Chapter 53
Human Computation:
A New Aspect of Serious Games

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ABSTRACT

The scientific study of serious games is a recent development, spanning less than two decades. One aspect in this field is human computation with digital games. The core of the paradigm is to outsource problems that are not yet solvable by conventional computational systems to humans. Therefore, these problems are reformulated into tasks that are then integrated into digital games. The players of the game then solve the problem while playing. Different human computation games have been successfully deployed, but tend to provide a relatively narrow gaming experience. This chapter analyzes the differences between game design for human computation and traditional digital game design. An in-depth consideration of these differences shows that it is a viable approach to build human computation games with a wide range of designs. The key issues of human computation game design are illustrated with the game OnToGalaxy.

INTRODUCTION

Human computation combines human mental abilities and computational systems at a large scale the term was firstly coined by Luis von Ahn. It is closely related to the field of social computation like wisdom of the crowd or crowdsourcing. While the power of a human computation grid can be substantial as shown by *reCAPTCHA* (von Ahn, Maurer, McMillen, Abraham, & Blum, 2008) it remains a challenge to motivate humans to contribute. Different strategies evolved in human computation projects to handle this issue. A promising solution is to use a new kind of serious games. The basic idea is to integrate human computation tasks into digital games and let a players solve the problems by playing the game. In contrast to traditional serious games

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these games are not a medium to "teach" human beings, or bring some immediate personal benefit to the individual, as in so-called "gameification" approaches. Human computation games reverse the flow of information and let humans create data for computational systems. That data presents the result of complex computation performed by a human contributor. The following *Background* section gives an overview of current human computation games and relevant publications in this field.

Although these games show the potential of the paradigm, the resulting games are still limited in terms of player experience. Compared to other current digital games their mechanics and dynamics are basic. Although, their design already applies interesting aesthetics, they tend to be homogenous in terms of experience and emotional depth. One reason for this is that human computation projects most often design games around the task they aim to solve. Yet, if human computation engineers really want to take advantage of a substantial fraction of the millions of hours spent by people around the globe playing games every day, it is necessary to broaden the experiences that human computation games can offer. This would allow these games to reach new player audiences and may furthermore lead to the integration of human computation tasks into existing games or game concepts. To achieve both goals this chapter introduces the paradigm of human computation in the *Background* section and explains general challenges of human computation systems in *Challenges of Human Computation*. Afterwards, it introduces a design concept for human computation games in *Designing Human Computation Games*. This concept takes into account the differences between human computation and traditional game designs laid out in the *Background* section. The human computation game *OnToGalaxy* is drawn upon to illustrate the key findings. This game forms a contrast to other human computation games as an action oriented space shooter comparable to asteroid clones like *StarScape* (Moonpod, 2004). The design method presented in this chapter will be explained along examples from the development of *OnToGalaxy*.

As various fields of computer science are dealing with human computation and crowdsourcing approaches, current literature on these topics is by various areas such as Human Computer Interaction, Artificial Intelligence, Data Mining, Computer Graphics, and Audio Processing. Projects that investigate the paradigms of human computation and crowdsourcing from different perspectives frequently are not aware of each other. This is problematic for researchers trying to understand the current state of the art within this field. As the paradigms of human computation and crowdsourcing mature, a common vocabulary is needed, because solutions to common challenges can be achieved, retrieved and compared much easier when described in similar terms. Furthermore, the identification of common aspects of those systems would allow for a reliable classification. Such an attempt is also vital to standardize design guidelines to develop and analyze human computation systems. Examples for attempts to automate the design of human computation systems are the *SeaWeed* system from Chilton (Chilton, et al., 2009) and Huang's approach toward an automatic task design (Huang, et al., 2010). This is also considered by Quinn (Quinn & Bederson, 2009). The section *Challenges of Human Computation Game Design* provides a more detailed insight into common challenges of human computation systems.

BACKGROUND

The paradigms of human computation or crowdsourcing are widely used and closely related to the social and semantic web. One example is *Wikipedia* (Wikipedia, 2010), the largest known encyclopedia edited by volunteer contributors only. One may argue that *Wikipedia* is not a human computation system for various reasons. Yet, it has many features that are of interest to the