Digital Game Ontology: Semantic Web Approach on Enhancing Game Studies

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Abstract

This paper is a report focus on the development of Digital Game Ontology[1] as a knowledge framework. At the end of this paper we suggest the direction of further development and use of this ontology as a core component for developing the future web applications of games.

Keywords: Digital game, ontology, semantic web, game studies.

1. Introduction

Digital game is an evolving media type, both in market and industry. Game, as new media, exists as a mixture of various traditional media types: literature, animations and music, with system and designed interactivities beneath it, which makes a game itself is a sensible crafted world, while each play event is a parallel universe to the game. Complexity of game as a media or as an industry is still increasing with the advancement of hardware & software technologies, which changing games form and the way people playing them. The interest on studies of game as an art form, as market, or relations of digital game and Ludology increase through time.

Recently, there are Music Ontology project [2] which suggest a general multimedia ontology framework and Game Ontology project [3] which aims to provide a framework of concepts and their relations to describe game and play activity. However, a comprehensive game ontology in semantic web ready format is not yet available.

So our effort is to make reference on the framework of Music Ontology and borrow Game Ontology project concepts, to produce a Web Ontology Language [4] based ontology which would be comprehensive enough to process a wide variety of concepts and events of digital game from game as media piece, its production, and player activities and experience, which is the aim of our project, currently named Digital Game Ontology.

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2. Technological details

The ontology is constructed by OWL-DL, as the W3C recommendation of ontology language, with most expressiveness while computational complete.

Protégé ontology editor and Protégé API [5] is used throughout the development process. It is well supported with active user base. The reasoning of Semantic Web Rule Language (SWRL) [6] is supported in database mode so the system can deal with a large amount of data in recent beta release, at this moment this project is not going to need another data backend.

3. Scope

As for digital game ontology we want it to be able to represent most of the related concepts pertaining to a play event instead of game as a piece itself. Game is a different type of media as opposed to traditional media, interactivity is involved with player not merely as an audience but the final creator of the game as separate universe. So, addition to editorial data of game pieces , such as a game's developer, publisher, genre, concepts of development event of how a game is created, like the relationship between game entities and deliverables from developers, and play as an event which players' behavior is recorded in structure, is the core of the ontology. The data collected with such structure will be useful for various studies and applications.

4. Ontology concepts

Digital Game Ontology imports the timeline ontology and event ontology of Music Ontology. Event ontology and timeline ontology [2] plays a very important role in our ontology as its ability in generally discribes an event – which can be used to described those like development / publishing events, and play events with more functions added. FOAF [7] vocabularies are imported at the same time to describe game developers and players as agents of above events, while game specific domain vocabularies are

constructed base on the Game Ontology project. This is a study of ontological structure of games.

Base on the logic of Music Ontology framework, we want to gain detailed data of game production and play, at the same time, provide flexibility of entering simple editorial data which any user can contribute. So our ontology can achieve different level of expressiveness for different granularity of data.

For editorial data we provide concepts like which game title released on which date and which platform, concepts that usually found in describing a game in any online media database or shop.

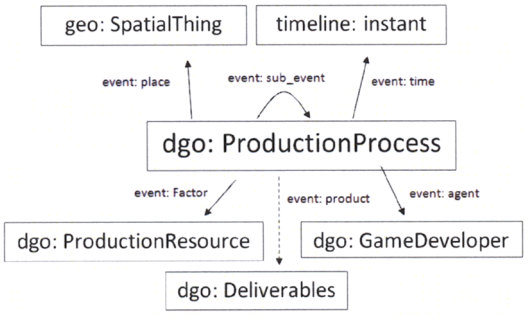

Figure 2. Overview of production process described with event ontology

Prefixes of concepts
– dgo : Digital Game Ontology (our ontology)
– timeline : Timeline Ontology
– geo : Geo Ontology
– event : Event Ontology

Figure 3. Overview of play process described with event ontology

* Vocabularies borrowed from Game Ontology Project
– dgo : Digital GameOntology (our ontology)
– time : Time Ontology
– geo : Geo Ontology
– event : Event Ontology

For production and development related data we use the event ontology concepts to bound a production event as shown in figure 2. Details of who did what part of a game within a production timeline can be recorded. The concept "deliverables" is work package which builds up a game entity or directly used in games (e.g. animation clips, 3D model of certain character) which links to the editorial data of the game.

For description of play, the high granularity of player interaction with the system is achieved by event ontology with the aid of entity manipulation class of Game Ontology Project, as shown in figure 3.

Table 1. Low level description of a very short instant in a battle recorded in video form of the game Armored Core 4 -
http://www.nicovideo.jp/watch/sm2686807

Captured screen	Agent	Entity manipulate	Factor	Statistics	Time
	Player1, robot1	to_target (robot2) *Targeting on robot2	none	AP,robot1,28367 AP,robot2,45764	0:21
	Player1, robot1	to_shoot (robot2) *Shooting robot2	Rifle	AP,robot1,28367 AP,robot2,45764	0:21
	Rifle bullet	hit (robot2) *Bullet hit on robot2	none	AP,robot1,28367 AP,robot2,45214	0:22

*AP = Armor pt

Table 1. demonstrate how a play event is decompose with "entity_manipulation" as unit, while each single action taken or being taken on an entity is established as a sub-event. It was a short instant of a versus play event in 2 seconds time. Player 1 controls robot1, target and lock at robot2, pull rifle trigger and successfully hit robot2 result in armor point deduction to robot2, i.e. damage. This example is simplified, while the granularity of the data can be increased freely with other "entity _ manipulation" concepts. You can record the movement of game entity in space, like robot1 in picture is moving down horizontally with robot2 maintain its height. The status of robot1 changes when it drop its weapon, or the electronic countermeasure value of battle field... Which, when utilizing its highest granularity, can re-construct the whole game world, entity and players' activity as it is played; While in a lower granularity, we can effectively record data we needed to fulfill a certain application or study need.

5. SWRL to cover complex reasoning

SWRL extend OWL-DL with rule language, which enhance the ontology's expressiveness and more intuitive reasoning on complex or fuzzy knowledge.

5.1 Game play rules express in SWRL

Game play rules between two entities can be captured in OWL-DL in a simple manner. But some rules could direct or indirectly relating several game entities, for example, now we want to capture the following rule, "you have character A, which, when equipped with item B and C. attack enemy D with maneuver E, so a critical attack could be achieved."

Rule language like SWRL can be used to represent complex rules as it makes translating such rule into ontology intuitive. The following would be translation of the above game rule, base on our ontology concepts, into SWRL rule language in human readable form.

Character(?a)
∧hasEquipment(?a, ?b)
∧hasEquipment(?a, ?c)
∧event(?x)
∧hasAgent(?x, ?a)
∧attack(?x, ?d)
∧hasFactor(?a, ?e)
→ CriticalAttack(?x)

5.2 SWRL and reasoning of genre

Genre is a time dependent and fuzzy concept which makes it hard to be implemented in multimedia ontology. Design of genre taxonomies and reasoning in DL is very hard to manage as any concepts of a certain media piece can contribute as a defining factor of its genre. [8] SWRL rules, as independent to T-box and ability to express complex rules with intuitive style, could be used to tackle the genre issue in multimedia ontologies. With such, a system is able to clearly define a genre by reasoning on characteristics of the media, study of genre could be enhanced, stronger searching ability to build media service achieving "what you feel is what you get", and also benefits the creators with a better understanding of their audience's needs.

The following example is a rule in human readable form definition of the broadest genre - action game, base on our ontology concepts. "a game about controlling single entity directly is an action game."

Game(?x)
∧ has_locus_of_manipulation
(?x, single_entity_manipulation)
∧ has_manipulation_method
(?x, direct_manipulation)
→ has_genre(?x, Action)

6. Extracting useful information

With the ontology T-box as the base knowledge framework, we can extract useful information and put into A-box of the ontology.

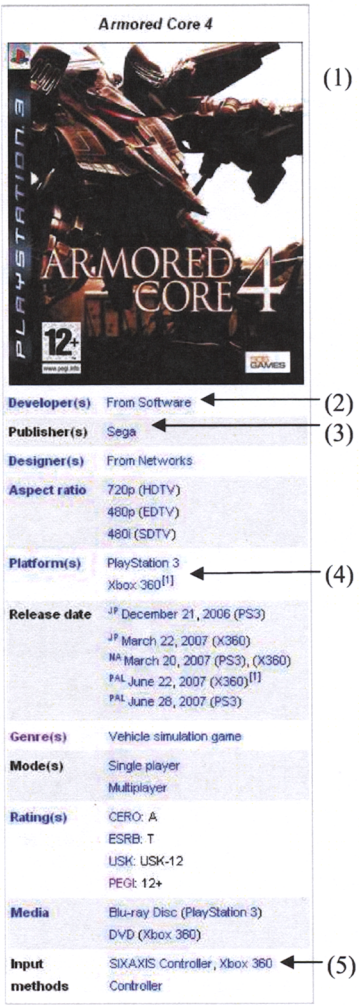

Figure 4. Part of Info-box of Wikipedia entry of Dreamcast game "Armored Core 4" [9] number marked correspond to Figure 5.

6.1 DBpedia as source of editorial data

Wikipedia, compared with other traditional encyclopedia and multimedia database, is a rich information source for multimedia information,

especially for digital games related entries. (Consider the demographics of people on Internet) However, Data inside were basically natural languages without structure.

The project DBpedia, as providing structured form of the data captured from Wikipedia. Instead of retrieving useful information from natural text in the entries, which is kind of fuzzy, basic editorial data is easily imported by extracting game resource through SKOS categories, transfer data from comma separated vector to MySQL, and transfer to A-box through Protégé API. The extracted form of info-box is especially helpful, where most of the basic editorial data is found.

An example of infobox data of a game in Wikipedia is as Shown in figure 4.

Currently this project extracted 11,108 video game titles from DBpedia by SKOS category of video game by years. Information of abstract and label is available to all titles , while basic editorial data like developer, publisher, designer, genre, is directly extractable from infobox list and the result is shown on figure 5. Corresponding info are marked between figure 4 and 5.

6.2 Different approaches of colleting play data

The experience of play covers all the rules and game design information indirectly. By collecting play data, we are not only capturing how the game world is crafted, but also the way player construct a new game universe on top of the game. Such process can reflect if some game design manner is appropriate or used in more origin research on play behavior, i.e. Ludology.

Game play data record in different granularity is supported in our ontology. It can be as simplified as only tells who played the game at what time, for more details the goal of game can be added, on top can record some player actions as sub-events. At the highest level of granularity a complete replay of the play is possible, players' decisions and concerns can be recorded also as a dimension top of the play.

There were efforts of extracting structured information of play from game play videos. [10] However, the process of video annotation would be manual, while strong domain knowledge and understanding of ontology structure to achieve such annotation. For this reason, it is hard for a high granularity play data to be annotated. Events in a very short time-frame or invisible / hardly visible game entities activities would not be able to annotate as well.

To achieve a detailed play event record in high granularity effectively, the best solution would be have the game to output all information the project need. we need to design a standard which unifies the format of output data and concepts used in it referenced on our ontology. The drawback is that we are not able to collect game play data of old games while we do not know if future games developer would like to support our standard.

So it is likely that this project need both approach of play data collection to fulfill our purpose.

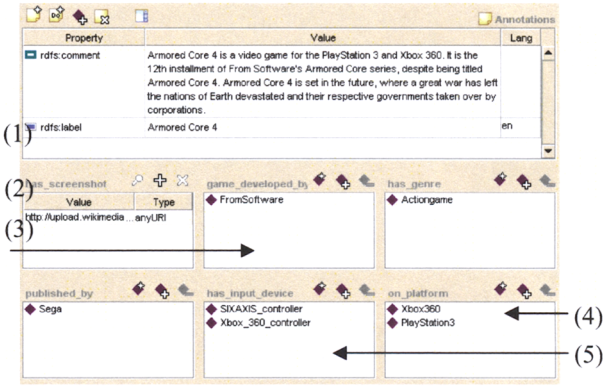

Figure 5. Some extracted information of game "Armored Core 4" into "Game" instance of our ontology, number marked correspond to Figure 4.

7. Future works

The expansion of the general entity manipulation concepts base on behavior studies is to be done, which allows a greater granularity on play event description.

We are concerning every possibilities in applications, like a cross-platform player community portal and or tools assist in studies of game and play.

We would like to design a standard format of game data output that support different granularity of play events, easy to manipulate, which base on the concepts of our ontology.

With a standard output format, the project will establish a portal, which is able to collect large amount of player and their play data, not only referencing basic data of game and rules but also a whole lot more functions, for example, graphical representation of play data, analysis of play flow and thus development of techniques for certain games. This could be an useful application for e-sport players.

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