A 3-D Educational Game for enhancing learners' performance in A star Algorithm

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Abstract. Many recent studies have reported the efficiency of educational games in making learners motivated and active while learning. At the same time, many studies as well have reported the difficulties of learning Artificial intelligence algorithms such as A star algorithm. Therefore, this paper presents a newly developed educational game which aims to help learners learn A star algorithm in a fun, interactive and easy way.

Keywords: Artificial intelligence; A star algorithm; educational games; computer science.

1 Introduction

Many studies have highlighted that mixing both playing and learning processes can enhance the learner's motivation while learning [1]. Consequently, educational games have started gaining an increasing attention from researchers and practitioners. In these games, learners are situated in a gaming scenario to complete a series of learning tasks individually, collaboratively, or even competitively [2].

At the same time, Artificial Intelligence (AI) has started to be used in different fields (education, medicine, etc.). It is a subpart of computer science which consists of making computers be able to perform the thinking tasks that humans are capable of [3]. One of the covered topics by AI is "search algorithms" in particular A star (A*) algorithm. However, many studies have reported the difficulty of learning artificial intelligence algorithms [4]. In addition, and from a practical experience, learners found learning A* algorithm using the traditional method in classrooms hard. Besides, many educational games with different pedagogical objectives for computers and mobile devices [5, 6] were reported in the literatures, but none of

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them focused on teaching A* algorithm in a fun and motivating way. Therefore, the main research question that this paper aims to answer is *Does the use of an educational game enhance the learners' performance in learning A star algorithm?*

In this context, this paper presents a newly designed 3D educational game called *A* game*. The rest of the paper explores the proposed research question as follows: section 2 starts by presenting a literature review regarding educational games and artificial intelligence. Section 3 presents the newly developed educational game to learn A* algorithm. Finally, section 4 concludes the paper with a summary of this research and some future directions.

2 Literature review

This section presents a literature review regarding educational games and their advantages as a learning tool. Besides, it explains the A* algorithm.

2.1 Educational games

Educational games were defined as applications using the characteristics of video and computer games to create engaging and immersive learning experiences with specified learning goals [7]. These games provide challenge tasks, encourage different levels of interaction, and provide enjoyable multimedia and instant feedback [8, 9]. Besides, they can be used to model learners and gather information about them [10]. Furthermore, educational games can make learners more active in discovering new ideas, information, and solutions of given problems [11]. Many of them are designed with different pedagogical objectives, such as computer architecture and programming skills training. However, none of the educational games currently aims to teach AI, in particular A* algorithm.

2.2 A star algorithm

To solve different problems, learners need to get a strong understanding of the way search algorithms work [12]. However, many studies have proven the difficulty of learning AI algorithms [4]. In particular, and from a practical experience, learners usually require a lot of concentration and mental effort to solve A* algorithm problems. Besides, they find learning A* algorithm using the traditional method in classrooms difficult and not motivating. Therefore, new learning methods for teaching this algorithm are needed.

In this context, the next section presents a newly designed 3D educational game which aims to help learners learn A* algorithm in a fun, motivating and easy way.

3 A*Game

To allow learning A* algorithm in an easy and motivating way, a 3D single player educational game called *A* Game* is designed. According to [13, 14], 3D graphics offers a better learning-playing experience, by using realistic graphics, sounds and addictive story lines. Besides, different game elements are implemented in *A*Game*, such as avatar and game objects.

In the game, the learner has to find the shortest path to the destination where a diamond is hidden. To do so, *A*Game* proposes a map, using Unified Modeling Language (UML) class diagram, where the learners can get information about all the possible paths and follow the shortest one to get to the destination. Each time the learner goes through a node, an immediate feedback, which is the execution of both the *Open* and *Closed* list will appear. This can help the learners to know if the visited node is correct or not. In particular, if the visited node is correct, it will be colored on the map. Consequently, the learners can visualize in a global view the traces of the shortest path, which is colored in the graph, hence organize what they have learned during the gaming.

To increase the challenge during the game, different enemies that the learner can encounter are implemented. These enemies will try to make learners change their taken path or lose before they achieve their destination.

Figure 1 presents a snapshot from the *A* game* interface where it is divided into two parts: the game environment and the game map.

Fig. 1. Snapshot from the game interface

4 Conclusion and Future directions

This paper presented a newly designed educational game entitled *A* game* for teaching A* algorithm in a fun, interactive and motivating way. Future research directions will focus on validating the efficiency of this game through different experiments. Besides, they will focus on investigating the impact of using the embedded UML class diagram (see figure 1) as a standardized concept map in the game.

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