Agent-Based Personalisation and User Modeling for Personalised Educational Games

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ABSTRACT

Personalisation can increase the learning efficacy of educational games by tailoring their content to the needs of the individual learner. This paper presents the *Personalised Educational Game Architecture (PEGA)*. It uses a multi-agent organisation and an ontology to offer learners personalised training in a game environment. The multi-agent organisation's flexibility enables adaptive automation; the instructor can decide to control only parts of the training, while leaving the rest to the intelligent agents.

CCS Concepts

•Human-centered computing → User models; •Computing methodologies → Intelligent agents; •Computing methodologies → Multi-agent systems; •Applied computing → Interactive learning environments;

Keywords

User Modeling; Intelligent Agents; Personalised Educational Game; Scenario-based Training; Difficulty Adjustment

1. INTRODUCTION

Many professional organisations require workers to make good decisions under risky and stressful circumstances, e.g. the fire department, army, police force, or hospital. In order to become proficient in this type of domains, learners need practice and experience with situations that are critical and/or exemplary for their line of work. Yet professionals who are active in high-risk domains cannot gather experience through learning on-the-job, because in real-life situations the wrong decision may well cause life-threatening complications.

Scenario-based training (SBT) is regarded as a suitable and effective training form [1, 8]. SBT enables learners to practice exemplary situations in *'scenarios'*: interactive role-playing exercises with human actors. Traditionally, scenarios are staged in a *physical - real life* - simulated environment. SBT offers learners opportunities to experience the consequences of their decisions in a relatively safe and controlled environment.

One of the major downsides of SBT is its heavy logistic and organisational demands, e.g. the clearance and preparation of an area to stage the scenarios, the preparation of elaborate scenario scripts, the training and instruction of role players, and the simultaneous presence of all people involved (actors, trainees, instructors). Another downside is that during scenario enactment it is hard, or even impossible, to alter the course of events in the scenario, making it difficult to personalize training. Furthermore, it is often problematic to monitor and interpret events in the scenario in a structured, systematic, and non-ambiguous manner - especially in large scale scenarios involving multiple locations, it can be difficult for one person to maintain an overview of what is happening.

Development of new training technology may solve or alleviate the obstacles that prevent ample and effective use of SBT, by placing SBT in a virtual (game) environment, and controlling parts of the training with the use of artificial intelligence [1, 4, 7]. This paper introduces the *'Personalised Educational Game Architecture (PEGA)'*, which aims to provide such technology by staging SBT in a smart game environment. PEGA uses artificial intelligence to attune the behaviour of the characters and the events taking place in the scenario to the individual needs of the learner. As a result, learners can develop their competencies at their own level and pace, even in the absence of an instructor.

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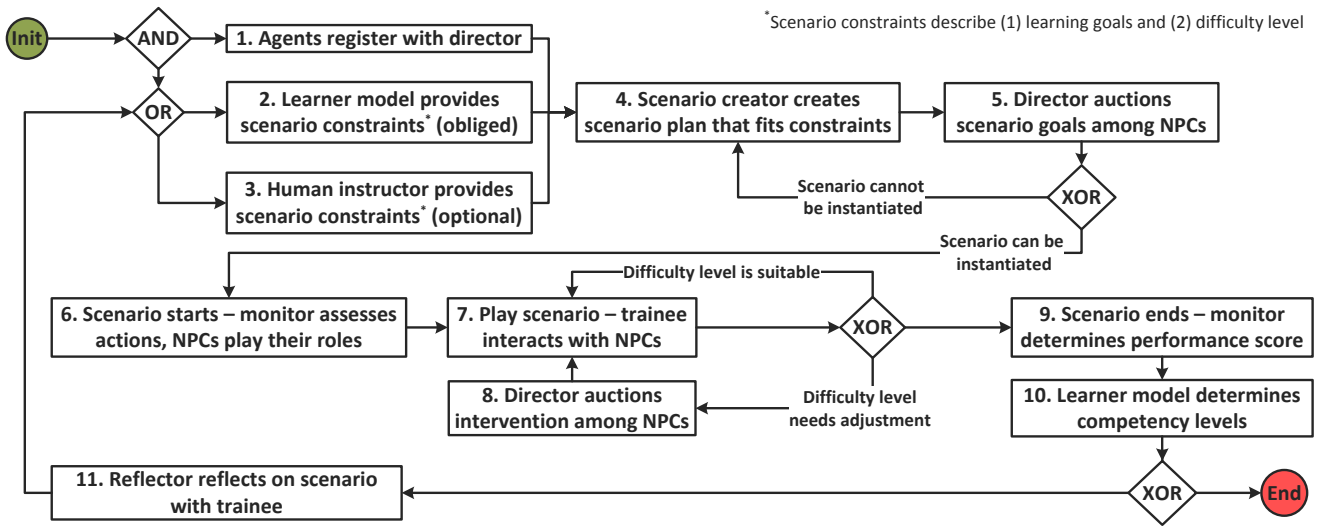

Figure 1: The behaviour of the multi-agent organisation

2. PEGA

PEGA describes an ontology and a multi-agent organisation. PEGA's *ontology* provides an explicit representation of the declarative knowledge needed for the intelligent agents to attune the game to the needs of the individual learner [6]. PEGA's *multi-agent organisation* partitions the training system into a collection of agents [2]. Scenarios are staged within a game environment inhabited by *non-player characters (NPCs)* with which the learner can interact, e.g. victims, bystanders, or friends of the victim. The *learner model* keeps track of the learner's competencies and motivation. It uses that information to determine a suitable learning goal and difficulty level. The *scenario creator* uses automated planning techniques and information in the ontology to generate a scenario that targets the learning goal - determined by the learner model - at the desired difficulty level [3, 6]. The *director* auctions the roles and goals among the NPCs. The *monitor* keeps track of the learner's actions to decide whether to adjust the scenario's difficulty level to better match the learner's competencies [5]. The *reflector* encourages the learner to reflect on the training performance after the scenario has come to an end. The behaviour of the multi-agent organisation is depicted in Figure 1.

3. DISCUSSION & CONCLUSION

PEGA's multi-agent organisation supports *adaptive automation*. The instructor decides the level of automation. The instructor can take up various roles in the training process while leaving the other roles to the agents, e.g. provide a scenario plan, monitor the learner, issue interventions, or take on the role of an NPC. The human instructor can also instruct the agents in advance of the training on how to control the environment to adapt it to the needs of the learner, enabling the learner to train in the absence of the instructor. PEGA's ontology supports coherent communication between the actors (both artificial and human) in the organisation. Future research aims to (1) develop more sophisticated agents to play their parts in PEGA, and (2) verify that learners' competency development is effectively enhanced by training with PEGA.

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