Frontiers of a Paradigm – Exploring Human Computation with Digital Games

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ABSTRACT

Each day millions of people play digital games with different motivations. These motivations rang from time beating to deep immersion into a narration or interacting with a community. To address all these different means, a range of game designs is necessary. Traditional human computation games cannot present all these aspects yet.

This work will give a game centered view on game design for human computation. To demonstrate the value of this view it will present a fast-paced action game called *OnToGalaxy* along with two different human computation tasks.

1. INTRODUCTION

Since human computation is integrated into digital games and has become relevant for science and industry, different fields of its application have been explored. The evolved designs have proved to be effective as well as efficient in many situations. An overview of current human computation games and relevant publications on game design will be given in section 2.

On the one hand human computation games provide a unique game play experience. On the other hand, they are focused on a special task and tightly aligned to it. This design focus makes them a game category on their own. Even though a range of appearances of human computation games has been presented, their core design is to some extent homogeneous. Many works on human computation with digital games are centered around a certain task or problem domain. Significantly fewer works are investigating possible game design aspects in the context of human computation.

This paper will focus on the paradigm of using digital games for human computation. Section 3 will demonstrate how to design a game comparable to other casual games that are played by millions of players every day. Benefits and drawbacks of using this design will be discussed as well in section 3.

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2. RELATED WORK

Digital games with a human computation task have a range of designs. They can be puzzles, multi-player environments or virtual worlds. They also have many application domains. Common tasks for human computation games are for instance relation learning or resource labeling. A well known example in this regard is the *GWAP* [18] series. Other games try to use human computation for natural language processing like *Phrase Detectives* [6] or *TwinMind* and *Actionary* [16]. Yet others, like *OntoGame* [15] are used to build and learn ontologies. These games preform human computation by integrating their task into puzzle-like games.

Even though many games are very similar in their use of design elements, some are different. *HeardIt*, for instance, stresses user centered design as its core idea [3]. This makes it different from other human computation games that are mostly designed around a certain task as their core element. *HeardIt* also allows direct text interaction between players during the game session, which is prohibited in other games to prevent cheating [19]. *KissKissBan* [9] is another game with special elements. It is a game that involves a direct conflict between players. One player tries to prevent the "kissing" of two other players by labeling images.

Another game that is special according to its design elements is *Plummings* [17]. This game aims at reducing the critical path of FPGAs. Unlike other games the task is separated from the game mechanics. The game is about a colony of so-called *Plummings* who need adequate air supply. By keeping the length of the air tubes as short as possible the player saves the colony from suffocation.

Another interesting game is *FoldIt* [4]. This game aims on folding proteins, which is a complex task. It is a single player

Figure 1: Second version of *OnToGalaxy*. The human computation task is to populate an ontology. The blue ship on the right is a labeled freighter. The red fighter ship in the middle is controlled by the player. On the lower right is the mission description. It tells the player to collect freighters labeled with words of touchable objects like hammer. In the example the freighter is labeled with leaf which fulfills the relation of being a touchable object. The explosion close to the fighter originates from a freighter that was shot down by the player.

game which needs a downloadable client. It presents simplified three-dimensional protein chains to the player, and provides a score according to the predicted quality of the folding done by the player. *FoldIt* is special because all actions by the player are performed in a three dimensional virtual world.

As the presented works show, human computation games have already developed in different styles. To further enhance the design of human computation games it is necessary to investigate game design and related literature. One of the earliest works in this regard was written by Crawford [7]. His book deals with questions of what makes a real game, why people play them, and how to design engaging ones. Crawford gives a restrictive definition of the term "game" in his book, which is later analyzed by different works on this topic. Salen and Zimmerman for instance gave an interesting overview on definitions of games in their book "Rules of Play"[14]. They also describe the aesthetics of interactive systems, and define core concepts like play, design, and interactivity. They looked at games through so-called game design schemes, or conceptual frameworks, including games as digital interactive systems in the context for social play and as a medium for storytelling.

Hunicke, LeBlanc and Zubek describe a formal framework of Mechanics, Dynamics and Aesthetics to give guides on designing digital games. Mechanics are the particular components of a game, at the level of data representation and algorithms. Dynamics is describing the run-time behavior of the mechanics acting on player inputs and outputs of the mechanics over time. Aesthetics is describing the desirable emotional responses evoked in the player, when he or she interacts with the game system [10]. Other works with an applied perspective on game design are for instance "Game Architecture and Design" [13] by Rollings or "Challenges for Game Designers" [5] by Brathwaite. Both books providing an interesting starting point for game design.

In the following section this work will look at human computation from the perspective of game design. It will describe how a game centered design can be applied and discuss the benefits as well as drawbacks of such an approach.

3. ONTOGALAXY

Every month 200 million people play casual games[1], spending up to two hours a day. The games they play can be of any genre and any type as claimed by the Casual Games Report [1]. As already argued in the previous sections, most human computation games provide a valuable, but specific sort of game play. To reach as many players as possible, it is necessary to expand the designs of games used for human computation.

Designing a game, that is different from traditional human

[1]Since the evolution of social network games this number might be much higher. Cause games like Farmville have up to 10 millions of player per day.

Figure 2: Third version of *OnToGalaxy*. The human computation task is to find synonyms for German verbs. The mission tells the player to collect all freighters (blue ships) with a label being a synonym for "knicken" (to break). The female character on the bottom is the copilot of the player. She guides the player through his or her missions and gives necessary instructions. The player is controlling the red ship in the middle of the screen.

computation games and able to perform human computation, is a complicated and complex task. To give an impression of how such a design can look like this work will present *OnToGalaxy*. *OnToGalaxy* is a fast-paced, action-oriented science fiction game comparable to games like Asteroids [2] or Starscape [12]. Some participants also compared *OnToGalaxy* to games such as *Frontier* and *Wing Commander*, at least to a certain extent. *OnToGalaxy* provides a simple storyline and a progressive game-play. Progressive elements used in the design of *OnToGalaxy* are, for instance, different levels and agents, as well as upgrade elements of the players spaceship. This is comparable to other browser-based casual games. The design was chosen because of its stereotypical elements, seen in many games of its genre. It also allows a good comparison to other human computation games because of its difference in many aspects. To evaluate the outcome in regards to human computation *OnToGalaxy* was designed to reproduce different gold standards. The two different tasks are depicted in figure 1 and figure 2. A depiction of the first version of *OnToGalaxy* is not given because it is similar to version two.

3.1 Game-Play

Since *OnToGalaxy* is a space shooter game, it is not obvious how to integrate the desired relation extraction task into the game. In the game the player is the commander of a spaceship. He or she receives missions from an imaginary headquarter, represented by an agent, which is his or her copilot. Beside the storyline, these missions are presenting different tasks to the player like: "Collect all freighter ships that have a call sign that is a synonym for the verb x". A call sign is a text label on top of each freighter. If a player collects a ship according to the mission description he or she confirms this label to fulfill the given relation. In the given example that means that the collected label is a synonym for x. Even though only two different tasks were integrated, the underlying game engine is capable of fulfilling other tasks where one needs to establish arbitrary relations between two elements. These elements could be words as well as resources like images or audio files.

3.2 Story Matters

A frontier that was explored very early during the design of *OnToGalaxy* was the coupling between task and game design. The first attempt towards a casual design was however not very successful, as player experience the decoupling of the task and the game elements to be "odd". This happens because solving a task like populating an ontology in a game looking like a space shooter leaves a gap in the players experience. Players of *OnToGalaxy* made jokes about this disturbing effect and tried to give various stories to solve the perceived discrepancy.

Taking this observation, as well as the resulting stories into account, the second version of *OnToGalaxy* provides a storyline trying to close this gap. Even though the first attempt does not solve the problem of impression in total, it however enhances the experience of the players and closes the described gap. After introducing a storyline, no com-

ments regarding this gap were given in the interviews. As explained by some participants of the pre-evaluation interviews the story allows them to close this gap and therefore experience the task as an inherent element of the game play.

However the second version of *OnToGalaxy* was still perceived as "work" or an ordinary task by some players. They do not complain about the gap but still perceive the task as too dominant. Although only very few persons gave comments, the question was whether it would be possible to overcome this issue. Considering possible differences between "normal" games and *OnToGalaxy*, it turns out that the conflict situation was different from other games. In contrast to other games *OnToGalaxy* permits to shoot down freighters, but does not include equal reaction.

After integrating aggressive behavior from the system in version three, the game was accepted by the players. The players in the pre and final evaluation of the third version did not describe the task as distracting any more. Some persons still complained about missions perceived to be too challenging. This, however, is a problem of game balance and is not a problem specific to the human computation task.

3.3 Achieving Speed

As already mentioned a critical issue to some games is speed. This is true for games like *OnToGalaxy*, which like other games of this genre rely on fast interactions. As presented elsewhere [8, 11] fast interactions can be achieved by using binary verification. In contrast to traditional human computation games, the player is not asked to give his or her personal impression, but should decide whether a given relation is valid.

An extension to this is categorization where the player decides to which category a certain element or relation belongs as already presented by Siorpaes and Barrington [15, 3]. Both approaches can be faster than typing personal thoughts into a text field. In case of *OnToGalaxy* the chosen interaction form is binary verification. The game presents a certain relation to the player via the mission screen, and asks to find elements represented by game elements that fulfill the given relation. The major drawback of binary verification and possible solutions are also described elsewhere [8, 11].

4. CONCLUSION AND FUTURE WORK

Casual games are having different genres and styles. This paper has presented an example implementation: the action game *OnToGalaxy* which is comparable to casual action games. It demonstrates that human computation tasks can be integrated into such games. It also shows that the task can be hidden in the game that it is no longer perceived as a dominant element of the game. On the other hand this can prevent players from asking questions about the use and effect of their actions. In our opinion it is therefore mandatory to make sure the player is informed of the use of his or her actions. The next step is to integrate an unsolved task into OnToGalaxy and publish the game on a casual games website.

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