EasyChair Preprint

№ 6846

# Towards Interoperability in Video Games

Janne Parkkila, Timo Hynninen, Jouni Ikonen, Jari Porras and Filip Radulovic



October 15, 2021

# Towards Interoperability in Video Games

Janne Parkkila
Lappeenranta University of Technology
Lappeenranta, Finland
janne.parkkila@lut.fi

Timo Hynninen
Lappeenranta University of Technology
Lappeenranta, Finland
timo.hynninen@lut.fi

Jouni Ikonen
Lappeenranta University of Technology
Lappeenranta, Finland
jouni.ikonen@lut.fi

Jari Porras
Lappeenranta University of Technology
Lappeenranta, Finland
jari.porras@lut.fi

Filip Radulovic
Ontology Engineering Group
Universidad Politénica de Madrid,
Madrid, Spain
filip.radulovic@upm.es

## ABSTRACT

In this paper we investigate the possibility how to enable transfer of meaningful game information between different video games. We explore the benefits of ontologies as a solution to this problem, and present an initial version of Game Ontology, a first step towards achieving interoperability between games.

## CCS Concepts

**•Applied computing → Computer games; •Software and its engineering →** *Semantics;*

## Keywords

Ontology, Video Games, Interoperability, Video Game Ontology

## 1. INTRODUCTION

During the last decade, the video game industry has gone through significant growth, mainly due to mobile games and digital distribution [10]. This growth has led to a problem of discoverability in the marketplace [8] and for players to find out about new releases. The distribution channels do not have capacity to display all new games and smaller studios lack the resources for high visibility advertisement campaigns. Lately, the game developers have started to request abolishing top lists of marketplaces [2] [1]. These top lists seem to have tendency to direct customer attention to only the few already-successful products.

This visibility problem is not a new one and has been studied by researchers in other fields. Marketing professionals have recognized co-branding [14] [3] and cross-promotion [6], [11] as tools for gaining visibility in huge-space markets. Such marketing strategies have been used throughout whole entertainment industry (music, movies, games) for a long time. However, video games possess an ability of being much more than just a window for product placement and logo flashing, bringing deeper engagement with more meaningful and enjoyable experiences alongside the marketing.

Exchanging game-related information between two video games could enable players to use common items between the games. For example, gaining an achievement in one game could unlock a special level or equipment in the other game. Such approach would enable game companies to exchange players between each other, by creating incentives to visit other games through such "hyperlinks" of games. The games could even share characters or have decisions in one game to have meaningful consequences in the other one. This hyperlinking of games could help with the problem of visibility and creation of deeper experiences for players. However, hyperlinking of games is not a widely explored area, and there are no current overall solutions for game companies to use.

The main research question in this paper is *how to model game information semantically to support transferring of game data between multiple games?*
The subquestions that require clarification before we can answer to the main question are:

- What are the core concepts that appear in games?
- How could the tools of semantic web support transfer of game information between different games?

As the result of our study, we suggest an initial ontology implementation of game data that enables transferring of game information between games, while retaining the original semantical meaning.

## 2. INTEROPERABILITY AND THE CASE OF GAMES - RELATED WORK

Transferring virtual content between products has been researched for example by Van Buskirk et al [13]. Linden Lab (creator of Second Life) and IBM demonstrated the interoperability between different virtual worlds by transferring avatars between Second Life and an OpenSim virtual

world. Also Van Buskirk et al. designed a seamless connection between an e-commerce web store and a virtual world: In their system a user would be able to drag items from the e-store as 2D images and drop them into the virtual world as 3D objects. Riedl & Zook [9] suggested that current advancements in technology and an ecosystem of games have untapped potential to create new and exciting cross-game possibilities. However, the problems of representing, collecting and reasoning of game information requires further study.

Ontological modeling of games or standardization of game information have received yet little research activities. Ontology of games has been researched in order to create a common vocabulary of games and to use it as a teaching tool for game students [16] [15]. In addition, ontological modeling approach has been used to analyze games [7] by also categorizing interfaces, input devices and other aspects related to playing games. Also, the temporality in games has been studied [17]. Another approach of classifying game information has been done in the form of Game Bricks [5], yet within the scope of game rules and their implications. Even though some concepts of games have been classified, the definition of common game elements and the implementation of game semantics is still missing.

Video game industry has some examples of connecting different games together. A good example of linking games together was done by CCP games to their own products. Two games, Dust 514 and Eve Online share the same universe, where the two games exchange data between each other. Even though Dust 514 is a first person shooter and Eve Online a massive multi-player game set in space, the two games manage to exchange information in a meaningful manner. Study by [4] shows that Eve Online and Dust 514 players feel the connection between games to be meaningful, bringing more feeling and immersion to the game. Also, the connection between two games can be considered valuable to the developer, as satisfied players spread the good word and are more willing to pay for satisfying experiences.

# 3. SEMANTICS OF UNIVERSAL GAME INFORMATION

Enabling interoperability between games does not only require standardized data, but additional semantic metadata. This semantic information allows games to make logical reasoning of the available data and enables them to reconstruct objects of other games based on the existing information. In order to define such semantic information, we need to answer to a question of *what are the core components of games?* The identification of common core elements allows us to categorize game information and to map relationships between these core elements. The result of such identification and mapping allows us to create an initial ontology for enabling interoperability between different games.

We followed the methodology for defining the initial informal ontology as presented by Uschold & Gruninger [12]. The suggested process starts with brainstorming session in which the goal is to produce all potentially relevant terms and phrases. In our research, we invited eight local video game developers to participate in a workshop session. The goal of the sessions was to produce possible descriptive cases of different manners how games could be connected to one another. As a result, the study participants came up with 83 different example cases. This included examples such as "Unlocking a special mission by playing another game", "Opening a Paris-style level by visiting Paris in real-life" and "Having a massive war between two different game worlds". Not all of the cases are possible with existing technology, but serve as a starting point for identifying possible connection points between games.

We then extracted concepts (nouns) from the example descriptions given by the game developers. We came up with 120 different concepts that we managed to map into 11 different categories. The categories were created by placing the extracted concept into groups based on their similarity and their relations. For example, Game Type category contains terms 'car simulator', 'FPS' (First Person Shooter) and 'Genre' as they are related to same idea of describing a type of game, even though FPS is a Genre of games. Once we had all similar concepts grouped together, we named the categories based on the concepts inside. The results our categorization are shown in Table 1.

As stated in [12], creating an ontology is always specific to the domain and use situation. Because one of the goals in this research is to create an initial ontology for interoperability of games and re-use of game content, the focus is in concepts that are implemented in games. The categories of abstract, media and money-related were left out from the ontology as they are not tangible concepts nor core parts of games. These three are more supportive concepts, than in the core of games (although money is without a doubt an important issue for game developers). This exclusion left us with eight categories to place in the ontology. The created ontology is shown in Figure 1.

All the ontology concepts are linked to game by directed arcs, portraying how the game concepts are connected to one another. Looking at the Figure 1 reveals that the concepts could be further split into two groups. The top ones - events, characters and items - define concepts existing in games. All of these affect the storyline and player progression in the game and are thus in the visible center of the game. The concepts in the bottom are more about describing the game and defining its form. Ranking compares player performance, game type and mechanics are about how the game is played and what is it about and location is about the background setting of the game.

The ontology shown here looks rather simple for enabling interoperability between games. However, the goal is to create an abstract, yet expressive model of games. More expressions leads to added complexity. This model is meant to be be extended for more specific use cases. A role-playing game could extend characters to be of different classes (wizard, warrior, thief, etc.) and items could be further extended to be a hierarchy of equipment, weapon, sword. Even though these extended concepts would not exist in other games, they always map to their original parent concept. Thus a sword would still be an item, similar to inheritance in program code.

To clarify how ontology would be used to define games, we can explore a simple example of Pong. The game of Pong has a game type of arcade (as it could be placed in the arcade genre) and ranking would a leaderboard containing top ten scores. Pong takes place in a playing field (the black square, although it could be also called tennis field or something similar). Game mechanics of Pong could be two-player game and tournament. Of the upper concepts, the paddles can be

**Table 1: List of game concepts categorized from interviews with game developers**

| Category | Explanation | Example | Count (N=120) |
|---|---|---|---|
| Media | Methods of communication, residing outside the game. Places for discussing and changing opinions. | Youtube video, Twitter | 7 |
| Money-related | Things related to use of money. The use of money or real-world equivalents of money. Also marketing related information. | Credit Card, In-app Purchase, Advertisement | 7 |
| Location | Locations that often serve as the scene for game events to happen. | an island, a school, a sport event | 16 |
| Game | The actual games played by people. | Eve Online, Pac Man, WoW | 8 |
| Item | Items are things found in games. These can either be functional things that are used or purely decorative for creating believable setting for a game. | a gun, a sword, a photograph | 20 |
| Character | Characters are the actors through which stories are told and events take place in games. There is no distinction between player and non-player characters | NPC Character, a police, a friend | 9 |
| Game Type | Different types of games and their genres. | Car simulator, FPS, Genre | 5 |
| Abstract | Abstract things that posses multiple meanings and are difficult to describe in one word | social interaction, weather condition, love | 15 |
| Game Mechanics | Mechanics related to games. These concepts exist in multiple games but don't manifest in similar ways | a mission, stamina, infinite ammo, game interface | 16 |
| Event | Events that happen in games. An event happens at a certain moment of time and often has consequences | Advancing in game, making a decision, gaining an achievement | 10 |
| Ranking | Different means to rank players, characters or their advancement in games. | Karma, Reputation, high score | 7 |

modeled to be characters as they are controlled by players. The only recognizable item in Pong is the ball that bounces on the field. Finally, the events that happen in Pong are for example "Player1 scores", "Player 2 scores", "Game Starts" and "Game Ends".

# 4. DISCUSSION AND FUTURE WORK

In this paper, we have examined the possibility of using semantics as a tool for enabling interoperability and content transfer between different games. The main contributions of this research are:

- Suggestion for implementing an industry-wide standard of game information transfer with the use of ontologies
- Identification of core game properties
- Creation of initial ontology of games

In order to construct an initial ontology of games, we identified characteristics of games and game content in a brainstorming session with game developers. The resulting concepts were disected and grouped into categories. This categorization finally lead into eight core concepts that form the initial ontology of games. The initial ontology serves as a starting point for a further research of ontologies for games.

The creation process of a final ontology requires strict measures and validations, before being ready for industry use. However, the Game Ontology is a an initial ontology that is not quite complete, and in the future we plan to extend the ontology and perform extensive evaluations over it.

For the future work we should investigate more deeply the reactions of game developers on sharing game information and possible requirements and restrictions they have. In addition, the views of players (the consumers of the game products) should be evaluated more in the future. Also, further evaluation and development of the game ontology is required, before it can be applied in industry use.

# 5. REFERENCES


[1] M. Arment. Get rid of the app store's "top" lists, 2013.

[2] J. August. Topping the charts and racing to the bottom, 2013.

[3] T. Blackett and R. W. Boad. *Co-branding: The science of alliance*. Palgrave Macmillan, 1999.

[4] M. Carter and M. Gibbs. ESports in EVE Online: Skullduggery, fair play and acceptability in an unbounded competition. In *Proceedings of the 8th International Conference on the Foundations of Digital Games*, pages 47–54, 2013.

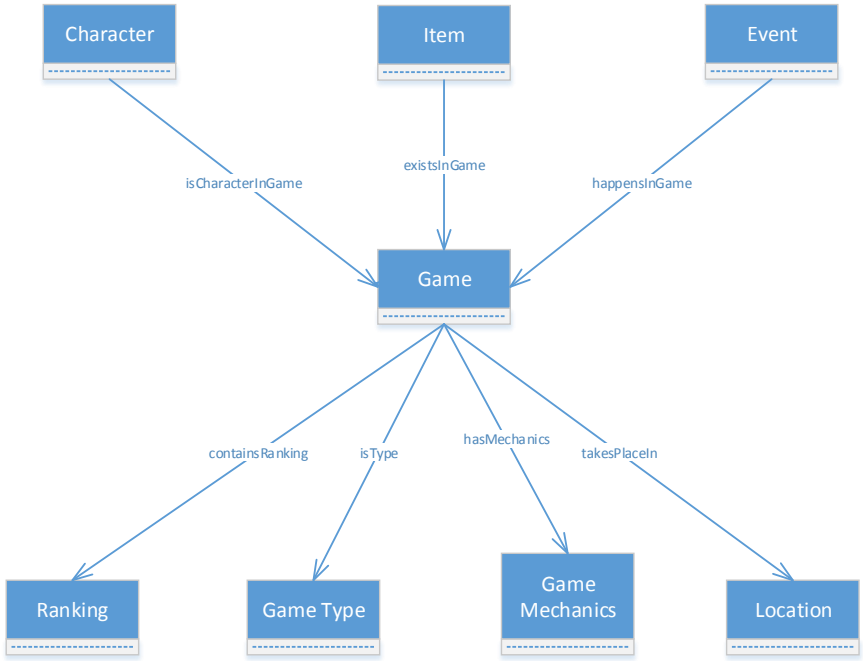


**Figure 1: Game Ontology**


[5] D. Djaouti, J. Alvarez, J. Jessel, G. Methel, and P. Molinier. Towards a classification of video games. In *Artificial and Ambient Intelligence convention (Artificial Societies for Ambient Intelligence)*, 2007.

[6] R. Gulati and J. Garino. Get the right mix of bricks & clicks. *Harvard Business Review*, 78(3):107–114, 1999.

[7] B. Hochhalter, N. Lichti, J. Zagal, et al. Towards an ontological language for game analysis. 2005.

[8] W. Prata, A. de Moraes, and M. Quaresma. User's demography and expectation regarding search, purchase and evaluation in mobile application store. *Work (Reading, Mass.)*, 41 Suppl 1:1124–31, Jan. 2012.

[9] M. O. Riedl and A. Zook. Ai for game production. In *Computational Intelligence in Games (CIG), 2013 IEEE Conference on*, pages 1–8. IEEE, 2013.

[10] O. Sotamaa and T. Karppi. Games as services-final report. *TRIM Research Reports 2, O. Sotamaa and T. Karppi*, 2010.

[11] T. Tang, G. D. Newton, and X. Wang. Does synergy work? an examination of cross-promotion effects. *The International Journal on Media Management*, 9(4):127–134, 2007.

[12] M. Uschold and M. Gruninger. Ontologies: Principles, methods and applications. *The knowledge engineering review*, 11(02):93–136, 1996.

[13] R. E. Van Buskirk and D. L. Wright. Virtual worlds seamless object drop integration, Apr. 8 2010. US Patent App. 12/756,505.

[14] J. Washburn, B. Till, and R. Priluck. Co-branding: brand equity and trial effects. *Journal of Consumer Marketing*, 17(7):591–604, 2000.

[15] J. Zagal and A. Bruckman. The game ontology project: Supporting learning while contributing authentically to game studies. In *Proceedings of the International Conference of the Learning Sciences ICLS 2008*, 2008.

[16] J. P. Zagal and A. Bruckman. Novices, gamers, and scholars: Exploring the challenges of teaching about games. *Game Studies*, 8(2), 2008.

[17] J. P. Zagal and M. Mateas. Temporal frames: a unifying framework for the analysis of game temporality. In *Situated Play, Proceedings of DiGRA 2007 Conference*, pages 516–522, 2007.