

# Automated Requirements Gathering using Intelligent Agents for e-Learning System

Nidhi Pandey, Shashank Sahu, P. Ahmed

**Abstract**— *The software requirements gathering process can be automated using intelligent agents. Such agents can be created to capture the requirements, as and when they may evolve during the requirements elicitation, analysis and negotiations, specification, documentation and validation phases.*

*In this paper we present an intelligent agent-based model for e-learning system environment. In this system three types of agents namely: Adviser Agent, Content Managing Agent and Personalization Agents have been developed. The major advantage of this model is that these agents can evolve in the course of their operations by enhancing their capabilities through their ever increasing learning abilities.*

**Keywords:** *e-learning environment, Intelligent Agent, Requirement Engineering.*

## I. INTRODUCTION

The software Requirements Engineering (RE) is basically a set of activities which concerns with identifying and communicating the purpose of a software-intensive system and the contexts in which it will be used [1]. Gathering requirements of any software system is the basic aim of its developer, and an e-learning system is a software system that allows learners to access electronically the learning resources that are distributed over diverse geographical locations. The recent advancements in Information and Communications Technologies (ICT) are providing very effective and efficient processes for delivering the learning contents to the learners. The contents are conveyed *via* a span of technologies such as the Internet, TV and videotape. In e-learning scenario learners requirements also have to be gathered. For this purpose, in this paper, we provide a model that supports requirements gathering for all the learning strategies. It is intelligent agent based model, and it is designed to capture dynamically the evolving requirements. This requirement gathering process, like any other software system, should improve the quality of e-learning systems as the quality depends heavily on the accuracy of user's learning requirements and their gathering process.

The e-learning content development process in learning environment is shown in Fig 1. which is an iterative process where planning, design, production and evaluation processes

are iterated. The e-learning system operates in two phases. The first phase is about the Content Development Process that develops the e-learning system iteratively. The Content Development Process follows planning, design and production phases to develop the e-learning system. An evaluation is performed at each phase to enhance the development process. The second phase concerns with the Learning Environment which is responsible for delivering the contents to learners and maintenance of the e-learning system.

The organization of the paper is as follows. Section II discuss about the intelligent agents and their roles in e-learning environment. Section III presents the related works done in the field of e-learning and agents. Section IV describes the proposed work. Section V presents conclusion and future work

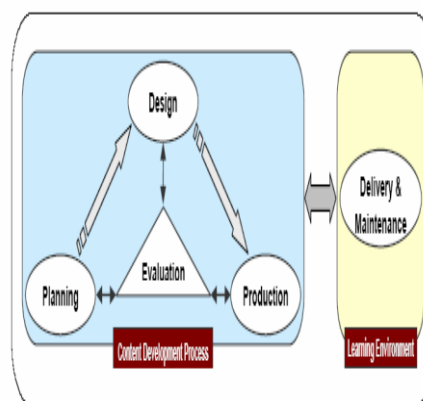


Fig. 1: The iterative process of e-learning [2]

## II. INTELLIGENT AGENTS AND THEIR CHARACTERISTICS

An agent is defined as “An encapsulated computer system that is situated in some environment and that is capable of flexible, autonomous action in that environment in order to meet its design objectives.” Agents are capable of relieving human intervention significantly and help in proper functioning of the system [3].

An intelligent agent (IA) is an autonomous entity which observes through sensors and acts upon an environment using actuators and performs its activity to achieve goals.

For e-learning systems construction, intelligent agents should prove beneficial as in e-learning systems there are many learners who seek knowledge. It is difficult to formulate a general teaching strategy for all learners.

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The main reason is that learners come from different backgrounds. Thus, intelligent agents may provide ideal solutions to such a diverse situation because of their characteristics described below [3]:

**Autonomy:** Autonomy of agents implies its independence to act at will. The agents have full control over their internal state as well as their own behavior.

**Heterogeneity:** Heterogeneity means agents have distinctly different and varying attributes.

**Proactive:** Agents act without external prompts.

**Communication:** The agents communicate easily among each other.

**Reactive:** The agents react to inputs received by them.

**Dynamism:** The agents should evolve dynamically by updating their attributes.

**Learning:** The agents acquire new knowledge to evolve itself.

In Fig. 2 properties of agent have been pictorially represented. The co-operative and learning properties make the collaboration agents. The agents which have the property of Autonomous and learning are termed as Interface Agents. All the three properties Co-operate, Learn and Autonomous provides the Smart Agent with all qualities.

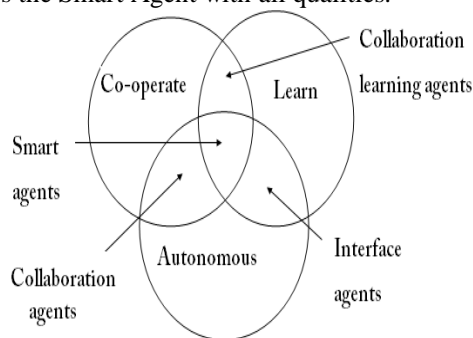


Fig 2: Representation of agent properties [3]

### III. RELATED WORKS

Recently, agent technology has been considered as an important approach for developing industrial distributed systems. Number of researchers has attempted to apply agent technology to different fields of application.

In the survey by Steffen Mencke, Reiner R. Dumke [2] a framework has been proposed in the crossover domain of e-learning. Agent technology describing several components of e-learning systems from an agent-based point of view has been given. Hence with the framework itself, classification and characterization possibility for the usage of agent within the domain of e-learning has been described.

N. Sivakumar et al. [3] has discussed the agent technology which has been incorporated in efficiency of e-learning system. They have dealt with the complexity of evaluating highly interactive e-learning environment. In their work by Salaheddin J. Juneidi, George A. Vouros [4] have referred to a wide range of applications and processes designed to deliver instruction through computational means so e-learning system may be elaborated. Konstantinos C et al.[5] have developed e-learning environment, where three

parts of the system have been discussed, the e-learning platform Front-End, the Student Questioner Reasoning and the Student Model Agent, which incorporates Intelligent Agents and Computational Intelligence Techniques. These parts are interconnected in an interoperable way.

Mukun Cao et al. [6] discuss intelligent distance education from a new point, focusing on agent’s independent decision-making process with the concept of education agent. It defines multi-agent distance education system’s abstract concept model, which is made up of three sub-concept models, they are education environment, education process and education agent.

P. Kuila et al. [7] have presented the paper in which an intelligent agent is defined that plays the role of an advisor for an e-learner to facilitate the learner to achieve his learning objective. It provides advices to assist an e-learner while solving problems that are normally provided by human experts.

Dawn G. Gregg [8] describes the approach that illustrate the advantages of using intelligent agents to facilitate the location and customization of appropriate e-learning resources and to foster collaboration in e-learning environments. So adaptive learning should be applied efficiently. Adaptive e-learning systems are built to personalize and adapt e-learning content, pedagogical models, and interactions between participants in the environment to meet the individual needs and preferences of users [9].

### IV. PROPOSED WORK

In this section, we present an e-learning model that is based on the concept of evolving agent. These agents evolve with evolving requirements of learners. Three such agents— **Advisor Agent, Content Managing Agent and Personalization Agent**— are proposed in this paper.

**Advisor Agent:** The role of the advisor agent is to give advice to learners of the e-learning software, and on the basis of the response provided by the learners the advisor agent will evolve, so that it can give better advice in the future.

The advice is given to the learners according to their operations on the e-learning software. On the basis of the learner’s operations, the advisor agent advises and recommends the field of learner’s interest in which he/she should pursue further learning.

The advisor agent may perform a pretest for new learners, or for other learners, whenever required to find out the topic of learner’s interest. Using the knowledge extracted from the test data, advisor agent will assess the weaknesses and strengths of learners. The pretest will be based on scores. As an example, the table below shows the score on hardware, software, IP addressing and cabling components of computer networking course.



**Table 1 Score Card prepared by Advisor Agent**

Field	H/W	S/W	Addressing	Cabling
Test Score	43	54	34	55

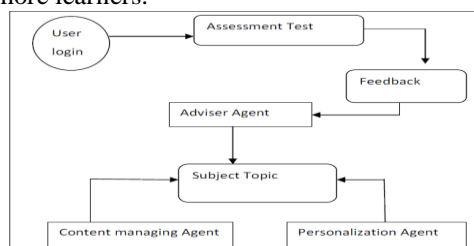
The test scores in Table 1 indicate that the learner is weak in IP address formation and manipulation, so by advisor agent would advise the learner to continue learning about IP addressing issues till he/she must score satisfactorily in future tests.

**Content Managing Agent:** This agent will assess learner's performance and provide them contents on the basis of their needs. It takes feedback on learner's progress at regular intervals. The feedback is dispatched automatically by this agent while learner is busy in learning with e-learning software.

The content managing agent continuously evaluates the usefulness of learning contents in terms of the evolving contents comprehensibility by learners. Depending on the evaluation result, this agent is expected to adjust the contents.

**Personalization Agents:** This agent is designed to customize the learning contents or environment according to the learner's requirements. This customizing will be based on the individual's preferred learning style and similar factor. Hence the agent will modify learning environment according to the learning style — not the content as such changes are performed by the Content Managing Agent.

These agents can be utilized in an e-learning environment to make the e-learning software evolve with new requirements as and when they arise. Figure 3 presents a model of above mentioned three agents. The model depicts working and position of agents in the e-learning software. First the e-learning software starts with user login. Afterwards an assessment test/pretest will be conducted by the e-learning software and its feedback would be dispatched to the advisor agent, and the advisor agent based on the feedback information, may suggest weaker topics for learning to learner. The content managing agent is active in the background and provides appropriate content to learner and takes regular feedback automatically for deciding useful content for learner. Meanwhile personalization agent is active and customizes the content according to user needs. No human intervention is required in this model. Software Intelligent Agents are active all the time to help the learner to fulfill their need and agents themselves evolve to provide better service to attract more learners.



**Fig 3: Model of Agent Based e-learning System**

## V. CONCLUSION AND FUTURE WORKS

An intelligent agent based model for building e-learning systems is presented. The model allows applications to evolve with the emergent requirements in its intelligent agent supported application development environment. The environment has three intelligent agents. These agents capture and evolve themselves with emerging requirements and improve their abilities dynamically. It is important to note that these intelligent agents will not only reduce the system development cost and efforts but also minimize the maintenance cost and efforts. At the initial stage of the development some extra efforts may be needed but further enhancement will be automatic because the system will evolve with emerging requirements, so the model will completely application system re-engineering cost and effort.

The development environment is open to adapt and accommodate new intelligent agents so, by adding more agents, new application systems can be created. We are in the process of expanding the models for diverse application creation.

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