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Agent Based Expert System for Online Assessment in Distributed Database Environment with Agent Cloning: A Modification

Khurshid Alam Borbora
Institute of Distance and Open Learning
Gauhati University, (IDOLGU)
Guwahati, India
e-mail: khurshidborbora007@yahoo.co.in

Ridip Dev Choudhury
Institute of Distance and Open Learning
Gauhati University, (IDOLGU)
Guwahati, India
e-mail: ridipgu2010@gmail.com

***Abstract*—** This paper introduces an alternate architectural framework of an agent based Extended Expert System for Online Assessment (EESOA) in distributed environment for the learners of ODL (Open and Distance Learning) System. The main modification is done in the question collection process by the mobile agent for student assessment form the different interconnected question database servers. Instead of Itinerary Design Pattern (in earlier framework), the Branching Design Pattern is used in this modified framework of EESOA. This necessarily uses the agent cloning process to perform the load balancing while retrieving the question set in the distributed question database environment.

Keywords- *Agent, expert system, online assessment, mobile agent, distributed database environment, agent cloning, load balancing*

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I. INTRODUCTION

In the previous design of EESOA [1],

- the Student fact database resides on the same server where EESOA resides,
- the Question fact databases (all databases are homogeneous) reside in different servers (distributed database environment),
- the Mobile Agent, QSGMA (Question Set Generation Mobile Agent) follows the Itinerary design pattern for collecting the question set for students' assessment.

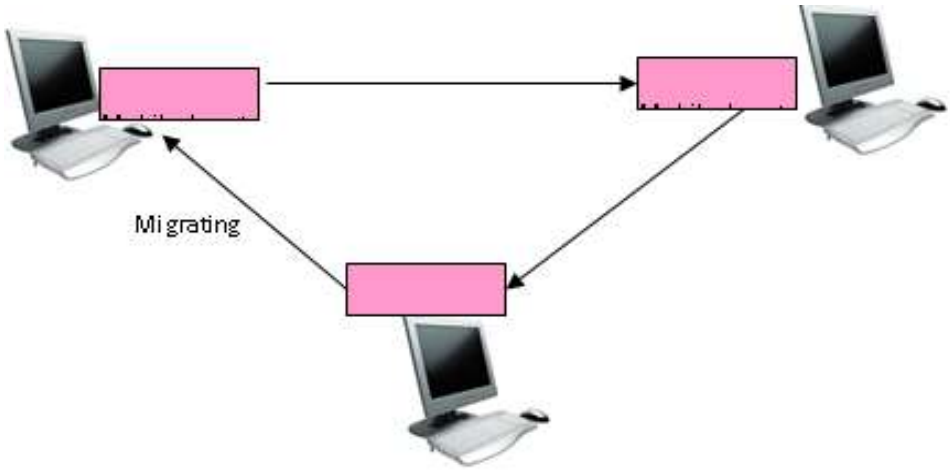

Fig. 1: Itinerary Design Pattern (adapted from Khurshid et al. 2014)

According to Itinerary Design Pattern [1], the agent receives an itinerary on the source agency which indicates the sequence of agencies/servers it should visit. In each of the agencies/servers, the agent executes its task locally and then continues on its itinerary. After visiting the last agency/server, the agent then goes back to its source agency/server. This design pattern is depicted in Fig. 1.

So, in the earlier design of EESOA (Fig. 2), since it follows the itinerary design pattern, the mobile agent, QSGMA, is stated with a list of servers (i.e. homogeneous database servers) in the main EESOA server to collect questions set for students' assessment. Then the QSGMA visit the first student fact database server in the itinerary/list and gathers questions, as indicated by the EESOA engine (in main server), and then it moves to the next database server in the itinerary/list.

At last, after visiting the last database server in the itinerary/list, the QSGMA come back to the main EESOA server. Thus, the mobile agent, QSGMA, has to travel database server to server to collect the questions set which take a considerable amount of time.

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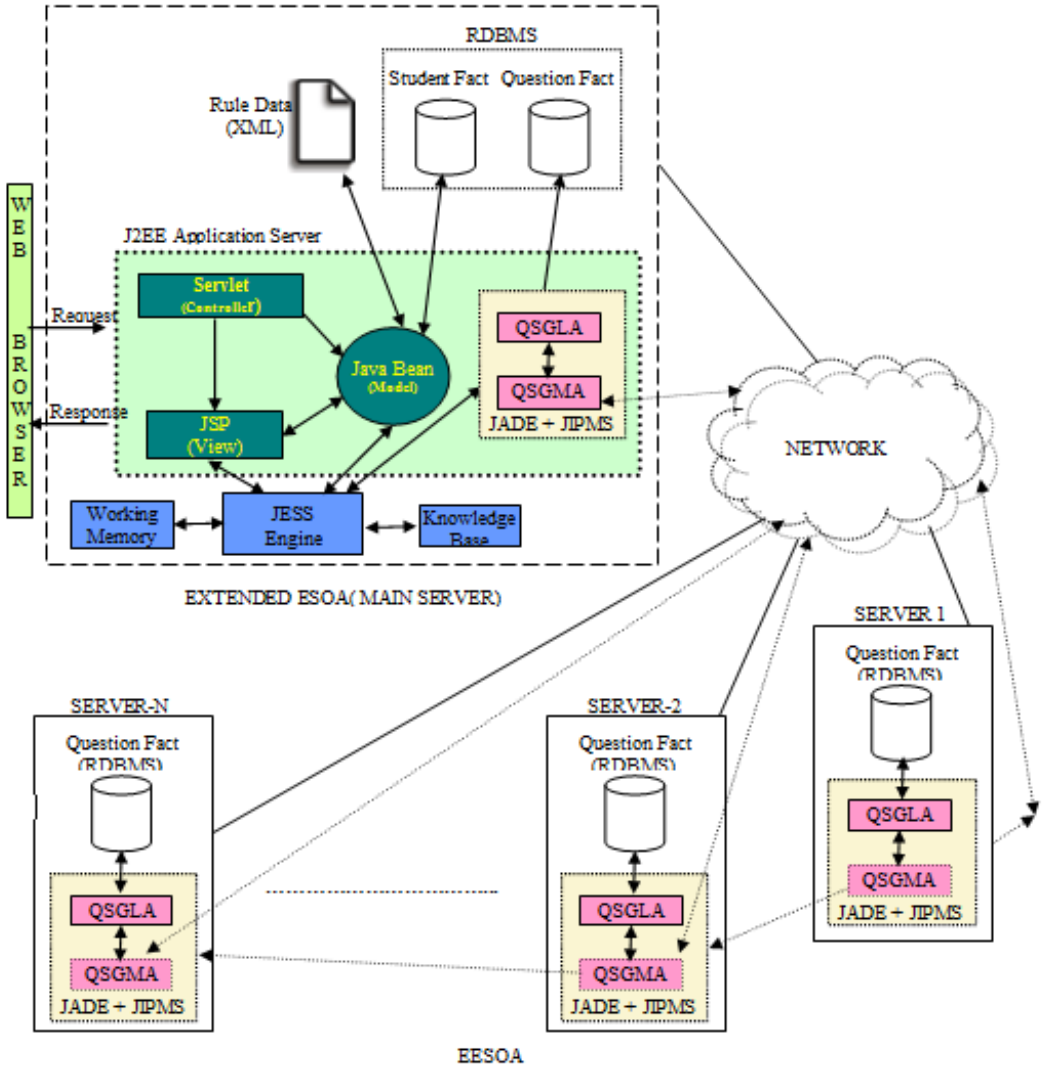

Fig. 2: Architecture of EESOA (adapted from Khurshid et al. 2014)

Now, if it is possible that for one of the student fact database server, one mobile agent can be associated then the time taken for collecting the questions will take less amount of time compared to the earlier design. This strategy in case of agent id popularly known as kind of design is Branching Design Pattern. So, in this design pattern, agent cloning is mandatory.

II. Agent & Agent Cloning

The growth in networked information resources requires information systems that can be distributed on a network and interoperate with other systems. Such systems cannot be easily realized with traditional software technologies because of the limits of these technologies in coping with distribution and interoperability. The agent-based technologies seem be a promising answer to facilitate the realization of such systems because they were invented to cope with distribution and interoperability. [3]

Agent Cloning is necessary when the agent gets overloaded with tasks. Agent overloads are due, in general, either to the agent's limited capacity to process current tasks or to machine overloads. Approaches to overloads, in general, include task transfer and agent migration. [4]

In Task Transfer, the overloaded agents locate other agents those are lightly loaded and then transfer the tasks to them, i.e. very similar to processor load balancing. [4]

Agent Migration basically required when the machine on which the agent runs becomes overloaded. In this kind scenario, the agent search for a less loaded machine in a network (wired/wireless) and then migrate to that machine carry-on his tasks.

Cloning is a superset of task transfer and agent migration: it includes them and adds to them as well. Cloning does not necessarily require migration to other machines. Rather, a new agent is created on either the local or a remote machine. [4]

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III. BRANCHING DESIGN PATTERN

In Branching Design Pattern (Fig. 3) [1,2], the agent receives a list of agencies to visit and clones itself according to the numbers of agencies in the itinerary. Then, all clones will visit an agency of the received list. Each clone has to execute its corresponding task and notify the source agency when the task is completed. The importance of this pattern is that it splits the tasks that can be executed in parallel. The treatment of the final results is an issue not covered by this pattern.

For instance, the clones can put the result of the task in a user interface or send it to another agent.

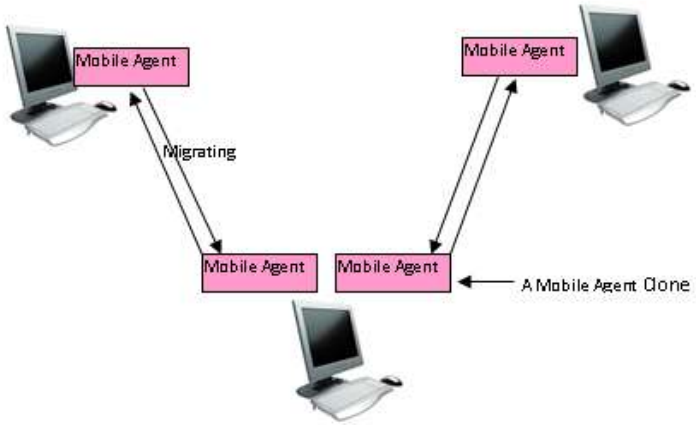

Fig. 3: Branching Design Pattern (adapted from Khurshid et al. 2014)

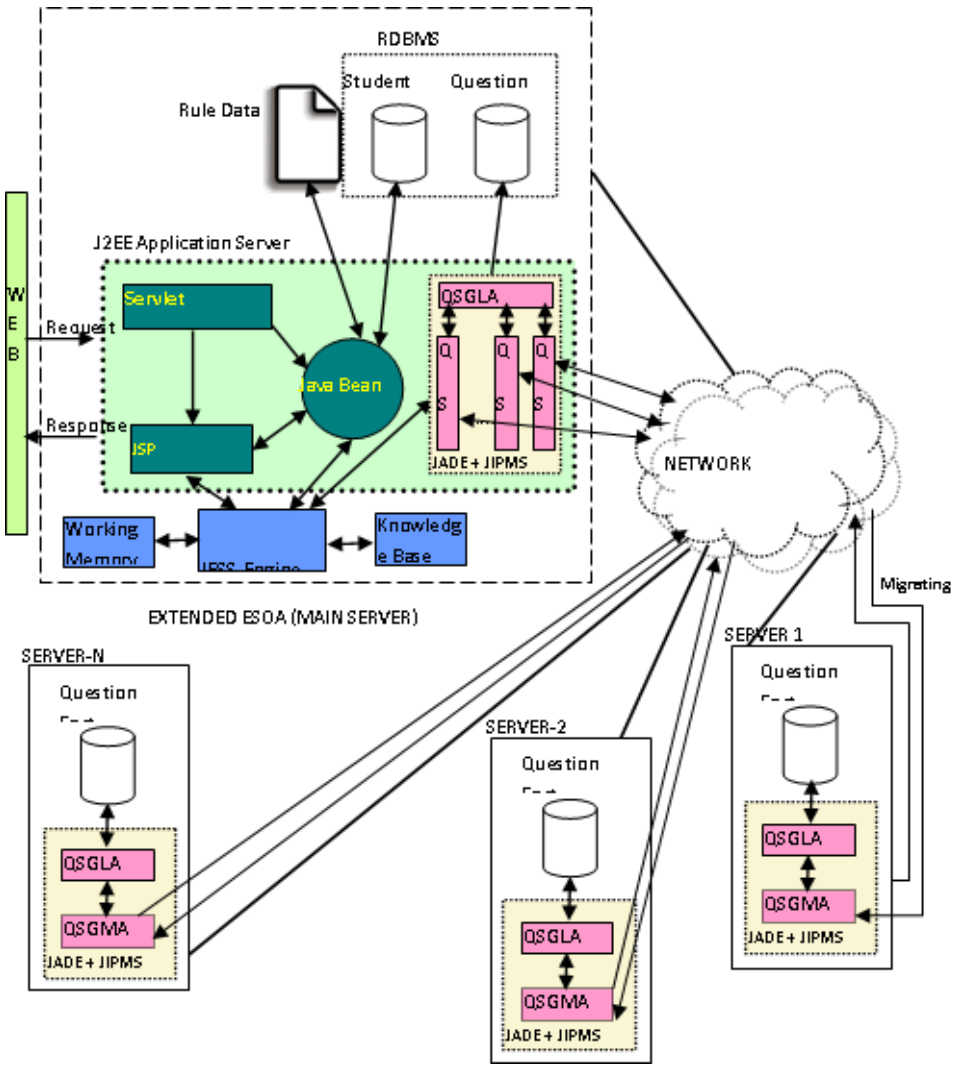

Fig. 4: Architecture of Modified EESOA

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IV. THE MODIFIED FRAMEWORK

The alternate/modified framework of EESOA is depicted in Fig. 4. In this modified framework (Fig. 4) also, the software tools/servers remains the same. But the modification part, as one see that (in Fig. 4), is that instead of a single QSGMA (as in Fig. 2) there are more than one QSGMA for each of the servers, which are clones of the said mobile agent.

In the earlier framework (Fig. 2), along-with other parameters, the QSGMA is initialized also with the total no. of questions to be fetched from question fact database servers as a whole and maximum no. of questions to be fetched from each of the servers.

But in the modified framework (Fig. 4), since the QSGMA clones are created, equal to the nos. of question fact database servers, then for each of the clones

questions to be fetched =

$$\frac{\text{total no.of questions required for assessment}}{\text{total no.of question fact database servers}}$$

With all the necessary parameters, each of the QSGMAs visits his target database server and fetches questions (as directed initially) and comes back to EESOA server. The EESOA server will wait for all clones to return from their target database servers.

Thus, the responsibility/load (in the earlier framework, Fig. 2) of a single QSGMA (in earlier framework) is divided into a no. of QSGMA clones (in modified framework). Also, it is obvious that the time to be taken to fetch all the questions for a particular assessment will be less, in case of the modified framework, compared to the time taken in the earlier framework for collecting the same for the same cause.

V. CONCLUSION

This paper presents the modified framework of Extended Expert System for Online Assessment (EESOA) in terms of the design pattern of mobile agent. Instead of Itinerary Design Pattern, the Branching Design Pattern (used in the modified framework) makes use of the agent cloning for the mobile agent (for collecting the question set) and then migrate the agent clones to the respective database servers ; thus, this design pattern helps in load balancing task for the mobile agent (in earlier framework). So, from the time as well as the tasks load point-of-views (in connection with the question set collection), this modified framework will tend to give better performance than the earlier framework.

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