Specific OWL-based RPG Ontology

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Abstract. *This paper deals with a problem of describing role-playing games in a computer readable format, such as an ontology. Ontology as a model represents a union of gaming, knowledge and artificial intelligence aproaches, and is therefore interesting to research as a description of a domain included in the modern market of role-playing games (and especially massive multiplayer online role-playing games) that have a rich turnover and numerous players available, which makes them a suitable domain to be researched. In this paper an onotology used for describing MMORPGs is presented and discussed along with suggested possible future research.*

Keywords. ontology, multi-agent system, RPG

1 Introduction

Initial idea this paper is going to address is creation of an ontological model suitable for description of a role-playing game (RPG). Motivation for the development of this kind of model comes from the needs of the ModelMMORPG project[1], where the general idea is to develop an intelligent automated computer agents able to interact within their group and in the game, turning into a kind of full-fledged players. Ontology of this kind would contain all the relevant, or even better, all obtainable information about the game and game mechanics, and such a description model might be successfully used when describing a new game or a new environment. Unified model for description of the above mentioned domain allows for easier game comparison, modeling RPG games in idea-state, modeling game-like real-world situations etc.

The ontology developed and described in this paper is based on MMORPG (Massively Multiplayer Online Role-Playing Game) styled game The Mana World[2]. As mentioned in [8], the mentioned game was selected for research on the project for several reasons, including open source nature of the game which allows for

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[1]Project description can be seen at http://ai.foi.hr/modelmmorpg.php

[2]The Mana World description can be seen at https://www.themanaworld.org/

code modification and addition of functionality, existence of a supportive community, standard support for a large number of interaction techniques to be studied, e.g. trade actions, chat amongst players, organized teams called parties etc., and the fact that this is a mostly completed game featuring a lot of quests to be analyzed.

The paper is structured as follows: after introduction in section 1, section 2 contains brief discussion of related work. Afterwards, section 3 describes the ontology featured in this paper, followed by a brief discussion about it in section 4. Possible future work is stated in section 5.

2 Literature Review

In a manner true to the general idea of the Semantic Web, part of which is an ontology as a concept [5], stating the Semantic Web as a concept that is about data formats which allows for common formating of data and integration as well as combination by usage of diverse sources [3], a number of existent ontologies used for describing computer games can be been found.

Ontology devised for description of computer games in general, named Digital Game Ontology, developed in 2008 by Chan and Yuen, is an ontology for generic game description, with a goal to *represent most of the related concepts pertaining to a play event instead of game as a piece itself.* [2] This ontology for generic description task uses various ontologies already available throughout the Internet, building on them and borrowing their concepts. Therefore, although suitable for a wide array of games, it is rather vague when dealing with details of a specific genre. Furthermore, the ontology is not available online anymore.

Another ontology aimed at modeling video game related information with main goals of capturing information about in-game events and players, was released in december 2014, and is described in [6]. This ontology uses concepts from various ontologies available online, and can be freely used under an Attribution-NonCommercial-ShareAlike 2.0 Generic licence.

A much more interesting work is presented in [7], containing idea of using RDF (Resource Description Framework, [9]) and OWL to model knowledge

present in a computer game. According to [7], in a game ontology *rather than organizing a game by its characteristics or elements, the elements themselves are organized.* Although the specific computer game style is in accordance with the subject of this paper, sadly the mentioned ontology is rather closed, having a highly constrained list of outer references.

Game description with goal of analysis and game studies was argued by Zagal et al. in [11] with the main purpose of the work being categorization of things that can be seen in a game.

While the mentioned three ontologies can be used to model description of games pertaining to several styles, none of them suggests using information in a way suitable for a computer agent to be able to comprehend the game in enough detail for it to play the given game.

Another ontology available online is created for knowledge modeling of a specific game named Traveller[3].

Therefore, ontology developed through this paper is about The Mana World, but is comprised of concepts spanning various already existing ontologies, honing one of the main ideas of The Semantic Web, allowing an agent to

> start off in one database, and then move through an unending set of databases which are connected not by wires but by being about the same thing. [3]

3   Ontology Development

Developed ontology is constructed using Web Ontology Language (OWL-DL) [10], using Protégé[4] ontology editor in the development process.

3.1   Starting Propositions

Main purpose of the ontology described in the next sections of this paper is to allow a computer agent, developed as an autonomous intelligent agent, to comprehend information available in a specific game called The Mana World. Even though developed specifically for the mentioned game, ontology is developed with universality in mind. According to the development method of an ontology described in [11, 4], the ontology defined in this paper is developed using the most obvious concepts first, refining and revisiting them, as new concepts are discovered, either more abstract or more specific.

A Role-Playing Game (RPG) is a game in which players assume roles of one or more characters in a fictional well defined setting [8]. More specifically, The Mana World game is of MMORPG style - Massively

Multiplayer Online Role-Playing Game, a style blending genres of role-playing video games and massively multiplayer online games, in which a very large number of players play a given game simultaneously often interacting with one another within a virtual world [8].

As is observable in definitions quoted above, unavoidable aspect of RPG and even more so MMORPG games is the player. Further, every player, in order to be a part of the game, must be in possession of a player character, which must be placed in an in-game world, and for the sake of interaction aspect some other characters must be present in the mentioned in-game world. While MMORPGs tend to rely on player-to-player communication and interaction, the world as intended must be developed and moderated by some non-player characters (NPCs) which live in the in-game world, and serve as e.g. information sources for the involved players.

In general, ontology in this paper is based on the Video Game Ontology (VGO) detailed in [6]. Concepts from FOAF (Friend of a Friend) ontology described in [1] are used as well since e.g. players and characters in essence represent persons. FOAF is an ontology for describing people along with their activities, and some basic relations amongst people and objects. Every individual or a group can be described using FOAF, creating a social network without the need for a centralised database.

3.2   Development Process

The most obvious starting point are the concepts with which a player gets in contact first, including players, player characters and non-player characters.

3.2.1   Characters

Containing classes `NPC`, `Mob` and `PlayerCharacter`, representing all non-player characters in the game, all monster characters in game and all player characters respectively, class `Character`, which contains all characters found in-game, is defined as equal to the corresponding class in VGO, therefore as a subclass of a FOAF class `Person`, as depicted by graph on Fig 1. Since one of the main aspects of MMORPGs is cooperation, new class must be added, containing description of players cooperating as a group, i.e. party. Nonexistent in [7], parties are well-suited to be defined as a subclass of FOAF Group concept, as shown in Fig 2.

Including classes from various ontologies, character system of The Mana World is completed using individuals and properties, as shown in Fig 3 below. `Lego` is a real-world player owning character `Luke` who is a member of player party `Spam`. Another individual, `Robin`, is a leader (and by subproperty a member) of the party mentioned.

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[3]Description of the Traveller game can be seen at `https://github.com/makhidkarun/Argushiigi`

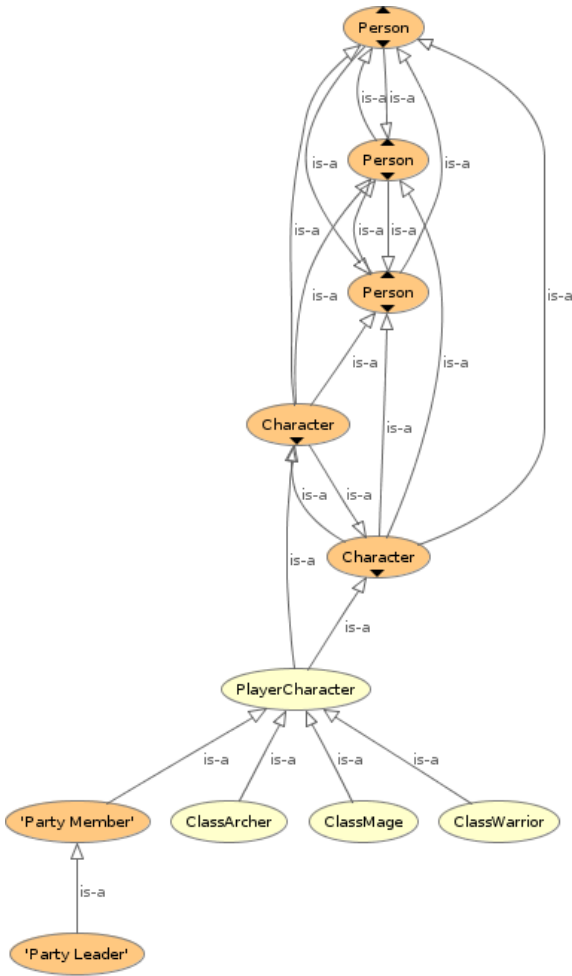[4]More about Protégé can be seen at `http://protege.stanford.edu/`

Figure 1: Character class is heavily related to several classes introduced in FOAF ontology, while classes NPC, Mob and Player Character are by transitivity subclasses of classes Person and Agent

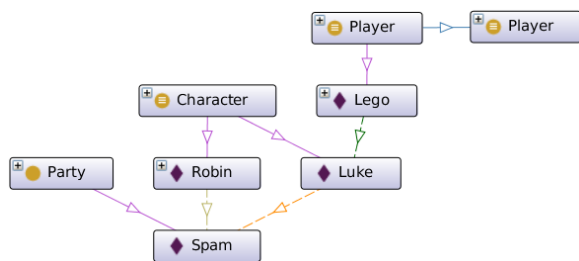Figure 2: Party class is subclass of classes contained in FOAF ontology

Figure 3: Visual representation of simple player-character and player character - player character relations
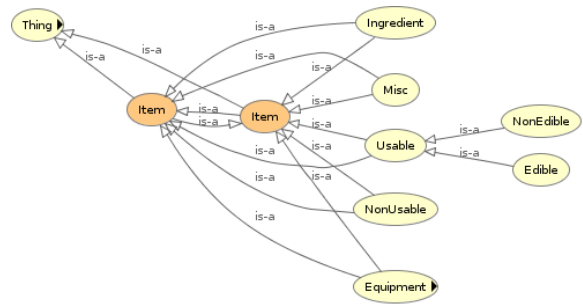

Figure 4: Classification of items

3.2.2 Items

Another crucial part of the MMORPG game (or RPG in general) are items. Obtainable as loot after defeating somebody in a game, as quest rewards, or as craftable items, VGO contains a single class Item, which is further detailed in this paper. Since various styles of items exist in The Mana World, it may prove useful classifying them accordingly, e.g. Equipment, Usable, Ingredients.

SWRL (Semantic Web Rule Language) rules are added to the developed OWL ontology to help item classification process according to their properties. Some of these rules are listed in Listing 1. As defined by SWRL, rules are in general formatted as antecedent → consequent, where both are conjunctions of atoms $(a_1 \wedge \ldots \wedge a_n)$ [4]. Rendered in natural language, rule in line 1 of Listing 1, has the meaning "If something is an item and this something deals some damage, then this something is a weapon." Similarly, line 3 in Listing 1 is rendered as "If something is an item and this something needs something else as an ingredient, and this something else is an item as well, then this something else is an ingredient." Notice there is no atom explicitly denoting difference of *something* and *something else*, but while something can be both an item and an ingredient, no item needs itself as an ingredient.

```
1    drgn:Item(?item), drgn:dealsDamage(?
       item, ?dmg) -> drgn:Weapon(?item)
2    drgn:needsIngredient(?spell, ?ing),
       drgn:Spell(?spell), drgn:Item(?ing)
       -> drgn:Ingredient(?ing)
3    drgn:needsIngredient(?item, ?ing), drgn
       :Item(?item), drgn:Item(?ing) ->
       drgn:Ingredient(?ing)
4    drgn:Item(?item), drgn:canBeEquipedAt(?
       item, ?slot), drgn:InventorySlot(?
       slot) -> drgn:Equipment(?item)
```

Listing 1: SWRL rules used to classify items

Relations of classes containing item descriptions are visually represented in Fig 4. All item classes are subclasses of class drgn:Item defined for this ontology, which is equivalent to vgo:Item class.

3.2.3   Location

While both classes `PopulatedPlace` and `PlayingArea` represent geographical areas, latter is about digital content, referring an in-game world. How these two classes are related with other classes in ontology, is represented in Fig 5. As is visible in mentioned figure, `PopulatedPlace`, a DBpedia[5] ontology concept is in relationship with `drgn:Player` class using `livesIn` property, a concept from VGO. Contrariwise, `PlayingArea` class contains class `Map`, which is in relation with class `Character` using property `isLocatedIn`. Considering `Character` contains only classes and individuals representing digital agents, it is only suitable to conclude that both `Map` and `PlayingArea` classes represent digital concepts as well. Furthermore, `Map` class is a specialization, since `PlayingArea` class by definition contains concepts where gameplay takes place, but on a game-wide level.
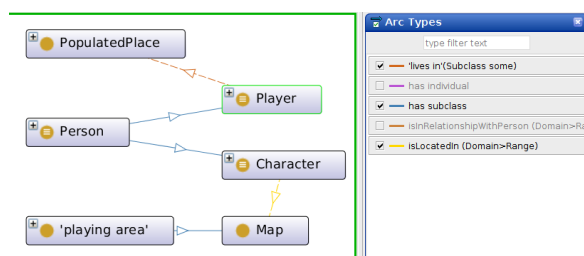

Figure 5: Visual representation of relations of location-based classes, in-game characters and players

3.2.4   Skills

Every player character is defined by its achieved skills and its given character statistics measured in points spent on some of character traits, such as Strength, Intelligence, Agility, etc. The Mana World recognizes three skill categories: basic skill, magic skill and focus skill; and seven character traits: Strength, Agility, Vitality, Intelligence, Dexterity and Luck. While skills can be further enumerated, being the reason to define them as classes (Fig 6), character traits are finite as specified above, and are recorded explicitly in numbers, making data property a more suitable way of documenting them. SWRL rules are used to define player character classes according to player character's respective character traits. Further improvement would be to include achieved skills in rules, yet such a classification would not be possible at the beginning of a game, with newly created character, since skills are achieved during gameplay, while basic character traits (and their intensity) are chosen while a player is creating a new character. Mentioned rules for player character classification are noted in Listing 2.

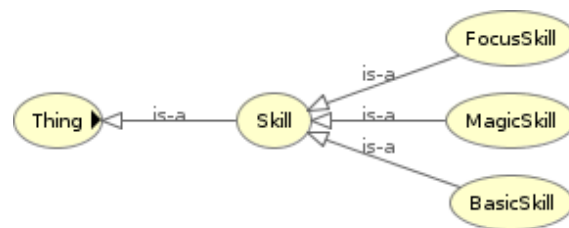[5]Description of DBpedia can be seen at `http://dbpedia.org/about`

Figure 6: Classes containing skill definitions used in The Mana World game

```
1  drgn:PlayerCharacter(?p), drgn:
       hasIntelligence(?p, ?int), swrlb:
       greaterThan(?int, 7), drgn:
       hasStrength(?p, ?str), swrlb:lessThan
       (?str, 5) -> drgn:ClassMage(?p)
2  drgn:PlayerCharacter(?p), drgn:
       hasDexterity(?p, ?dex), drgn:
       hasAgility(?p, ?agi), swrlb:
       greaterThan(?agi, 6), swrlb:
       greaterThan(?dex, 7) -> drgn:
       ClassArcher(?p)
3  drgn:PlayerCharacter(?p), drgn:
       hasVitality(?p, ?vit), drgn:
       hasStrength(?p, ?str), swrlb:
       greaterThan(?vit, 6), swrlb:
       greaterThan(?str, 8) -> drgn:
       ClassWarrior(?p)
```

Listing 2: SWRL rules used to classify player characters

Since player character trait intensity is designated during the player character creation process, each character trait can have intensity $i \in [0,9]$. SWRL provides useful built-in constructs working with number values, e.g. `swrlb:lessThan` [4]. As a combination of SWRL built-ins and OWL classes and properties, rule in line 1 of Listing 2 states that "If something that is a player character, and that something has intelligence of some value, and that value is greater than 7, and that something has strength of some value, and that value is less then 5, then that something is of class Mage." Meanings of other rules of Listing 2 are explained likewise.

3.2.5   Properties

Object and data properties, building blocks of every ontology, are used to further detail concepts contained by ontology classes. Data properties are in this instance mostly used for player character description using various character statistics (including player character traits), basic item description, e.g. price or weight, and basic player or character information, e.g. name or username. Data properties form relations amongst almost all the included concepts. Both property types are used in further inference process, as shown by SWRL rules. Developed properties make this particular ontology more detailed and distinct when compared to e.g. VGO.
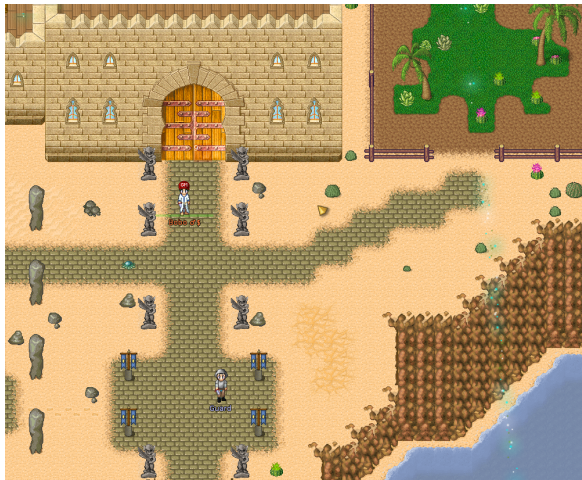
Figure 7: Part of The Mana World in-game

3.3 Particular Example

Example used to demonstrate developed ontology description prowess, developed as a part of ModelMMORPG project, is called *Quest for the Dragon Egg*, situated in The Mana World part of which is shown in Fig 7. The mentioned quest includes several NPCs, e.g. Arch-Wizard, Hermit and Pauline the Witch; several items, e.g. Dragon Egg and Hatching Potion; several monster characters (mobs), e.g. different types of Dragon monster; numerous locations, e.g. swamp and snake cave; and one specific spell.

Arch-Wizard is giver of the quest, and the only place the Quest for the Dragon Egg can begin. Once the given player starts the quest, they must cooperate with other members of their party to create the Hatching Potion and to find the Dragon Egg. Hatching Potion requires various ingredients, including Mauve Herb, White Fur, Leather Gloves and others. Dragon Egg is safeguarded by an Egg Collector NPC which can be found on one of three different maps, never on two places at the same moment. Both Hatching Potion and the Dragon Egg must be brought to the Hermit NPC which will hatch the egg. The given player is then instructed to visit the Arch-Wizard NPC, who will teach the given player how to cast #dovahkiin spell. It is worth noting that while carrying the Dragon Egg, three players must be present within line of sight at all times. These three players are the given player and two named helpers who cannot be changed after once being chosen.

Relationship of the mentioned concepts is depicted and described through the following three examples. Description of an individual is achieved using classes, properties and other individuals as described in this paper and describes most of the selected quest's mechanics. Fig 8 contains a crude description of a player character, its owning player and its situation (having started the quest given by Arch-Wizard NPC located on a party specific map).
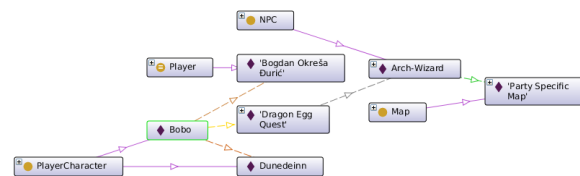

Figure 8: Player character named Bobo belongs to a player with specific name, and has started Dragon Egg Quest by the Arch-Wizard which can be found on Party Specific Game

Last example showing parts of ontology described in this paper is describing NPCs. Graph in Fig 9 shows a quick overview of NPCs involved with the given quest and their respective classes. Furthermore, simple properties (relationships) are displayed and their effect is shown.
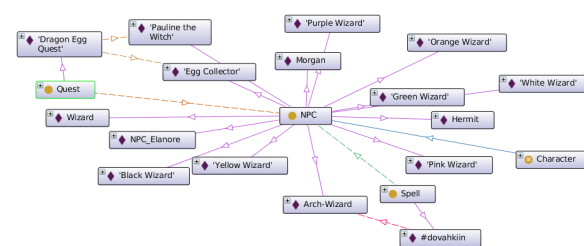

Figure 9: Most of NPCs included in the quest are show here, along with their basic properties and relationships

4 Discussion

Ontology providing description as shown in this paper can be sufficient for gameplay process automatization. Providing autonomous agents are developed which can roam freely in the in-game world, ontology as the one described through this paper would provide them with valuable information on how to navigate through and interact with the given world. Information on where to find a specific NPC, where to look for a specific item, what items are needed for a particular item, which monsters, items and NPCs are involved with some quest - all that is valuable to an autonomous agent is present in the ontology. Enhanced by rules for more potent inferencing, knowledge model of the particular game is usable in communication with digital agents, and real-life players.

Some improvements are bound for a higher quality model. Ontology in this state is unable to express constraints contained in textual description, e.g. two named helpers and their constant presence. Further properties, or even adding new class containing constraints such as the one mentioned, might be able to solve this. Another interesting aspect of the ontology addition might be including class containing com-

bat features, e.g. fire, burning, poison which are then added to appropriate weapons as a fighting effect.

It is evident that ontology covering aspects of one game only is lacking generalization. As such, some details included in this ontology should be removed, or adjusted for another game being described. Elements contained in The Mana World are rather general though. Some specifics, e.g. character race, race-wise weapon constraints, or constraints derived from game-mechanics do not exist, nor are most of them applicable to The Mana World, making this ontology a rather general one. Many of the details included in this ontology are applicable to other RPG style games as well.

5 Conclusion & Future Work

Aside from taking into account elements mentioned above, this ontology is created manually, adding every NPC, item, character and spell individually. Automatization of the process would greatly increase usefulness of this model. Automatic extraction of concepts from the code (since The Mana World is an open-source game) is possible through mapping the code available and concept recognition.

That way, ontology used as a knowledge model for a specific game (The Mana World) might be used in future research of ModelMMORPG project, since it contains all the most important information pertaining to the game mentioned.

Conforming to activities planned during the ModelMMORPG project, developed ontology, with some improvement pending, will be used in development of intelligent autonomous agents, firstly for testing purposes, situated in the world of The Mana World. With their development based on interaction of players with elements of the game and other players, these agents will use an ontology such as the one described in this paper, to comprehend the game, i.e. to understand the world in which they are located.

6 Acknowledgments

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