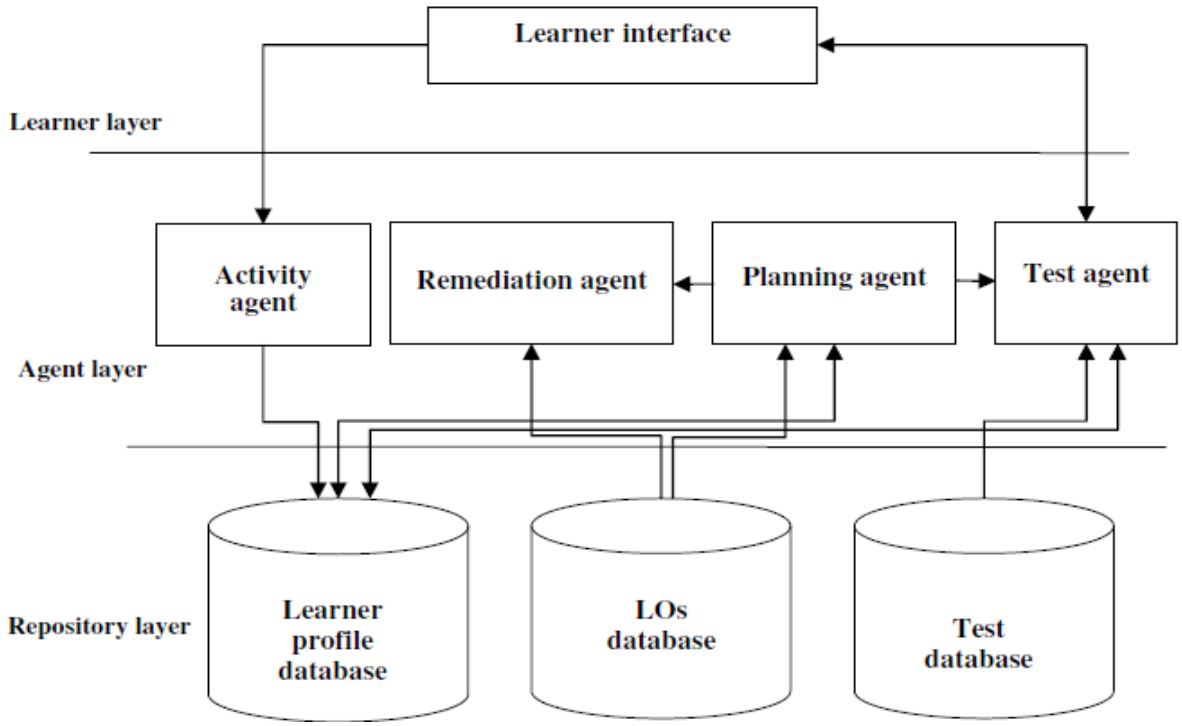

Fig: Educational content structure for agent based E-learning system

In [13, 14], change is managed by maintaining versions of ontologies i.e. V_{old} and V_{new} through conceptual relations. Record/list of the changes causing transformation from V_{old} results to V_{new} is maintained in "Change Log" with exact sequence of changes. Structural diff module tracks the mapping between concepts and properties added/removed on having an updated.

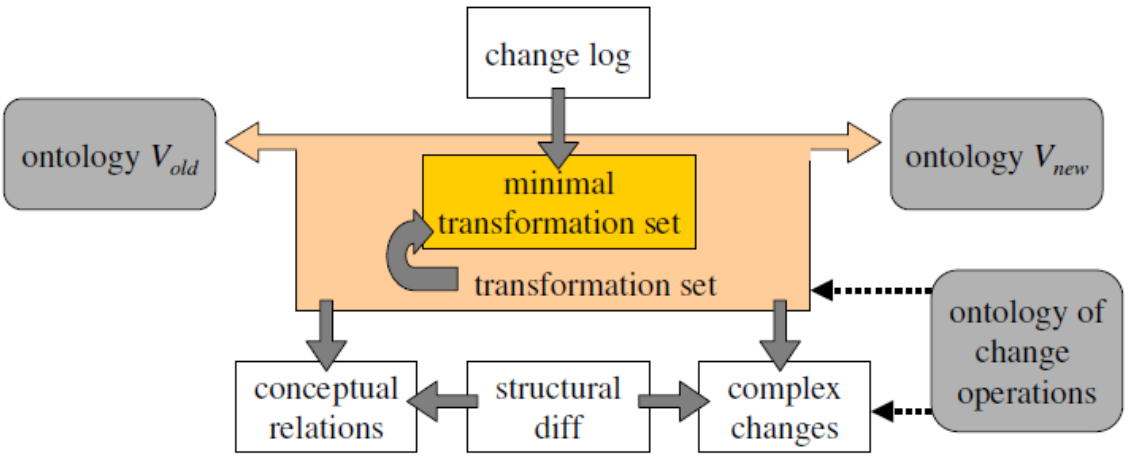

Fig.2: Relations between different change representations

The research presented in [15] proposes an E-learning system based upon multi-agent-system based generic E-learning architecture for learner/instructor in virtual environment. Study focuses on representation of knowledge and pedagogical model (to add, delete, modify instructive concepts), learner model and interface model are focused in addition to instructor model (for providing knowledge about exercises to be performed). Veracity of conditions is evaluated by manipulating models contextualized for specific environments using M1-level knowledge based on learner-instructor relationship.

3. PROPOSED ARCHITECTURE

Keeping in view the importance of change management in e-learning systems as articulated by efforts orchestrated above, we plan to come up with system that is equipped with feature of retaining the history of LO changes/updated in a central knowledge repository. Each time request for a LO change is triggered; it is evaluated on the basis of some given parameters to see if it is a valid change or is otherwise. We plan to come up with evaluation parameter such as LO change type (topic, sub topic, chapter, and annotations), change severity, change priority, change validity, change module and description. These parameters specific to learning content change will be acquired by "**Content Change Receptor Agent (CCRA)**" for use by "**Learning Object Change Analyzer Agent (LOCAA)**" and stored in content repository. This will not only contain previous content change requests but would greatly help in reaching a conclusion regarding validity of change. If we need to use any knowledge engineering technique to decide upon validity of change, this repository can aid by working as a training set as well as the test bed for number of change validation cases. The changes asserted as valid or invalid ones will be retained in the repository for future references. Repository will be handled by "**Manage Learning Repository Agent (MLRA)**". If we are not able to draw any concrete verdict about validity of a change with above process or by not having a similar scenario in the given phase, we use neural networks (or any other AI technique) for deciding upon the change validity. AI model can be trained, tested and evaluated for (predicting the validity of change) through datasets available in the repository. After some prediction is made and we get the status of change validity, instance of change request along with valid/invalid status is stored to repository. This process of adapting to an appropriate solution via AI technique(s) will be managed by "**Change Revision Agent (CRA)**". This model is illustrated in Fig. 3.

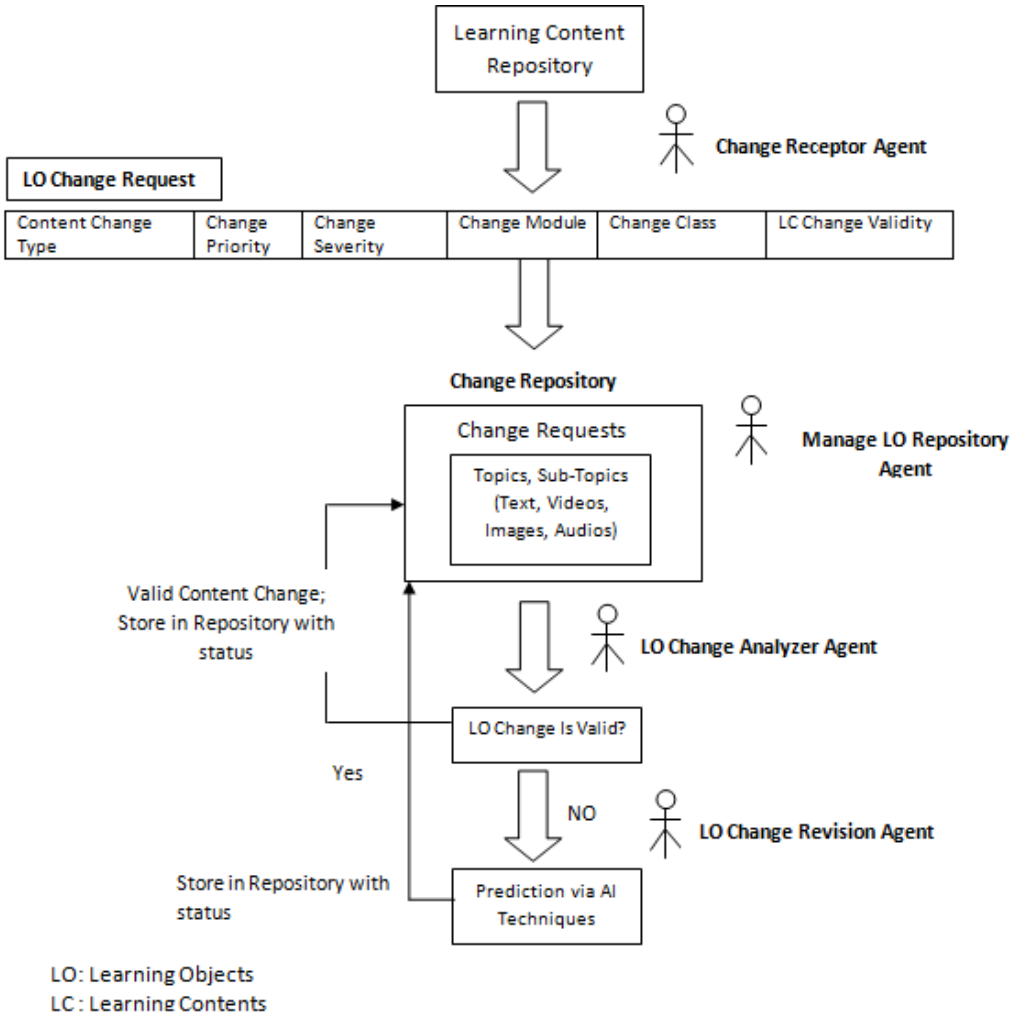

Fig.3: Proposed Framework: A multi-agent system for LO Change Management in E-Learning

4. CONCLUSIONS AND FUTURE WORK

In order to complement efficient process of e-learning, a content change management with different types of tool and capabilities are necessary Therefore, to help in provision of a widely automated support for this process; a review of important efforts has been presented. A generic infrastructure in this context has been proposed. New concept of managing content change via agents and repositories has been put forth. This idea is inspired from incorporation of ontologies in the system and exploitation of agent systems from domain of Multi Agent Systems. Finally, we envision to enjoy many benefits if this system is made operational with a standardized representation of LO change requests in repositions (ontology may be used here).

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