Alternate Reality Game for University-Level Computer Science Education

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Abstract: Alternate reality games are a relatively new genre of games that use many different types of media to deliver an interactive narrative to the players. They consist of puzzles that can be very challenging and therefore they often call for collaboration among the players. In this work-in-progress paper, we describe our plan of using an alternate reality game in university-level computer science education. The primary target group of the game is university students from the field of computer science, but anyone is welcome to participate. The tasks and puzzles in the game involve computer science concepts, and therefore programming skills and basic knowledge of computer science are needed. Finding the initial clue, the trailhead, of an ARG is typically an achievement in itself. Similarly, our game is not part of any official curriculum, and we will use many trailheads in several media to promote the game. Also, the game organizer is not revealed to the players during the game. Since the game is not part of any official curriculum, participating is completely voluntary. Even though some of the skills needed in the game are very similar to the skills needed in completing similar course assignments, players will not receive study credits for solving the puzzles. They are just enticed to join the game to solve engaging challenges with other players. The game will have a wide range of puzzles from different fields of computer science, so that it would be difficult to solve all of them individually. Hence, the game calls for collaboration among the players. Getting students to join the game will be a challenge. Therefore, one of the research aims of this study is to investigate what motivates students to participate in ARGs when there is no reward in terms of study credits. We will also study the suitability of an ARG as a tool for computer science education and community building.

Keywords: ARG, alternate reality game, computer science, game-based learning, collaboration

1. Introduction

Alternate reality games (ARG) are games that use many different types of media to deliver an interactive narrative to the players. They consist of challenges and puzzles that are part of a bigger quest that the players are trying to solve. The puzzles can be very challenging and therefore they often call for collaboration among the players. Typically, ARG participants are actively engaged in the game and solve difficult tasks collaboratively or individually in order to make progress. This offers an opportunity for educators to use ARGs to engage students in learning tasks. In this work-in-progress paper, we describe our plan of using an alternate reality game in university-level computer science education.

2. Related Work

Alternate reality games are a relatively new genre and they lack a concise definition. The idea of ARGs is to use different media creatively and interact with the players letting the game evolve in real time. Therefore, ARGs can be very different by nature and it is hard to come up with a definition that suits them all. McGonigal (2011) describes ARGs as *antiescapist* games, meaning that ARGs are not played to escape real life, but to get more out of it. Kim et al. (2008) also describe ARGs as games that are designed to blur the distinction between player's experience in the game world and the real world outside the game.

There are some good examples of ARGs that managed to engage participants in collaborative puzzle-solving. "The Beast" was one of the first successful ARGs (Kim et al., 2008). It was created in 2001 to market the movie "Artificial Intelligence" and it managed to get over three million players. Another well known ARG, "I love bees", was developed as a viral marketing campaign for the Halo 2 video game (Kim et al., 2008).

Although ARGs have mainly been used for marketing and promotion of commercial products, they have been used in education as well. Connolly et al. (2011) developed an ARG called "Tower of Babel" for supporting the teaching of foreign languages. They report that students' attitudes towards the game were very positive and they found it to be a useful way to motivate students in learning a foreign language. Whitton (2008) describes an ARG that was designed specifically for higher education to provide students an alternative way to acclimatize themselves to university life.

Alternate reality games have a great potential to be used as a part of education. Moseley (2008) presents several features of ARGs that would be beneficial in educational contexts and should be born in mind when designing an ARG for education:

- Problem solving at varying levels
- Progress and rewards
- Narrative devices
- Influence on outcomes
- Regular delivery of new problems/events
- Potential for large, active community
- Based on simple, existing technologies/media

It is important to acknowledge the purpose of an ARG and the potential target audience. Whitton (2008) states that ARGs generally appeal to a small proportion of the population, but those who do become involved, typically are extremely engaged in the game. Whitton's statement suggests that ARGs can be very effective as an alternative way of learning. However, if the majority of students are not engaged in the game, it is not suitable for a compulsory assignment.

Although ARGs are not a commonly used method in computer science education, there are similarities to other methods that are widely used. Programming competition tasks have many similarities with the individual puzzles in a computer science ARG. However, there are also significant differences in the overall setting of an ARG and programming contests. ARGs try to increase the engagement by creating a compelling story and a sense of bigger purpose rather than providing several non-related tasks. Also, in ARGs, realizing the actual task is often part of solving the puzzle.

3. ARG for Computer Science Education

In this section, we describe an alternate reality game designed for university-level computer science education. The game will be held during semester 2012-2013 and it will last for several weeks. It will take place partly online and partly on campus. The primary target audience is university students from the field of computer science, but anyone is welcome to participate. The game has a main quest that the players are trying to solve and several smaller puzzles. By solving the puzzles, players reveal clues for the main quest. They can also see their contribution for solving the quest in form of achievements and rewards. The puzzles in the game involve computer science concepts, and therefore programming skills and basic knowledge of computer science are needed.

In ARGs, finding the initial clue for the game, the trailhead, is typically an achievement in itself. Similarly, our game is not part of any official curriculum, and we will use many trailheads in several media to promote the game. From a player's point of view, the game organizer is not known, and the player is just enticed into the game to solve engaging challenges. Therefore, participating in the game is voluntary and the players will not receive study credits for it, even though some of the skills needed in the game are very similar to the skills needed in completing similar course assignments. The game will have a wide range of puzzles from different fields of computer science, so that solving all of them alone would be difficult. Hence, the game encourages players to team up and solve the quest collaboratively.

After finding the trailhead and solving the first puzzle, players are invited to participate in solving the main quest of the game. Players stay anonymous, but they are presented a map that shows other participants creating a community of players who are solving puzzles together in order to crack the main quest. Next, we present an example puzzle from the game.

3.1 Example Puzzle

The initial clue of the puzzle is a webpage that contains only one image representing a simple character (Figure 1). In order to solve the puzzle, the pixels of the image must be sorted based on the red component of the RGB value. Because there are several pixels with the same red component value, the sorting algorithm must be stable in order to preserve the order of the pixels with the same sorting key. The image, which is formed after sorting the pixels, is shown in Figure 2. The resulting image is a QR code that can be decoded with any QR code scanner. When scanned, the QR code reveals an URL, which contains the actual solution to the puzzle.

Figure 1: The initial clue.

Solving the puzzle merely based on the initial picture is very difficult. Therefore, additional clues can be given to implicate the need to investigate the RGB values and sorting. These clues can be given to different participants or they can be revealed in few days after the original puzzle is first shown.

Solving this puzzle requires understanding of the RGB color model. Participants need also programming skills to be able to manipulate the image data and implement the sorting of pixels. They also have to understand the difference between stable and unstable sorting algorithms and choose a stable algorithm for this puzzle. In addition to the technical skills, participants need problem solving skills, perception and collaboration in order to hit on the right ideas to solve the puzzle.

Figure 2: Desired output image.

4. Discussion

One of the challenges of the game is to get enough active participants. The parts of the game that call for collaboration need a critical mass of players to work. This can be partly addressed by providing more clues for the difficult puzzles, but genuine collaboration among people can be achieved only if the number of participants is high enough.

The game lasts for several weeks and it is possible to join in the middle of the game. Even thought collaboration is encouraged, we want to offer everyone the possibility to solve the puzzles regardless from the fact if they were involved from the beginning or not. Therefore, it is a challenge to design the game mechanics in a way that solving a puzzle contributes to the collaborative goal of solving the main quest, but at the same time the puzzle is not spoiled for everyone else who are still working on it.

We want to keep the game separate from the official curriculum for two main reasons:

- To find out what motivates students apart from getting the course credits.
- We feel that introducing the game as part of a course would make it less appealing and it would remove some of the mystery of the game.

During the game, players might get clues to puzzles via e-mail. This offers us a way to get contact to the players also after the game. We will collect feedback from the players for evaluating the suitability of an ARG in computer science education and to find out the reasons why they decided to participate. This ARG is closely related to learning computer science concepts. However, the same concept could be used to create an ARG covering several topics that would be suitable for all university students. If successful, it could be a way to offer an opportunity for students to meet people outside their department, share knowledge, and learn from each other in a motivating way.

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