Use of an Adaptive Agent in Virtual Collaborative Learning Environment

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Abstract. Personalized education in an ICT enabled environment is a contemporary matter today. The adaptation of education to diverse types of student is becoming a big challenge. Proposing personalized learning in the digital era, we obtained a new dimension called an agent based adaptive learning. This has led to adopt knowledge management practices that provide innovation in knowledge clustering for active learning. In the ICT enabled learning, the learners are geographically scattered. Agent-Oriented System simulates the teaching-learning pedagogy by sensing the environment, listing several traits, observing the user behavior, finding pattern and learning pace of the learner. This leads towards imparting intelligence to an agent that helps both learner and the tutor to build a smart teaching-learning environment. This paper proposes an agent which works as a middleware which uses semi supervised learning mechanism with both forward and backward chaining for the inference to impart intelligence in learning environment.

Keywords: Agent-oriented system · Backward chaining · Forward chaining · Knowledge management · Semi-supervised learning

1 Introduction and Current Status

An e-Learning may be truly effective when the pedagogy, offering and measurement technique aligns with the learner's ability and proficiency skill. The talent, skills and pedagogical view must be treated in an effective way to make the e-learning environment an interactive and informative environment. The Virtual Collaborative Learning Environment (VCLE), which is an agent-based system, wherein the system infers the knowledge from the available knowledge. The overlap in learner, domain and technological knowledge in a collaborative learning environment encourages the agent based learning environment to connect and capture the knowledge which is implicitly available either in the domain database or with the learner (Fig. 1).

© Springer International Publishing AG 2018
S.C. Satapathy and A. Joshi (eds.), *Information and Communication Technology for Intelligent Systems (ICTIS 2017) - Volume 2*, Smart Innovation, Systems and Technologies 84, DOI 10.1007/978-3-319-63645-0_65

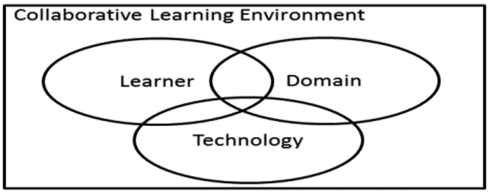

Fig. 1. Knowledge overlapping in VCLE

In this Help and Learn environment, a centered view of knowledge is not just residing in learners mid but in the interaction between leaner and between learner and content stored. In this open context, other Internet resources are being utilized which makes a rich learning environment.

An agent is an encapsulated computer application designed for the specific domain which is capable of performing actions that helps in making decisions in the prescribed environment in order to meet the design objective. In the progressive advancement in the field of computer science together with the multiple disciplines, universal environment, no barrier bars in physical location, and diversity of community with no or more learning obsession, makes researcher interested in proposing such a module that helps in filling the gap between the learner as well as the tutor. Agent which is a middleware that works as a bridge between an interface and database or knowledge base that allows and offers the personalized interface to the user in different environment. In the area of an artificial intelligence, an agent stands for in an environment which makes its own conclusions and acts in the environment through actuators. Here the approach proposed is an "Agent-Oriented" design environment in the problem domain in the teaching learning paradigm.

Agent-Oriented Computing environment is a mixture of Computer Science, Artificial Intelligence and Object Oriented paradigm which imparts intelligence to the system. In the given domain area the agent oriented computing environment exploited as a mechanism to solve the complex problems and for developing a system which is called an intelligent system (Fig. 2).

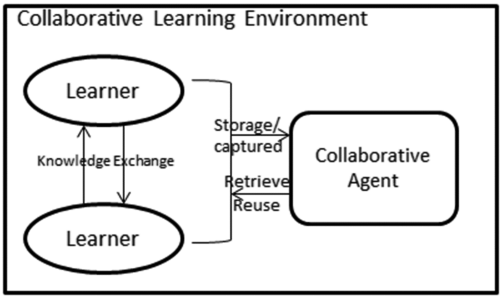

Fig. 2. Knowledge management in VCLE

2 Basic Need for an Adaptive Agent

Individuals learn differently. An adaptive learning is used to cope with individual differences in the environment. More and more researches are focusing on applying the recent technologies to personalize the pedagogy and content. Aptitude Treatment Interaction (ATI) theory states that is the choice of the instruction method matches with the aptitude of learner, the outcome will be higher. Learning Oriented Assessment proposes the iterative and recursive process till the competency scale is achieved. Learning oriented assessment focuses not only on assessment but also on how instruction and feedback can be tailored. Learning systems provides feature that identify the need of learner, tailor the content and provides the personalized approach to the learner. As per the literature regarding varying requirements of the learner as well as the tutor, we put forward the adaptive agent functionalities for teaching-learning environment that not only helps both learners as well as tutors. Model of learning that suits the individual needs of students is based on the new paradigm of personalization of education environment by considering the learning ability, current knowledge, and learning pattern

3 Characteristics of Agent-Oriented Design

Agent-mediated knowledge management comes as a solution a dynamic collaborative learning environment. It exhibits flexibility in behavior, providing the knowledge with "reactive" and "pro-active" manner. It serves as a tailored assistant, which maintains the user's log and behavior. General tendency and acceptance of smart electronic gadgets such as laptops, handheld PDAs, smart phones etc. are becoming so much popular in daily routine that not only offers fundamental platforms, but also raises issues on how to take benefits of these gadgets to enjoy this global computing environment. With increasing popularity and wide acceptance of such environment, the demands are also increasing that satisfies the users in the universal environment. This changes the access method and interaction pattern of the users in the environment and demands a pattern that recognizes the need, and pattern of the user and accordingly fetches the facilities and offers it to the users. As a solution to this, an agent-oriented approach provides these requirements with key advantage of autonomy, collaborative environment, and also an intelligent approach to the user as well as the admin of the domain which is teaching learning environment.

Various components are being identified in the teaching learning environment that promotes use of the agent based system. This components needs to interact with each other as data may be distributed and vary. System may need to interact with different other external agents for the effective services. System may need to monitor the user and user activities in the system; based on this, system may need to update the user details or other content available. Typical features that help the framework and works as a middleware which implements artificial intelligent model in the given domain.

Some of the silent characteristics of an Agent are:

(1) Robust degree of independence
(2) Reactivity i.e. responding in a timely manner to the change in environment and deciding when and what to act
(3) Proactivity i.e. the agent should respond in best possible action that are anticipated to happen
(4) Communicability i.e. should support facility to communicate with other agents
(5) Elastic behavior
(6) Multi-threaded control
(7) Supports concurrent and distributed approach and many more.

Some of the silent properties of an Agent for the teaching learning environment are:

(1) Flexibility
(2) Mobility
(3) Adaptivity
(4) Rationality
(5) Collaborative ability and many more.

4 Agent and Teaching Learning Environment

In the era of digitization, users are moving from manual to digital world, classroom teaching is more or less being supported by online resources. This increases the competition amongst the service providers in providing more and more advanced feature that makes the environment more user friendly and user centric. Here the environment encapsulates the agent which is not a part of it. Teaching learning environment are equivalents that have some properties which are then being used by an agent that generates an output which would be more powerful and useful for the users of the environment. Here users include both the learner as well as the admin.

Virtual environment, which provides platform to the learner that enhances learning skill and also allows the admin/tutor a platform that can identify learners, and learners competitive skill.

Major topological division of agent in a learning environment that should provide cooperative, autonomous and learning environment which provides user friendly interface which makes an environment a “smart environment”.

Role of an agent in VCLE is to encourage the flow of knowledge of the learner in which learner feel free to share insights, experiences and know-how. The environment allows learner to perform this by using the blog as well as discussion forums. This gives the learner to be more innovative, thoughtful and competitive.

5 Conceptual Design Architecture

The layered design of an environment:

Mainly the architecture is divided into four layers (Fig. 3):

(a) An interface layer
(b) The database layer
(c) The Internet Resource Layer
(d) The agent layer (Hidden).

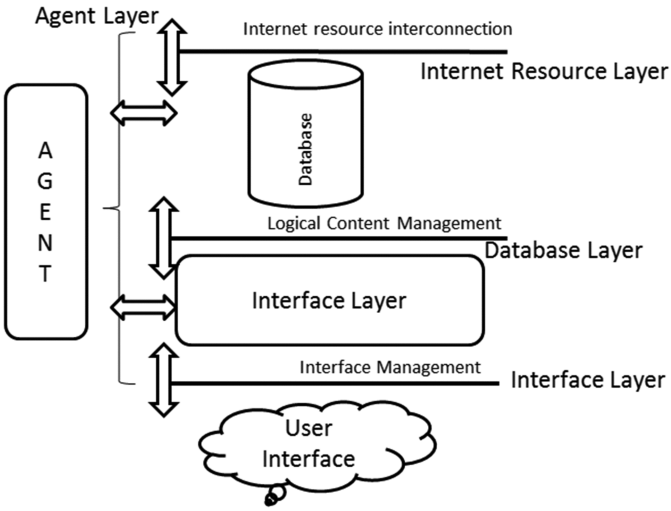

Fig. 3. Layered design of VCLE

5.1 Agent Layer

The agent identifies mainly three parameters: (i) Pedagogical view (ii) peer-learning view (iii) demonstrative view. The agent layer which works side by side in the working portal which has the functionalities which continuously monitors the activities being performed by the user. It monitors every task being performed using an interface layer by the user and accordingly sets the weights and at glance gives a competency scale to the user in the environment. Every offered features by an interface layer; agent works independently and captures the details of the user with its weights and on the action as well as the reaction of the agent allows the database to bifurcate the content.

Agent layer also helps admin to prepare and arrange content, prepare and arrange the question pool, helps managing the evaluation pattern based on average competency skills.

This agent uses combination of supervised as well as unsupervised learning to make it more user-friendly and flexible.

The feedback and the responses of the learners in the environment are tracked and being utilized after classifying learners and then being applied the regression method

on it. So one can say the supervised learning is used by the agent in identifying the learner behavior in the system. Here the all types of responses and feedbacks are captured and then on the basis of the previous responses by other learners or by same learner the agent applies the regression mechanism to read the behavioural aspect of the learner in the environment.

The semi supervised approach is also taken into consideration by the system in which the situations and cases are identified where the resources are utilized and feedback or returns are not filled or ignored. The system uses the active learning approach in which the responses are filled and then utilized in a way that the decision theory can be applied on the data and can be used in the best manner.

As the system uses all the parts of Expert System architecture to make the system a "Smart System".

(a) Knowledge Base (consists of IF-THEN statements i.e. rules)
(b) Database (stores current situations)
(c) Inference engine (which is Knowledge Base+Database)
    (i) Forward chaining (data driven)
    (ii) Backward chaining
(d) Explanation and reasoning mechanism
(e) User Interface.

6 Conclusion

On the basis of the preferences, personal characteristic and qualities, learner will be presented with learning content which suits them the most. One of the basic building blocks of adaptive learning is the storage of study materials. In order to provide tailored learning to each type of learner, content must be prepared in many different variants, in various forms. For different virtual learner, different learning content are proposed. The system also evaluates the learner's effectiveness and efficiency continuously. The simulation of teaching – learning cycle via an agent records the whole learning process. It identifies the correction of pedagogical aspect of the learner in real process and then makes necessary corrections in offerings and evaluation parameters. Several factor triggered interest in the agent for Virtual Collaborative Learning Environment (VCLE) which are innovation, globalization, easier navigation, quicker interaction between learners and between learner and tutor. The major functioning of the agent here is to trigger out the learner behaviour and pattern that infers the competency level. This helps tutor in identifying the group competency and accordingly the portal sets the evaluation pattern for the learner.

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