A Personalized Quiz Game Based on Multi-Agent System

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Abstract. The intelligent agent based systems have existed for many years, only recently its surge of mainstream popularity motivated researchers to acknowledge its educational value. With the increasing usage of educational games, using intelligent agents in the game to provide reliable personalized services has become more critical. Quiz game is a game genre which is easy to develop and doesn't have limitation to any subject and user group. Multi-agent based system is flexible and can save resource. This research designs a quiz game based on multi-agent architecture, the game is therefore so-called multi-agent based Quiz-MASter. Beside the quiz game, this paper also presents a framework of personalized assessment game. With the Quiz-MASter and the framework, the instructors can aware of students' playing status and experiences while the students playing the game and don't feel that they are taking exam/quiz at all.

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1   Introduction

Game based learning(GBL), which is a popular and potential learning method in e-learning. And there are more and more research issues have been proposed. Just like edutainment and serious games introduced a new important marketing direction to practical technologies such as agent technology, human-computer interaction, multimedia interaction and ubiquitous computing. This exciting outcome also pointed out the educational potential using computer games or video games. Several commercially succeeded games, although not intentionally designed, have interesting learning, socializing, and interacting strategies embedded in the games. In game based learning scope, how to let students learning with game awareness not learning awareness. This is a very important issues. Like lots of commercial games or online games, it attracts many people into game scenario. If we can design some educational games which motivate students not only in the game but also out of the game.   It will helps students learning with more game awareness not learning awareness in educational game.

Agent technology have existed for a long time, but less researches combined with educational values or educational technology. Because we want to develop software that is open, intelligent, and adaptive, and modeling a system as agents gives us a way of establishing flexible boundaries for automated system[16].Hence, we integrate agent technology into game based learning system. In the system, agents have been developed to monitor the use of software by students as captured by the log files, and matching teacher models of learning activities with actual student behavior extracted from log files gives powerful information to teachers. Besides, less researches discussed about personalized feedback by intelligent agent. If we use agent technology to assist e-learning system or other educational system . The students and instructors will get more complete and personalized feedback from agents.

In this paper, our research focuses on developing a Multi-Agent System-based educational assessment game that would help students get familiar with the course contents through friendly competitions. We explore the use of software agents in educational applications, in particular, the use intelligent software agents to provide appropriate feedback and personalized materials to students.

Conceptually, QuizMASter is designed similar to a TV game show, where a small group of contestants compete by answering questions presented by the game show host. Contestants score points by correctly answering questions before their opponents do. The answer given, along with the length of time taken to respond, is transmitted back to host agent. Scores will be tallied, and the feedback on a player's standing will be provided to motivate the player. This is the reason why quiz game show is popular on TV and PC game [11].

In QuizMASter, students naturally take the place of game contestants, however the game-show host has been replaced with an intelligent software agent. By studying the reaction of students to the game, and by altering the feedback provided by the

game show host, we hope to determine the degree of success the agent has at motivating the player [11].

In this paper, we will discuss the game and assessment in section 2, and introducing the multi-agent based quiz game in section 3. In section 4, we will describe how the agents work in the game. At last, we will discuss the research issues and make conclusion about the research.

2   Game & Assessment

2.1. Game Genre

Actually, there are too many game genres in current game market. But most of taxonomies can be divided into following categories: (1) Action games (2)Adventure games (3)Fighting games (4) RPG (5) Simulations (6)Sports games (7)Strategy games[13]. In fact, most of games can't be classified to specific one game genre. For example, the basketball game, it not only belongs to sports game, it also can classify to strategy game too. Because there are many tactical plays based on the defense of competitor. Once the competitors change the defense, you should change your tactical play on the court. Besides, Different games genre may have different learning effects. Hence, there is a research issues about what kind of learning effects do the different game genre have?

2.2. Assessment Methods

In traditional test, due to the technology was not ripe, only paper-based test can used in class. With the progress of technology, more and more learning material can used in computer or other portable devices. Of course, it includes the assessment material. There are lots of assessment methods can use in computer-based test and paper-based test. We just list some of methods below: (1) single choice, (2) multiple choice, (3) order, (4) associate, (5) match, (6) gap match, (7) inline choice, (8) text entry, (9) extend text, and (10) hot text[12].
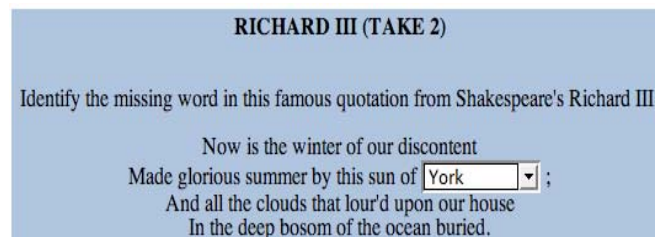

Figure 1. The example of inline choice [12]

And some graphical-based types are: (1) hot spot (2) select point (3) graphic order (4) graphic associate (5) graphic gap match (6) position object (7) slider (8) drawing (9) upload (10) auxiliary files[12].

Figure 2. The example of hot spot [12]

In fact, the quiz game can display most of assessment methods which don't need more responded time. With different kinds of methods in quiz game, students have different interaction with host. And it may cause better game playing efficiency.

2.3. Educational Game for Assessment-Quiz-Master

Few people would deny that TV Game shows are popular recently. Since their first appearance in the 40's and 50's, TV game shows have attracted a large and steady audience that among teenagers and older audience [8]. While there are many educational games available, many are targeted to a younger learner. We believe the TV quiz game show format will not only appeal to young leaner but also appeal to older student. The Quiz-MASter game [8] is one of the quiz game show. And our framework design in this paper is following by the idea of Quiz-MASter.

This game is a small group of contestants that compete by answering questions presented by the game show host. And the contestants score points by correctly answering questions before their opponents do. Finally, the contestants who get higher score in the game is the winner. In this kind of competitive game, players are engaged by when their competitors got the points during the game. It will make user concentrate more on the game material due to the competition. Because most of player want to win the game. This is why the quiz game so popular for a long period time. The Quiz-MASter game was designed with the sense of competitive. It will let user have the motivation to win the game and concentrate during the game playing.

2.4. Multi-Agent System (MAS)

To model a system as agents gives us a way of establishing flexible boundaries for automated system [2]. Because we want to develop software that is open, intelligent, and adaptive [3]. Hence, we use multi-agent system as our system tool. Multi-agent system is a system composed of multiple interacting intelligent agents. And using the multi-agent approach can address the issue of scalability by separating reasoning capabilities from other functionality of the system [10]. In the use of e-learning, the agents will be able to communicate with the learner, prompt and store user

preferences and to arrive at a reasoning mechanism to relay suitable, interesting, and useful information to the learners[7]. Besides, the MAS are flexible and saving source. Firstly, if you want to revise the service in the system, you don't have to revise for all the system. Only the agent with the service should be revised. Secondly, the agents only work when the system need services from the agent. If the agents don't work, it will be in hibernation. And it helps system to save resource.

3   MULTI-AGENT BASED PERSONALIZED QUIZ GAME

This system architecture is designed to adapt user's learning/game playing behavior during their game play/learning then give the suitable game material/learning material to the user. The system is a multi-agent based which can divide into following six agents and three databases. We will describe each agent and database on following paragraph. The goal of this system is building a framework to build personalized assessment games and maximize the learning performance via collaboration and personalization [5]. The following figure 4 is the conceptual design of system architecture:
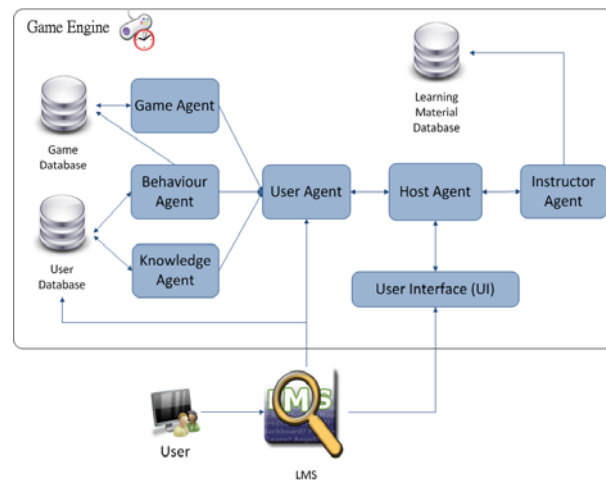

Figure 3. System architecture of Multi-Agent Game

◆   Agent
1.   Host Agent:
        The host agent, just like the host in TV quiz game show. And give user the personalized game content. With the similar knowledge level of competitor, the user can feel the sense of competitive that will let user focus on the quiz game. And its task as below:
        ■ Ask player questions in the quiz game

- Arrange similar knowledge level of competitor into same match
  1. Designated computer player (NPC)
  2. Put human players together
2. Behavior Agent:

   The behavior agent will detect the following information during the game. And send the information to user agent.
   - Response time
   - Answer that student selected　in quiz
   - Test score
3. User Agent:

   User agent's task as below:
   - Distribute the appropriate user model to the user[4]
   - Ask and collect the information form following agents
     1. Behavior agent
     2. Knowledge agent
     3. Game agent
   - Send the following information it collect from other agents to host agent
     1. Preference content type
     2. Student level
4. Instructor Agent:

   The instructor agent sends the request from host agent as follow. And also provide the related learning material or other external material that are recommended to students (ex: website, files...)
   - Suitable subject for the user
   - Suitable quiz difficulty for the user
   - Suitable content type for the user
5. Game Agent:

   The game agent respond in following task in the game, then send the information to host agent.
   - Game ranking in the game
   - Game playing history of each user
   - Manage mechanism of rewards and penalties in the quiz game
6. Knowledge Agent:

   The knowledge provides the user's knowledge background from which subject or quiz difficulty have user learn. And analyze knowledge background by user's learning situation that base on which subject has good test performance in the game. Finally, send the those information we mentioned to the host agent.

- Database
  1. Assessment Material Database

     This database use to store the related assessment material. When the instructor agent receiving the request from host agent. The instructor agent will provide the assessment from database to host agent.
  2. Game Database

     This database use to store different game paying information from different user which includes game ranking, game playing history, game reward

mechanism.
3. User Database

   This database use to store related user information which personalized game need, such as preference subject, user model

Based on previous system architecture of multi-agent game, we also design a flow of personalized assessment game(see figure 4) which game users have personalozed feedback after playing multi-agent quiz game. The order of personalized assessment game as below:

1. Learner survey
2. User need
3. Questionnaire
4. Game playing
5. Learning activities in LMS
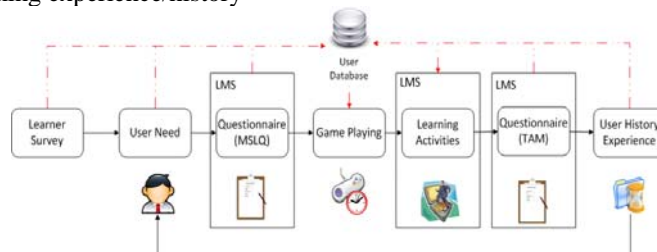6. Gaming experience/history

Figure 4. Flow of Personalized Assessment Game

◆ Learner survey

This learner survey only take in first time, and it focuses on game attitude, computer attitude, learning experience and learning style. In the beginning of personalized game, we have to know whether the game users are good at game playing or computer operating. And also realize the learning style and learning experience of users. Because the personalized quiz game, we need to know related background from users. Getting more related background from users, more personal feedback give to users.

◆ User need

In second step, we will ask following questions from user.(1) Which subject or knowledge does the user need or prefer ? (2) Which game content type is user need or prefer ?

In first question, we can realize the knowledge or subject that users are interest in. And integrating the default value and game playing results that will give users more complete feedback.

In second question, we can realize what kinds of game content type are user need or prefer. Because some users are used to read text content, some users are used to read figure content. This is why we asking this questions.

◆ Questionnaire

In questionnaire step, we use the following questionnaires to user.

(1)TAM (Technology Acceptance Model)

(2)MSLQ (Motivated Strategies for Learning Questionnaire)

Those questionnaires are use to check technology acceptance and motivation from users.

◆ Game playing

In step, users are going to play multi-agent based game, educational Game for assessment. And the agents will collect game behaviors from user when game playing. Those game behaviors will help agents give more adaptive feedback to users.

◆ Learning activities in LMS

In this step, we use some learning activities in LMS, such as forum (asynchronous), chat (synchronous) and shared resources. The learning activities will enhance interactions from student to student and student to instructor. More learning interactions lead better learning efficiency.

◆ Gaming experience/history

After game playing, the agent will collect some information from game playing from user, such as which subject/competitor they have played? and the score, game duration during the game. When user playing the personalized game after first playing time, it will give user related personalized game content or game information from previous game playing information. No doubt, more data from user will give himself/herself more accurate feedback.

4 Scenario in multi-agent quiz game

In this section, we will give a scenario in multi-agent quiz game. Firstly, user Peter login to the LMS, and the LMS will trigger the multi-agent assessment game system. Due to the LMS has the login information of user, LMS will sends the user information to the multi-agent system. The system asks related information from other agents for the user. The detail process of assessment game as below:

1. Host agents asked user agent for related game material about user
2. Since the past game playing history that recorded in database, knowledge agent, behavior agent and game agent will provide game playing history to user agents, such as test history, score history, competitor history.
3. After user agent getting related information from other agents. It analyzes what kinds of quiz should be accessed in this tournament by the user, such as what difficulty? Which subject?
4. The user agent sends the information analyzed by itself to host agent. The host agent transfers those information to instructor agent.
5. The instructor agent provides related game material from database to host agent.
6. Host agent assigns the quiz to user by the material which provided by instructor agent. Host agent also arranges the match which involve similar level of user.

5 Research Issues Discussion

The implement to the integration of multi-agent system and personalized assessment game is our core work in the future. We discuss our future work in the following two parts: multi-agent system and personalized assessment game.

In the aspect of multi-agent systems:

(1)   How many agents used in the system is optimal?
(2)   How does the agent communicate with other agents in saving resources way?
In the aspect of personalized assessment game:

(1)   The mechanism of personalized assessment. Such as how to generate suitable quizzes to the players/learners? How to provide suitable hints to the players/learners?
(2)   How many students are suitable in each competition?
(3)   How many quizzes in the game are suitable to the student?
(4)   How to define a user level and user model in the personalized assessment game?
   At last, as pointed out in [9], there is an important issue about game based testing. If students have good performance in the educational game, how do we know the student who is good at game playing or good at game content (subject)?

In the future work, we will focus on those research issues we mentioned before. Our research goal is using multi-agent system to implement personalized assessment game. And the game can provide adaptive subject and adaptive game content style to the user. Besides, system can save resources due to the multi-agent system.

6 Conclusion and Future work

In this paper, we proposed the framework of personalized Quiz-MASter assessment game and the flow of personalized quiz game. It used intelligent multi-agent system to implement, and included following six agents and three databases: (1) user agent (2)behavior agent (3)knowledge agent (4)host agent (5)instructor agent (6)game agent (7) assessment material database (8)game database (9)user database. Those six agents have their specific service in the system, and only work when the system need. With the services provide by intelligent agent, user can play the personalized assessment game by the flow of personalized quiz game. Actually, the personalized game or adaptive game based learning have become very popular in game based learning and game based testing. Hence, it may be of interest for future research that personalized content type for quiz game and develop a multi-player multi-agent based Quiz-Master. In the future, we will implement those system architecture and focus on the learning/game playing behavior from user. Then analyze those information and give user more personalized and more accurate feedback.

Acknowledgement

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