3. AN ENHANCED ARCHITECTURE FOR ITS

3.1 Introduction

Educational system in general and the learning process in particular are heading for a rapid change in the next millennium [142]. According to Skinner's theory of learning Skinner [144], education is nothing but the transmission of knowledge and can be done by breaking down any subject into a well organized succession of modules and a question-answer process. Computers and computer networks are becoming major sources of information for the present and future generations. Computers can provide individualized and interactive education for everyone.

Due to the rapid growth of the use of computers in education, as well as the introduction of the World Wide Web (WWW), a large number of Web-based educational applications have been developed and implemented. Cuban (2001) reported that CBT is still generally underused as an instructional tool for teaching [31, 66]. On the other side, Internet is now becoming more and more important and is being integrated into many activities related to education and training.

It also provides an infrastructure that supports unprecedented communication capabilities and opportunity for collaboration. Web-based ITS has potential capability to provide individualized tutoring to large number of students geographically distributed. While web technology promises many attractive features to build Web-based ITS, it would still be a challenge to represent knowledge objects that are scalable, reusable and interoperable [61].
Several Web-based learning and evaluation systems have been also designed during last two decades, such as WebCT [159], QUIZIT [157], ASSYST [69], PILOT [150] and e-manipal as proposed name for the interactive Learning System (iLS) [126]. Such system provides learning materials in a better-understandable format as well as evaluation of content understanding.

However, the most widely used question types of the evaluation are multiple objective types, limited to yes/no pattern, multiple choice/single or multiple answer, and fill-in-blanks questions with a fixed string and numeric answer [46, 62, 89, 135]. In addition to these, such systems were designed without keeping in mind the individual capability and capacity of understanding. Due to all these reasons, it is almost impossible to satisfy individuals’ needs.

Further, a knowledge base ITS can only be effective if the teaching model plans the teaching strategies properly. A major drawback of any knowledge base ITS is writing rules for generating teaching strategies. It solely depends on the knowledge of the expert. Another problem is that often experts themselves disagree and can write different rules for the same given problem.

One other drawback of a knowledge base ITS is building an efficient and complete student model. The adaptation technique which changes dynamically for different kind of students depends on the student model. Again the development of the domain knowledge base is a very tedious job. It can only be developed by domain experts. Development of domain knowledge base is very costly in terms of time and effort required.

Most of the existing knowledge base ITSs were restricted to a single domain. So, changing them or reorganizing them to teach different
subjects were either impossible or required the intervention of the system developers. Again, attempting to design a domain independent system has got its own problems. A procedure or a strategy to teach Physics may not be successful when used to teach History [51]. A single teaching method would not work in a multi domain teaching environment. Another disadvantage is that the delivery medium of all the existing systems was also restricted to usually one language. This may prove to be a serious drawback in a cosmopolitan society.

To overcome problems discussed in earlier chapters as well as in this chapter, one of the most crucial and important options left to researcher is to provide standardize teaching learning environment using ICT. In this chapter researcher has presented proposed solution as an intelligent educational ITS- namely HKDA System which satisfies almost all such requirements discussed earlier.

This thesis is concerned with the design and construct a heterogeneous environment, development in an open architecture and implementation of cost-effective ITS to teach procedural knowledge as well as facilitating the acquisition of conceptual knowledge, in multiple subjects.

3.2 Architecture of HKDA System: An Overview

The new Higher Education area has produced a number of changes in teaching and assessment methods [56, 143]. In the past, the weight of the learning process was borne by the teacher and the student was a participant user of the class. In the new teaching model, the student is at the centre of the learning process and the objective is not only based on the acquisition of knowledge, but also on competences (this word refers to a set of skills, knowledge and attitudes that an individual must possess in order to be capable of perform a specified job) [56].
The objective of proposed HKDA System is to provide best possible quality services to student/trainer as well as to teacher/tutor for learning and improvement in various expertise areas. It helps individual student/trainer to set their own level of standard according to their area of interest, apply knowledge to real world problems, preparation, reflective revision processes and test for assessment.

The goal is to provide students with opportunities to apply their knowledge to real-world problems and also to help students to manage their own learning. While giving examinations in the form of practice assessment, student/trainer can also learn the subjects immediately. System also helps teachers/tutors to draw an attention in student/trainer learning capabilities, their past and present performances in particular courses, subjects or topics.

The teachers/tutors are enabling to collect the subjects, procedures and, exercises of the educational domain, together with the correct and incorrect solving plans and their correspondent deviations. A methodology guide is being established to assure a correct data definition. A promising line is related to the use of student solutions to infer new solving models and errors.

To achieve stated objectives, several intelligent agents have been identified. They are running in the background with their predefined role to tracks different aspects of student’s performance like learning pattern, behavior and personal traits. All these information is stored into Knowledgebase of the system. An extensive effort has been conducted to find best ITS for these tasks, while keeping in mind goals such as platform independence, modularity and web-based access and scalable agents that supports access to heterogeneous information resources as emerging semantic web database.
Researcher has proposed three layers architecture – User Layer, Knowledge Management Layer and Data Source Layer which is shown in Figure 3.1.

3.2.1 User Layer

The User Agent (UA) in this HKDA System is broadly treated as student, teacher, parent and management. This UA interacts with user to obtain his/her user preferences that are managed by Preference Agent (PA). These preferences include the relative importance attributed to terms used to pose queries like profile of the person’s preferences, subject/topic selection for examination, evaluation criteria, bias, the perceived authoritativeness of Web search engine results, and other preferences to be used by the Knowledge Agent (KA). The Preferences Agent can also learn the user’s preference based on experience and feedback related to previous queries.

These preferences include the relative importance attributed to terms used to pose queries, the perceived authoritativeness of Web search engine results, and other preferences to be used by the Knowledge Agent. The user indicates an initial query to the Query Formulation Agent.

3.2.2 Knowledge Management Layer

This layer is explicitly defined knowledge management activities with major component of the knowledge-based enterprise. The Data Source Layer handles both query execution and database object manipulation. The Data Source Layer can create new database objects, as needed using a set of code templates. Specialized intelligent agents reside at the various layers and perform well-defined functions.
This HKDA System as a scaleable agent-based system that supports access to heterogeneous information resources such as the Web, open-source repositories, XML-databases and the emerging Semantic Web. In this research, researchers have focused to use model link the complementary ontologies such as the temporal, spatial, feature, etc. The HKDA architecture is general and modular so that new ontologies and new information resources can be easily incorporated.
Figure 3.1: HKDA System Agent Architecture
3.2.3 Data Source Layer

This layer consists of www, Document Repository and HKDA DB Server. WWW is treat as HKDA Web Server where WASCE Application Server @ IBM is installed. All the web services are coming from this Server. Document Repository is exclusively image types of format .jpeg and .gif, upload files like .xls. HKDA DB Server acts as database server which contains DB2 @ IBM. This Data Source Layer is rich enough as Ontology Repository is available. Apart from that this layer also maintains security system as YAW Server which is discussed in Chapter 8.

3.3 Communication to Agents

In the User Layer, the User Agent interacts with the user to elicit user preferences that are managed by the Preferences Agent. These preferences include the relative importance attributed to terms used to pose queries, the perceived authoritativeness of Web search engine results, and other preferences to be used by the Integration Agent. The user indicates an initial query to the Query Formulation Agent. This agent, in turn, consults the Ontology Agent to refine or generalize the query based on the semantic mediation provided by the ontology services available.

The Ontology Agent uses a conceptual model for the domain by means of the Ontology Web Language (OWL) schema specification of the Imagery Domain Model, which is based on ISO 19115 and 19139. The Web Service Agent uses domain knowledge regarding the data sources, such as QoS attributes, source authoritativeness, and image sizes, to optimize the execution of sub queries. The Integration Agent is responsible for compiling the sub-query results from the various sources, ranking them according to user preferences supplied by the Preferences Agent. Table 3.1 describes the role of few important intelligent agents.
<table>
<thead>
<tr>
<th>Agent Name</th>
<th>Description</th>
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<tbody>
<tr>
<td>Knowledge Agent</td>
<td>This agent interacts with other agents to share information or barter for specialized services in their specialized domain.</td>
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<tr>
<td>Meta-Agent</td>
<td>It performs agent mediation during knowledge transactions, marshalling resources and managing agent interaction.</td>
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<tr>
<td>Learner Agent</td>
<td>This agent captures the cognitive state as well as the characteristics of the learner and identifies possible misconceptions.</td>
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<tr>
<td>Tutoring Agent</td>
<td>Responsible for forming an adaptive presentation of the lesson to be taught to the learner.</td>
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<tr>
<td>Advising Agent</td>
<td>Advising agent is responsible for selecting the alternative action that the learner was more likely to have intended.</td>
</tr>
<tr>
<td>Domain Advisor Agent</td>
<td>It supports meta-agent, working as knowledge advisors. Meta Agent uses Advising Agent to help plan knowledge transactions, manage conflict resolutions, and direct activities toward an attainable objective.</td>
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<tr>
<td>Web Service Agent</td>
<td>This agent provide an agent domain knowledge brokerage. In the process of creating a response, the Knowledge Agent may need to post queries of its own Shrimad Rajchandra Enterprise Architecture (SREA) ontology. The Meta Agent again uses the Web Service Agent to find a suitable destination agent and dispatches the question accordingly.</td>
</tr>
<tr>
<td>User Agent</td>
<td>The User Agents are knowledge resources for user interfaces, and they are intermediaries between Meta Agent and users. The User Agent accepts questions from the user. Before forwarding them to the Meta Agent, it ensures that they are ontologically well formed and potentially answerable.</td>
</tr>
<tr>
<td>Communication Agent</td>
<td>The Communication Agent is responsible for presenting the information in a unified and easy to access fashion. In order to make the interaction more natural and enjoyable, an animated,</td>
</tr>
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</table>
Communication Agent is used to present the system’s advice to the learner.

Table 3-1: Functionality of Commonly used Intelligent Agents

Since expressions are ontologically constrained, meta-agents can collect knowledge from a variety of sources and perform knowledge operations on them while limiting domain dependency.

3.4 Network Diagram for HKDA

The software components for proposed HKDA System includes: Browser, WWW Server, Service Oriented Architecture (SOA), Asynchronous JavaScript And Xml (AJAX), HKDA DB Server, Document Repository, Ontology Repository and YAW Server as shown in Figure 3.2 given below. The browser and the WWW server are the basic software for HTTP communications over the Internet. HKDA DB Server contain database of HKDA System. Ontology is a description of the subjects and relationships that exist among agents. YAW (You Are Watching) Server keeping track of user activities. User can send request through www.srimca.edu.in to HKDA server. User identification is done at server side, and server response to the service requested user.
Figure 3.2: HKDA System Network Diagram
The following agents get activated whenever students are going to give examination like Question Agent, YAW Agent, Tutor Agent, Teacher Agent, Answer Agent, Expert Agent, Knowledge Agent etc. All agents’ responses are through the www.srimca.edu.in.

Student: Students get a new platform not only to gain knowledge but also to evaluate the knowledge inside them. The simplified and effective way to of joint efforts of learning will give them a great ground to run in up to the limits of their will power. Tools like articles and online examinations do provide them a new deal of learning and perfection.

Teacher: Realizing that a student teacher relationship is the most important relationship in education, HKDA tries to give them a new media of interaction. This new media leaves behind the limitation of time management and curriculums. Further it is quite possible for keeping in mind of teacher to process capability and capacity of individuals.

Parent: In today’s busy scene, personal visits to the institution may not be an easy task for parents. The reporting system in HKDA enables them to have a closer look to their wards performance and will provide a fact-based approach to their wards life irrespective of geographical location. Besides this e-news, polling and forums brings them closer to the institution.

Management: Organization management become systematic and easy for maintaining and updating the different aspects. All the management aspects of the institution like the admission process, message broadcasting, notice boards and such others are taken into account, which not only saves resources but also provides efficiency in working as well as updating information.
3.5 Conclusion

In this chapter, using three layers architecture, the HKDA System as a scaleable agent-based system was proposed as an environment that allows the objective accomplishment of this thesis. The principles of HKDA System have showed an adequate potential in the development of educational system, this is due to the fact that a cooperative way facilitates the solution of many educational learning procedures.

In this scenario, HKDA System supports access to heterogeneous information resources such as the Web, open-source repositories, XML-databases and the emerging Semantic Web. In this research, researcher have focused to use model link the complementary ontologies such as the temporal, spatial, feature, etc. so that new information resources can be easily incorporated.