

# BOKHARI- Intelligent Multi-agent based e-Learning System (IMBLS) for Interactive Distance Learning

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*Abstract: The major challenge for developing country like India is that there is a large and diverse population of students and insufficient number of qualified teachers as well as lack of infrastructure for such large population. Distance learning mode has shown a capability to address these concerns, even though a lot of progress taken place in this field, but interactivity is still the major concern in Distance Learning Environment (DLE) is to make it as much interactive as classroom teaching while retaining the other benefits of E-learning systems like ease of access and time management. Multi-agent based system had shown its capability in the field of E-learning in order to develop an E-learning system which is collaborative, Interactive, Adaptive and Intelligent. This paper highlights the flaws in the existing systems and proposes a new Multi-agent based E-learning Architecture named BOKHARI-Intelligent Multi-agent based e-Learning System (BOKHARI-IMBLS) that is a web based interactive E-Learning system designed for the distance learning environment. Its architecture is based upon seven individual agents working in a collaborative fashion to provide an E-learning environment that is interactive, adaptive, collaborative, secure and efficient. The main focus of the system is to enhance the interactivity at the user level as well as to reduce the complexity of the system. This system has an abstraction layer in the form of a web portal that hides the complexity of internal details of the system working from the end user and provides easy handling of the system.*

*BOKHARI-IMBLS provides the learning material to the learners according to their personalized needs, monitors the learning behavior of the student. It allows Student to collaborate with their tutor as well as fellow Students beside this it also takes care of security issues of E-learning systems.*

## 1. INTRODUCTION

Recently, the use of Artificial Intelligence (AI) in the field of Education has been seen. Through the use of AI in education, Intelligent Tutors [1, 2] have been made that software programs that tutors consist of four modules, namely; Student Module, Tutor Module, Interface Module and Domain Module. Student Module contains the information about the student, his/her current knowledge of a subject on a particular domain. Tutor Module contains the knowledge about the teacher's action on different circumstances, domain/Expert Module contains the information about the subject or contains the knowledge of subject and Interface Module contains the

information about how the system will interact with the student but whole E-learning process will not confine under these four modules. E-learning system requires the interaction between Student and teacher and between students.

Multi-Agent system showed its capability to address these issues intelligently. Through the use of Multi-agent system several E-learning systems have been proposed and implemented.

This paper has organized into 7 sections. Section 2 describes Agent Technology, section 3 describes Use of Agent Technology in E-learning, section 4 gives the background study, Section 5 provides the comparative study of Existing systems, Section 6 describes Proposed Architecture section 7 describes the detail of Agent used in proposed model and at last conclusion.

## 2. AGENT TECHNOLOGY

Agents are the software programs which work on behalf of its user and having properties like Autonomy, Proactive-ness, Social ability, Reactivity etc., it takes the input from the environment process it and produce the output to the same environment. It is quite difficult for a single autonomous agent to solve all the problems due to shortage in resource sharing. When these autonomous agents work together in order to solve a complex problem by using its own local information then the overall system is known as Multi-agent System (MAS) [3]. The field MAS is influenced and inspired by many other fields such as Economics, Philosophy, Game Theory, Logic, Ecology and Social Science. In Multi-agent system all agents are loosely coupled so that if some change is made in one agent then it will have a negligible or very less effect on the overall system. In MAS, the agent must help the other agent who is in need even if the agent has to suffer because the main goal of the agent is to think about the overall goal of the system and not for the internal goal of the agent [4].

MAS is one of the rising technologies, and its application came into existence during 1980's. Distributed Vehicle Monitoring (DVMT) was the first MAS application which is

used for monitoring the movement of Vehicle [5]. Since then it has been applied in various applications like E-Commerce Auction, Social Science, Supply Chain Management, Robotics, Air-Traffic Control, Telecommunication, Financial Portfolio Control System, Computer Games, Sensor Network, Robot Soccer (A team of box-pushing robots) etc [6]. It has recently being used in learning environment and the main reasons for its application are its suitability for the complex, distributed and collaborative environment [7]. It is also suited to the web environment due to its flexible nature [8], [9]. In E-learning, Multi-agent system appears to be a promising move toward the challenges in an educational environment [10].

**3. AGENT TECHNOLOGY IN E-LEARNING**

Agent technology is growing day by day, and spread its root in almost every field whether its simple E-mail filtering or an Air-Traffic control system and E-learning is also not left untouched. The main advantages of using MAS in the field of education are as follows.

**Collaborative:** Provides intelligent interaction among the collaborative team members

**Adaptive:** Provides the personification of students and tutors and saved all users information from the routine operations

**Student-Teacher Interaction:** Provides a better interactivity among the students and teacher.

**Intelligent:** Gives intelligence to the E-learning system, so that the system will know about its user and help accordingly.

**Allow reusability:** Remove duplication of effort- jobs can be shared among different applications of the system.

**4. BACKGROUND STUDY**

Several Multi-agent based E-learning systems are available supporting different combination of agents, having implemented with different technologies and using different methodologies. The common goal of these systems is to improve the learning ability of the Student/learner. Most of the systems have been designed to provide adaptive learning, like F-SIMLE [11-13], Baghera [14-17], EMASPEL [18-20] and MASPLANG [21-22]. Some of them are having collaborative feature which allows the interaction among the student as well as among the students and teacher, like I-MINDS [23-28]. It makes the group of similar students ‘buddy group’ and allows communication among the team members. ALLEGRO [29] allows the direct communication among teacher and student. Some of them are providing web-based learning like Bahera. Some of the systems are domain dependent like F-FMILE, Baghera and ELECTROTUTOR [30].

**5. COMPARATIVE STUDY OF EXISTING SYSTEMS**

This section compares some of the existing Multi-agent based E-learning systems on the basis of various features. Table 1 compares the various systems on the broad outline of interaction, domain dependent, reachability through the web and type of system that it is open source or propriety software and also security of E-learning system.

**Table 1. Comparison of existing Multi-agent based E-learning System**

E-learning system	E-Learning Features						
	Interactivity Features						Domain Dependent
	Student-Student Interaction (Collaborative)	Student-Tutor Interaction	Student – Content Interaction (Adaptability)	Web-based	Open Source	Security	
F-SMILE	No	No	Yes	Yes	No	Partial	Yes
ELECTROTUTOR	No	Yes	Yes	No	No	Partial	Yes
ALLEGRO	Yes	Yes	Yes	Yes	No	No	No
I-MINDS	Yes	Yes	No	Yes	No	Partial	No
Baghera	No	Yes	Yes	Yes	No	No	Yes
EMASPEL	No	No	Yes	No	No	No	No
MASPLANG	Yes	No	Yes	Yes	No	Partial	No

This comparison shows that all the systems are propriety systems and cannot be used as open source that hurts the economically poor countries and full utilization of the E-learning infrastructure is not possible for them. Student to Teacher interaction is necessary in distance learning environment because of the reason that student and teacher are at a different geographical location [30], but it has been found that most of the systems have not been taking it seriously. Baghera, F-SMILE and E-MASPEL are also lacking in Student to student interaction feature. Security is a crucial issue but most of the systems provide partial security in the form of login and password.

## 6. PROPOSED WORK

Previous Section discussed and compared some existing Multi Agent based E-learning systems that have been developed and implemented, but most of them lack all the features like intelligence, accessibility, interactivity, adaptability, collaborativity and security in one single system. Here, in this section we proposes a new Multi-agent based E-learning Architecture named BOKHARI- Intelligent Multi-agent based

e-Learning System (BOKHARI-IMBLS) that is a web based interactive E-Learning system designed for the distance learning environment. Its architecture is based upon seven individual agents working in a collaborative fashion to provide an E-learning environment that is interactive, adaptive, collaborative, secure and efficient. The main focus of the system is to enhance the interactivity at the user level as well as to reduce the complexity of the system

### 6.1 Architecture of BOKHARI-IMBLS

This section describes the Architecture of BOKHARI-IMBLS. The proposed architecture is a four layer architecture that is user level, web level, system level and data level, as Shown in Figure 1. *User level* describes the Human agents; there are two types of human that is Student and Tutor. Students are those who participate in learning activity and tutor are those who actually prepare the content of the course. *Web level* describes a highly interactive website that takes data from the student as well as tutors and sent back to the system for processing and provides processed information to the students on personalized need.

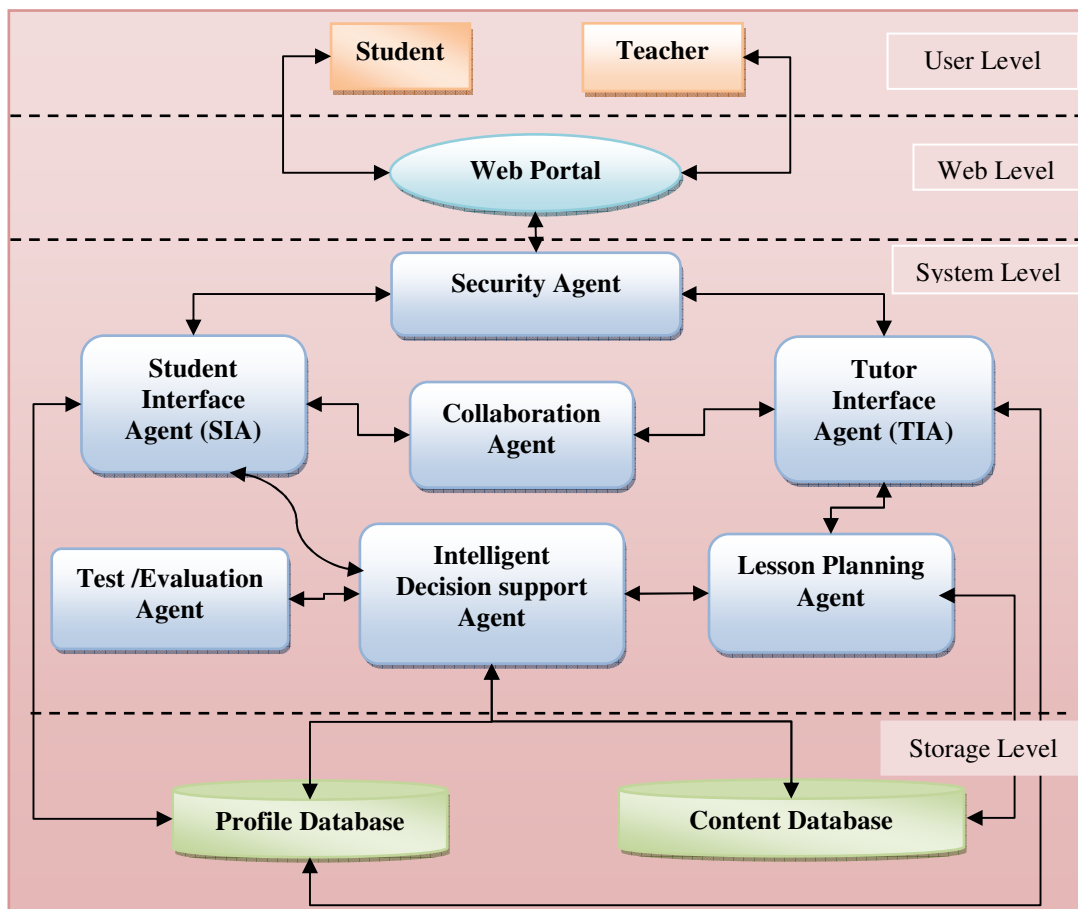


Figure 1. Architecture of BOKHARI-IMBLS

## 7. AGENTS USED

The system has Seven Agents: Student Interface Agent (SIA), Tutor Interface Agent (TIA), Collaboration Agent (CA), Intelligent Decision Support (IDSA), Test/Evaluation Agent (TA) and Lesson Planning Agent (LPA) and Security Agent (SA). This section describes the role of each agent as follows.

### 7.1 Student Interface Agent (SIA)

Student Interface Agent (SIA) is used to help students and is concerned with student interface and provides interactive operations for student. SIA contains two main operations, namely monitor and the helper.

### 7.2 Tutor Interface Agent.

Tutor interface agent has directly interacted with the tutor and helps teachers complete their daily lesson preparation. It is responsible for providing the tutor an interface that makes the interaction with the system easy and help them with efficient planning in terms of resources available, teaching methods, Lecture preparation and student performance evaluation. This agent allows tutor to interact with student.

### 7.3 Intelligent Decision Support Agent

The prime objective of this agent is to take the intelligent decision, it is responsible for generating Adaptive content as per the need of the student, and different student gets different content on the basis of their ability. It would take information from the student profile database and take intelligent decisions accordingly

### 7.4 Collaborative Agent

The collaboration agent is primarily responsible for enabling any kind of communication between tutor and students. The communication can take place between a tutor and students and among the groups of students having enrolled in the same course.

The communication can be set up at the request of a student and any available tutor or in case of student to student interaction a student can approve for the communication setup.

Once a communication has been setup and approved, the different entities can interact with each other. Such type of collaboration enables a student for 24x7 learning in an interactive environment and does not restrict the learning to a specific time frame

### 7.5 Lesson Planning Agent

This agent is responsible for development and innovation as well as day to day operation of a specific course. The LPA is

also responsible for planning and execution of a course. This uses Student's learning abilities to provide advices for the teachers and intelligently checks whether other teacher have upload the same content and if found then avoid duplication of efforts and inform the teacher.

It monitors the student progress.

- It collects the feedback of the students from the profile database and uses this information for course designing.
- It also assures that course content allows student achievement of objectives associated with that course.
- It Interact with TIA in order to supervise the Tutor of the assigned course.
- It collects the feedback from profile database and on the basis of these it will advise a tutor to take any corrective measures

### 7.6 Test/Evaluation Agent

This agent is used to evaluate the student's marks. It will collect the information from the student interface Agent and sent it to the IDSA who use this information for judging the progress of the student

### 7.7 Security Agent

This Agent will be responsible for security issues in the E-learning system. Security of the proposed system will be in the form of authorization, authentication, integrity check and encryption of the data. We introduce an authorization layer between the user and the system that will be responsible for providing access to the legitimate users of the system only based on the login credentials and its role. In addition, the security agent will be performing encryption of the data stored in the profile database. The SHA-3 hash function is used for the integrity check as well as authentication and AES can be used for encrypting the data

## 8. CONCLUSION

This paper describes the Agent technology, the advantages of agent technology in E-learning. This paper compares the existing Multi-agent based E-learning System on the basis of their features, after comparing some of the Existing systems we found that no system is open source, they are lacking in incorporating all the features like Adaptability, Collaborativity, Interactivity, flexibility and security into a single system. This paper also proposes a new Architecture called BOKHARI-IMBLS for distance learning. The main focus of the system is that it incorporates all the features like intelligence, accessibility, interactivity, adaptability, collaborativity and security into a single system. This paper

describes the Architecture of BOKHARI-IMBLS it also highlights the Agent used in the proposed system.

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