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Virtual E-Learning Application developed using Mobile Agents

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***Abstract*—** E-Learning is one of the most interesting ”e-“domains available through the Internet. The main problem to create a Web-based, virtual environment is to model the traditional domain and to implement a new model using the new suitable technologies. Distance learning domain is analyzed and investigated the possibility to implement a context aware E-Learning service using mobile agent technologies. From these E-Learning services we focus on various teaching/learning entities. Here we attempt to build an Virtual Learning Environment which tries to impose E-Learning concepts such as content delivery, self-assessment ,final assessment and grading.

***Keywords*—** E-Learning, Virtual classroom, VLE, distance learning, mobile agents, Aglet

I. INTRODUCTION

Education is a lifelong learning, initiative learning and in present days it is one of the most appealing e-domains available through the Web and Internet. With the rapid revolution in the area of computers and networks, people are more interested and attracted towards distance learning. The advances in the Web and Internet technology has crossed over the limit of space and time, reduced the learning cost and improved the learning efficiency. Therefore, many distance learning applications have been constructed by various community websites. The term distance learning replaced with E-Learning covers, a wide set of applications and processes, such as web-based training, computer-based training, virtual classrooms, and digital collaboration [1].

The most important issue to create a web-based or an virtual environment to suite the new trends in web technologies. So we need to shift from the traditional domain model and to implement a new model using the most suitable technologies such as mobile agents. The traditional method includes general Client/Server approach [2] using the PHP, JSP, Java applets, HTML, DHTML etc. platforms. The new approach is concerned with creating web-based services for Virtual Learning Environments [3] which involves a complete knowledge and analysis of the learning domain.

There exists a great difference in the learners in age level, sex, and social role, their culture, education background, attention, interests, and hobby [4]. Giving corresponding learning contents and tactics to realize teaching according to learners’ needs is challenging and is very difficult.

In addition, traditional systems have also exhibited some other problems, such as weak interaction, uneven geographic distribution of teaching resources, different structures of different kinds of networks and learning groups, which makes learners feel un-confident and suspicious in E-Learning[5].

Therefore, how to use some related technologies to solve the existing problems in E-Learning becomes more urgent. And some additional constraints have to be considered: independence of the VLE [6], independence of the implementation technology, scalability and accessibility. To overcome, all these limitations and constraints, the proposed approach is use of Mobile agents in Adaptive E-Learning[7].

E-Assessment[8] is one more important part of E-Learning. The traditional methods of assessments where student writes on paper using pen/pencil has overcome in this approach. Bayesian

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network approach[9] seems to be adapted in few applications in evaluating learners' assessments. We try to address this issue as probability base E-Assessment.

Context-aware is a style of computing in which situational and environmental information about places, people, and things is used to anticipate immediate needs and proactively offer enriched, situation-aware and usable content, functions and experiences.

So we have made an attempt to develope one such application which focuses on virtual learning environment i.e. E-Learning application. This application is context aware and uses mobile agents to communicate between various entities. Java Aglet [10] as mobile agent platform is used in developing this application.

II. MOBILE AGENT WORKBENCH- A SOLUTION

The mobile agent technology [3] [4] can overcome some limitations of the well known server-client model:

1. scalability issues for many users – if the number of users increases over a threshold the server will not be able to process all the requests, causing long latencies and even requests loses.

2. bandwidth / latency – transferring all the evaluation engine information in one step by using a mobile agent reduces the overall network communications overheads, and also allows the user to access all required information instantly.

3. Moreover, the evaluation of the test can be performed directly on the client's computer. In this way the server is freed from the task of grading students

4. Query some of the personal preferences of the student directly from the student's machine,

5. Integrate with some other office tools the student uses,

6. Monitor the activity of the student in the VLE - creating a user profile (areas of interest, learning speed, learning techniques)

7. Perform some background searches for materials that might be of interest for the student

8. Offer a message board to the student with the news of interest for the student.

9. Offer important messages for the student regarding his assessments / exams. This is achieved through the communication between this agent and an agent residing on the VLE's machine. In this way the student is always informed about his incoming exams, or about teachers that are online and available for direct chats, or about live discussion forums that might exist.

Maintaing a live connection to the server is one of the problems with the server-client models. The client must schedule a periodic request to the server to query for updates or news. With mobile agents this drawback is overcome as the communication between the existing agents in the agency can happen in any direction.

III. PROPOSED ARCHITECTURE

The Figure 1 displays the architecture model which shows the working of agents between different entities in the application.

The various entities proposed in the architecture are

1. Administrator
2. Teacher
3. Student
4. Content
5. Assessment

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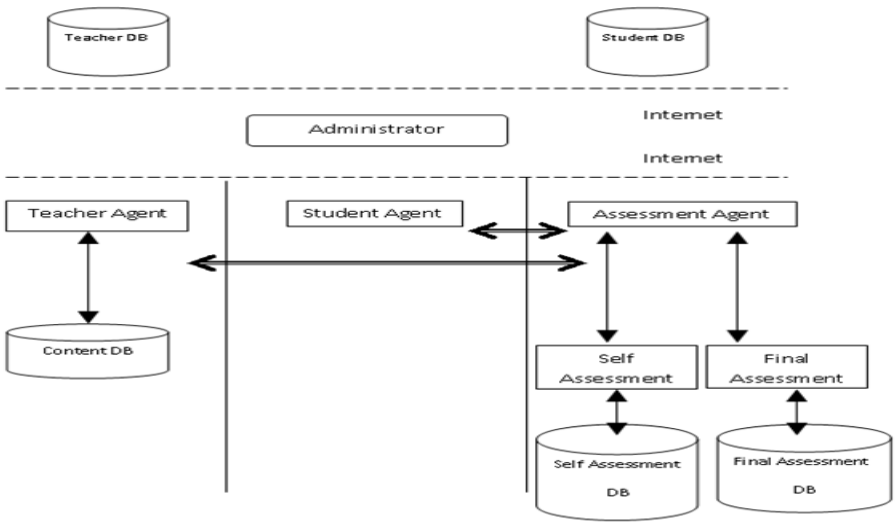

Figure 1. Proposed architecture model

3.1. Administrator Entity

It is the main admin management entity. It deals with teacher, student, content and assessment databases.

3.2. Teacher Entity

Teaching authority (the Teacher) does two things

(i) If an existing teacher, then provides authority to upload the new contents in file formats.

(ii) If a new teacher then he/she has to register himself/herself with providing proper information like qualification and experience.

3.3. Student Entity

Learning entity (the Student) does two things

(i) If an existing student then he/she provided with contents from content database to read.

(ii) If a new student then, he/she has to register himself/herself by providing some personal information and subjects of interests.

3.4. Contents Entity

This entity does two things

(i) Aids teacher to view existing contents from fetching it from content database and also can help to edit and upload the contents.

(ii) When student requests for any content then this entity will fetch from content database and displays it.

3.5. Assessment Entity

With respect to Teacher, assessment entity does two things.

(i) Self Assessment Create Entity

This entity helps teacher to view existing self assessment questions by fetching it from self assess questions database and also can help to edit and create a new set of questions.

(ii) Final Assessment Create Entity

This entity helps teacher to view and update final assessment questions by fetching it from final assess questions database and also can help to add a new question to database.

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With respect to Student, assessment entity does two things.
(i) Self Assessment or Test entity
Displays self assessment questions, fetched from the self assessment questioner database and helps student to evaluate himself.

(ii) Final Assessment Entity (as an Evaluation Engine)
Displays final assessment questions, fetched from the final assessment questioner database and grades the student.

IV. OPERATIONS OF AGENTS

In this part we will focus on operations and interactions performed by various entity agents.

4.1. Teacher Agent

Teacher can perform 3 operations, shown in Figure 2.
(i).Content related

- Content preview and validation, content edit , update and upload to content database.

(ii).Self assessment related

- Review and update the self assessment questions and also create a new set of self assessment questions.

(iii).Final assessment related

- Review and update the final assessment questions and also add new assessment questions.

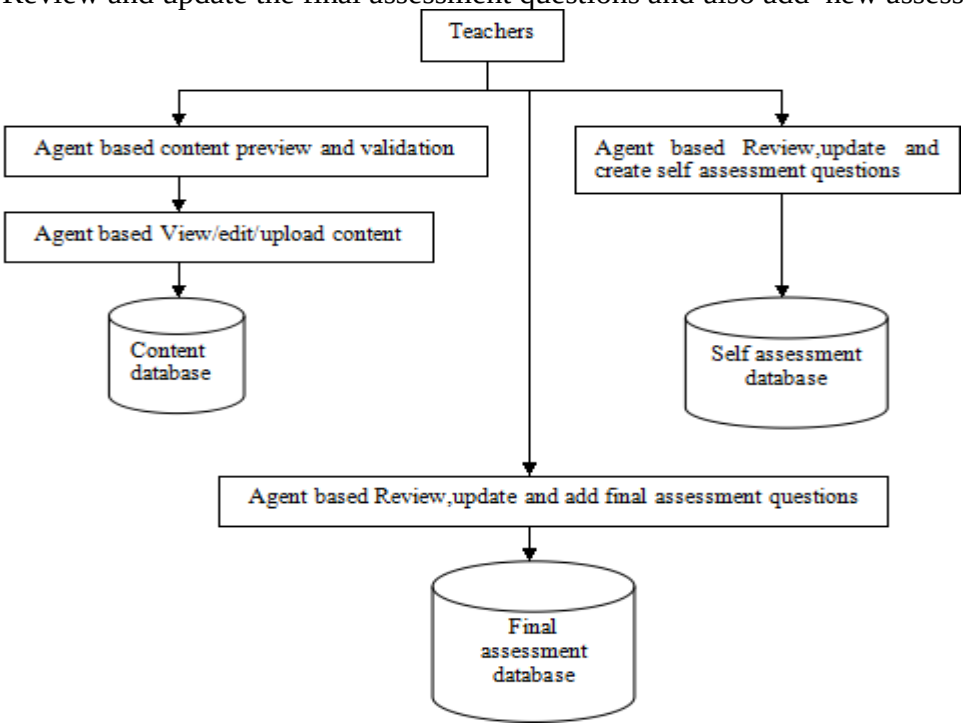

Figure 1. Functions performed by teacher agent

4.2. Student Agent

The working model of student entity is as shown the Figure 3.
Student can register himself under 3 categories or levels

1. Beginner
2. Intermediate and
3. Expert

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4.2.1. Beginner level.

(i). Beginner students will start with beginner level contents.
(ii). After reading is over, they test themselves by undergoing a simple beginner level self assessment.
(iii). Depending on the result, pass or fail the student will get upgraded to the next level.
(iv). If pass, beginner student will get upgraded to intermediate level and
(v). If fail, will get remained in the same beginner level.

4.2.2. Intermediate level.

(i). Students can register, claiming themselves as Intermediate.
(ii). These students have to undergo the beginner assessment before starting the intermediate level contents.
(iii). If they pass, they will become eligible for intermediate level and if they fail, they have to start from beginner contents and the claimed intermediate level will be degraded to beginner.
(iv). After intermediate content reading is finished, students have to undergo intermediate self assessment.
(v). If they pass, they will be upgraded to expert level and
(vi). If they fail, they will be retained in intermediate level.

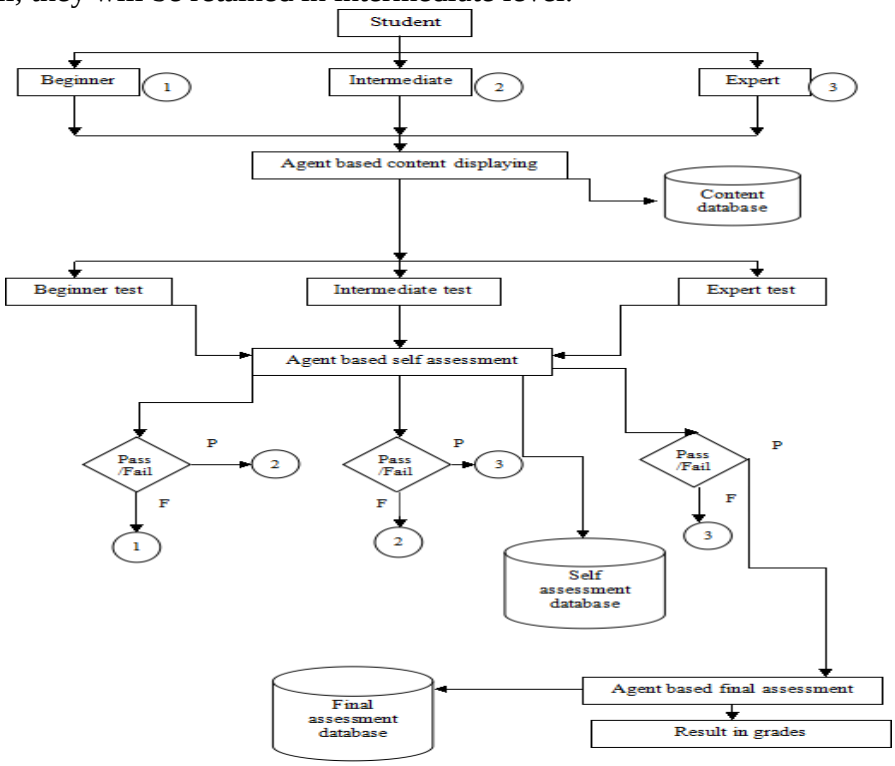

Figure 3. Functions performed by student agent

4.2.3. Expert level.

(i). Students can register, claiming themselves as Expert.
(ii). These students have to undergo the beginner assessment and intermediate assessment before starting the expert level contents.
(iii). If they pass both the tests, they will become eligible for expert level and if they fail, they have to start with the corresponding level in which they have failed and the claimed expert level will be degraded to the corresponding level of failure.
(iv). After expert content reading is finished, students have to undergo expert self assessment.
(v). If they pass, they will be upgraded to final level and
(vi). If they fail, they will be retained in expert level.

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4.2.4. Final level.

(i). Once the students go through, all the above 3 levels and pass the respective self assessments, the final stage is to go through the final assessment test and

(ii). Students undergoing through this test, will be graded with A+, A, B and C grades with respect to their performance.

(iii). Once the test over, for that subject it will be considered as finished level.

4.2.5. Finished level.

After the final level, if a student again wants to study the same subject, is not allowed. He/she after taking the final assessment test, and after they get graded then they will go to finished level for that subject.

V. ACTIVITY DIAGRAM OF APPLICATION

The figure 4 depicts activity diagram, how all the student, teacher and assessment agents co-operatively work. Figure also shows how different activities are carried out. It also shows the different databases and connectivity with these agents.

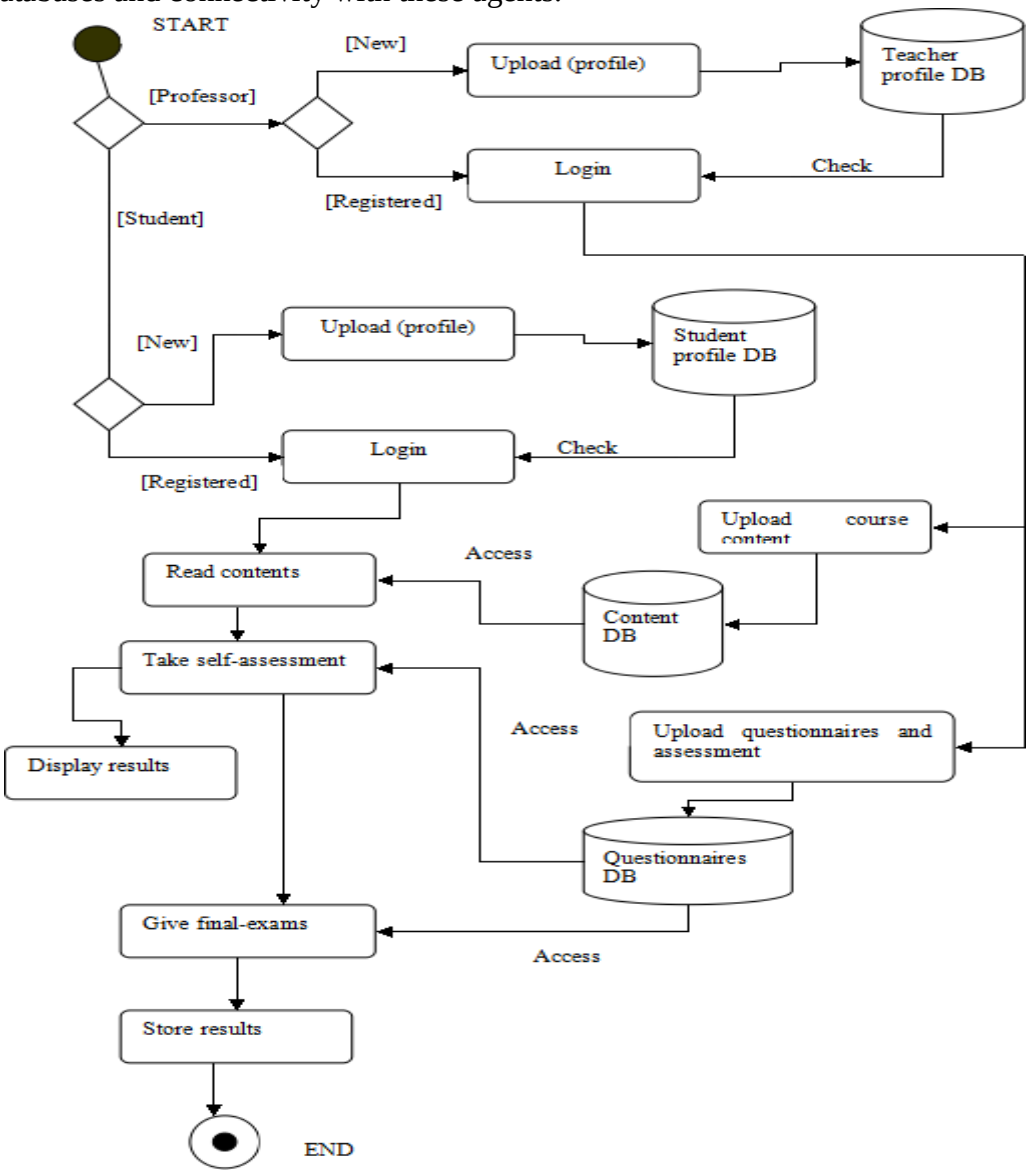

Figure 4. Activity diagram of Teacher, Student and Assessment agents

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The Virtual Professor class is an interface between applets and agents. It keeps data for the currently logged user and other useful data for the system. This class is associated with every agent and applet class in a "communicate with" association. The purpose of this class is to enable the communication among applets and agents. It makes easy for the system to keep track of the information concerning the currently logged student. It also enables the applet interface to run with no direct contact with the agent objects.

The Content Provider is a class parent for the rest of the agent classes. It defines agents' behaviour. The Content Provider class ancestors have to implement only a few methods for executing their specific task. The Content Provider responsibility is to invoke those methods when certain condition is reached.

Every agent class inherits Content Provider class. The most typical is the Course Selector Agent class. This class is an aggregate of objects of several different classes. Select Query and Update Query objects are used for executing SQL statements on remote databases. Objects of Subject, Course, and Professor and Occupation classes represent structures for transferring data between databases.

The learner interacts with teaching server through internet; learners put forward the personalized learning request according to their knowledge structure and learning plans. Then, learning service center analyze learner's learning history and demand, creating mobile agent which stands for learner's learning request. Finally, the system distributes learning request services into distance system through learning service center, and learning resources or personalized learning guide are obtained from the appropriate teaching system.

Mobile agent is generated by student agent after user successful registration. Mobile agent embodies the students' learning characteristics, which is responsible to take instructional results or learning resources to learning service center.

VI. STUDENT ASSESSMENT

Assessment means evaluating the students' acquired knowledge. It also provides the means for a student to get valuable feedback regarding his progress. Assessment agent is a highly dynamic component of the VLE, involving both synchronous and asynchronous communication between students and instructor. Interaction between student agent, question agent and database is depicted in Figure 5.

Student assessment is of 2 types (i) self assessment and (ii) final assessment.

A student undergoes self assessment to evaluate himself. Once he/she is confident with the subject, student will take final assessment.

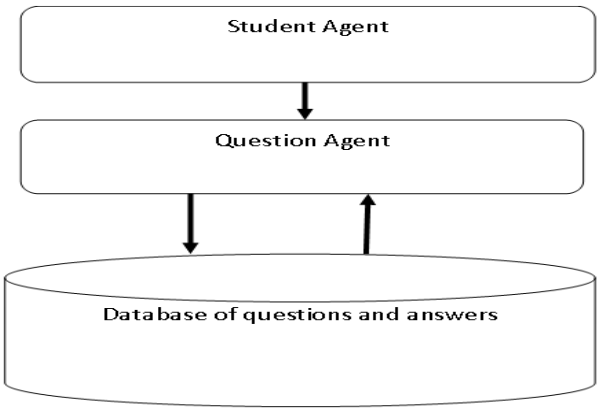

Figure 5. Assessment service architecture

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The concepts involved in student evaluation are the following and shown in the Figure 6.

- Assessment type (Compulsory Examination, Self-Assessment)
- Question
- Question Type
- Correct Answer
- Assessment procedure (as an Evaluation Engine)
- Grading

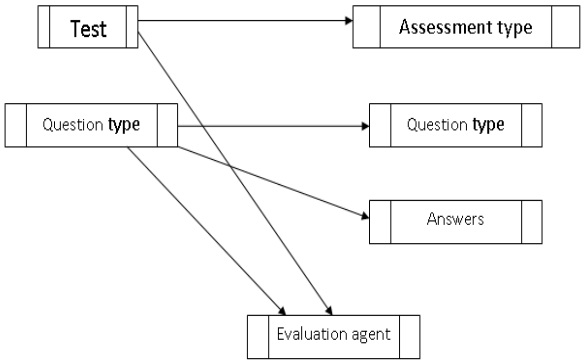

Figure 6. Student evaluation concept

Assessment of a student is depicted in the following Figure 7 which is a sequence diagram.

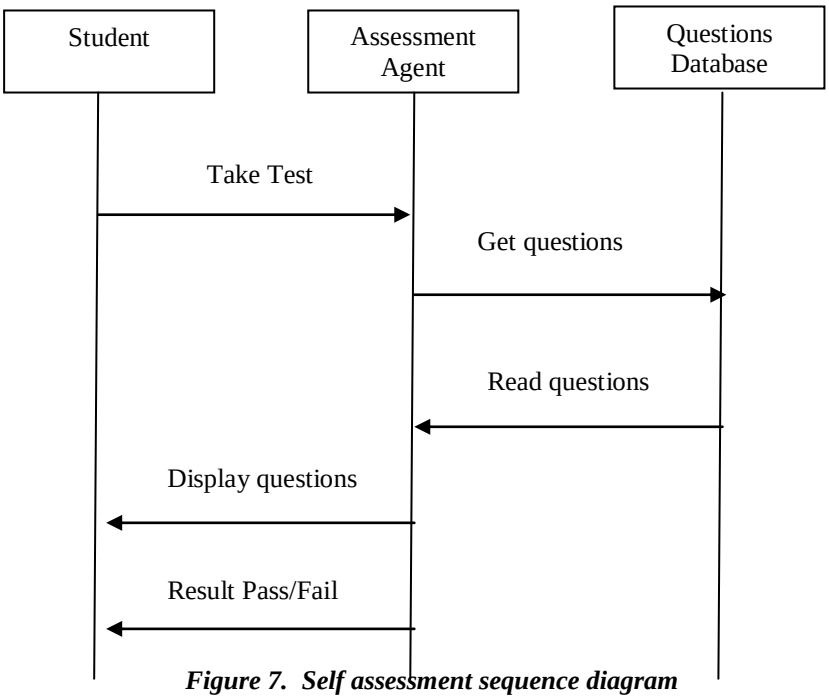

Figure 7. Self assessment sequence diagram

Student exam assessment is done on the probability of his correct answers. Questions will be of 3 levels (i) Easy (ii) Moderate (iii) Difficult. Random questions will be displaying as student goes on answering. Depending on the correct answers the level of difficulty will be changing. Figure 8 will show the exact working of this assessment process.

For example, in beginning from the Question Database 1 question will be chosen at easy level. And depending on its correct or wrong next question is chosen, this process is will continue.

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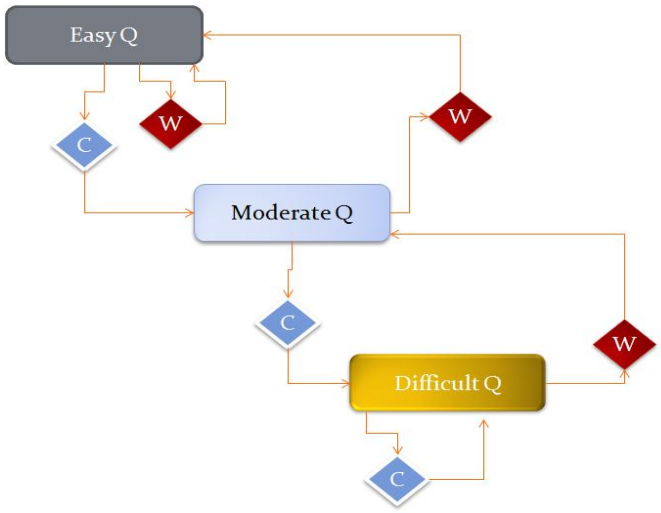

Figure 8. Assessment process

According the correctly answered questions student will be graded A+, A, B and C and fail. If fail, student should retake the exam.

VII. RESULTS AND SAMPLE SCREENSHOTS

- Allows the user to access all required information instantly.
- Transferring all the evaluation information in one step reduces the overall network communications overheads.
- The evaluation of the test can be performed directly on the client's computer.
- The communication between the existing agents in the agency can happen in any direction.

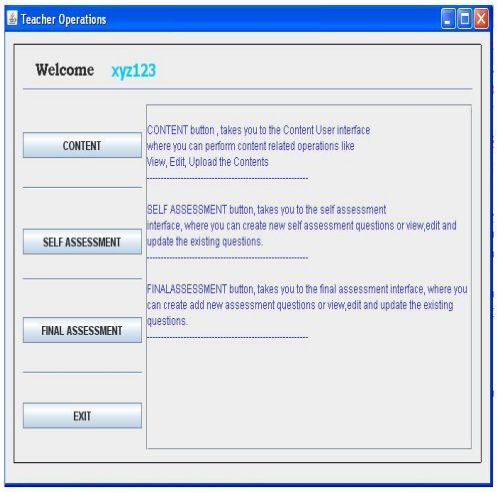

Figure 9. Login screen

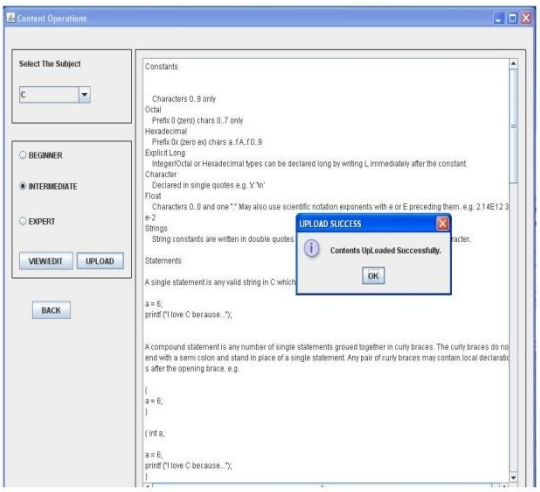

Figure 10. Content display screen

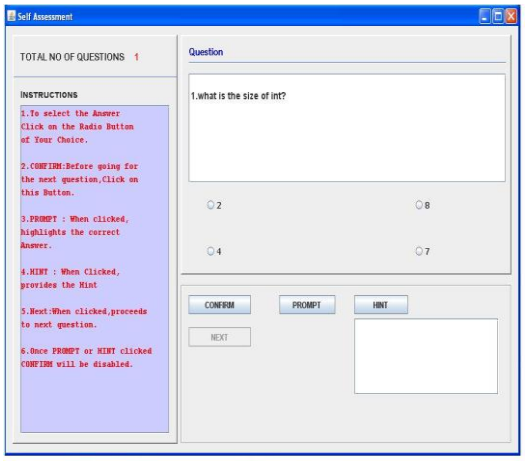

Figure 11. Teacher adding questions

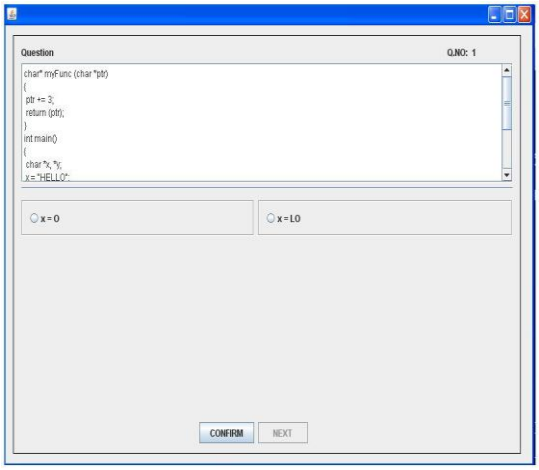

Figure 12. Assessment process

VIII. CONCLUSION

We have attempted to develop a VLE application using mobile agents. We are interested in our work to analyze and model specific areas of Virtual Learning Environments and to investigate the most suitable technologies to implement the developed models, particularly mobile agent-based technologies since we are dealing with a distributed and complex environment. So implementation and development of this Virtual Learning Environment using mobile agents can be proved more efficient than the traditional client/server based approach. Aglets serve for platform independent which uses Java (applet) technology with mobile agent combined, providing mobility, is used as platform to develop this application.

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