An Interactive Storytelling Model for Non-Player Characters on Electronic RPGs

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Abstract

Software-based RPG consists of traditional RPG themes and rules. However, the challenge of emulating the universe arises in the context of electronic RPGs. Moreover, such universe must be broad, be populated with interacting characters and allow exploration. Interactive Storytelling (IS) models are able to produce plots and interactive stories showing up proactive intelligent agents. This work proposes an IS model for electronic RPGs that takes into account its traditional counterpart. Our model includes a coherent scenario representation and an action system that considers time lapse. Moreover, it allows the description of autonomic characters which are able to define goals, plans and make decisions. This paper also describes a case study constructed by means of a prototype implementation.

Keywords: interactive storytelling, role playing game, procedural content generation

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1. Introduction

Digital games have potential encompassing the visual and musical arts, as well as issues related to narrative and ludological, *i.e.*, referring to fun [Ware et al. 2014]. Role Playing Game (RPG) emerged in the 20th century as a game of interpretative storytelling in which players gather in groups. Each group has a "master" who tells the story and manages events as well as secondary characters and the antagonists. The other players, on their turn, should interpret the protagonists. Actions and events within the game are described for each player, but those obey rules that determine what is possible for each character. Therefore, there are cases where actions may not succeed because the RPG system comprises a set of rules allowing to simulate success or failure by means of polyhedral dice.

The origin of the RPG is associated with board games and is inspired by the works of Tolkien [Fairchild 2007]. RPG games gave birth to a digital game genre, the so-called electronic RPG. This genre is endowed with the ability to provide adventure and exploration with narrative elements. However, the electronic RPGs have limitations on the exploration of scenarios, interactions and dynamic changes to the plot due the limitations of computational models covering such wide and complex simulations.

A number of studies on Interactive Storytelling (IS) proposed models to simulate the creation of narrative processes and to create autonomous characters who perform and make decisions [Meehan 1976; Ware et al. 2014]. Therefore, such a complex behavior requires modeling characters' goals and how to achieve them. It is also necessary to model their motivations in order to adapt into a digital narrative. That said, IS models can provide a wide range of unfolding resources for electronic RPGs.

These are the main contributions of this paper:

- We propose a model for intelligent agents that emulate characters in electronic RPGs;
- This model is built on top of concepts from IS and it was designed to provide compatibility with traditional RPGs systems;
- Our implementation has abstract, extensible representations of story world elements, such as objects, characters, actions and objectives. As an example, a battle system extending these representations was implemented and incorporated to the proposed model;
- A case study plot was developed and tested by resorting to a wide range of features provided by our implementation.

It is worth noting that the proposed implementation framework allows for further investigations, *e.g.*, the use of Procedural Content Generation (PCG) for electronic RPG and characters' emotional control approaches.

The rest of this paper is organized as follows. Section 2 contains a literature review about related work on RPG and IS, as well as a discussion about definitions and relevant IS models in the context of RPGs. The proposed model is presented in detail during Section 3. Section 4 describes a case study developed for an epic plot and the results obtained. Finally, conclusions about this work and future investigations are found at Section 5.

2. Related Work

Interactive Storytelling can be associated with Procedural Content Generation (PCG) because it is necessary to generate game elements at runtime. Nevertheless, the definition of PCG is broader than generation of characters and answers as it includes physical elements such as vegetation, distribution maps, stories, levels, challenges, buildings, behaviors, sounds etc. In short, PCG can be applied to virtually any game contents. An overview about PCG was made by Hendrikx et al. [2013], where the authors present a remarkable literature review about such techniques in their various approaches.

Within the scope of IS, the first work that focused on an interactive narrative model was the Tales-Spin system developed by Meehan [1976]. He also defined a model [Meehan 1977] that allowed the character to develop plans and targets. The formulated problems are solved by resorting to the Stanford Research Institute Problem Solver (STRIPS) developed by Fikes and Nilsson [1971]. This formulation allows elaborate action plans for agents to seek comprehensive solutions to it. Actions found by the STRIPS standard are atomic, deterministic and can only be caused by the agents. Despite our model does not adopt STRIPS, this standard is important for understanding a myriad of other IS models [Weld 1994; Ware et al. 2014].

Lebowitz [1984] presented the first results on modeling complex characters with interpersonal characteristics. The author focuses on the development of soap-opera narratives while maintaining a coherent and consistent plot. Consistency is defined as the idea that the events shown in the narrative can be logically explained: a consistent story should avoid creation of events with contradictory properties. A similar model can be found in Mateas and Stern [2003]. They proposed Façade, a complex game that addresses fundamental aspects of an interactive experience, such as dynamic character decision making, real-time audiovisual feedback and natural language interaction. More general models were also developed recently, such as Suspenser [Ware et al. 2014; Cheong and Young 2015], that adapts cognitive psychology theories and, in order to manipulate the suspense from the reader's perspective, uses a plan-based model of narrative comprehension to determine the final story.

There are other bibliographical references worthy to mention in the context of this work. Fairchild [2007] analyzes various reading aspects of printed descriptions of RPG, of its handling and of its circulation, in order to discuss how its language effectively supports and performs the power relations through which a particular type of material can be constituted as relevant object for educational purposes. Following that line, Vasques [2008] also studies the potential of RPG as an educational tool.

2.1 Traditional RPG Definitions

The first developed RPGs were inspired by board games and created by Gary Gigax and Dave Arneson. They are acknowledged as the creators of Dungeons&Dragons (D&D), a game based on elements of Tolkien's Middle Earth universe [Fairchild 2007; Vasques 2008]. Other titles were released since the introduction of D&D, each of those with wide variations in how the game was played. However, even with considerable differences within the RPG titles, such titles present two important features that characterize them as RPGs.

The first important feature is a rule set known as “system”. An RPG system numerically describes a character's states and skills plus its mental and physical capabilities. This allows to carry out combat and competition simulations based on polyhedral dice that emulate the expected behavior of successes and failures committed by characters described in the game.

The second important feature is the scenario definition, *i.e.*, the concept of universe that is depicted in the game world. This implies in contextual elements. Some RPGs tend to have physical and political geography elements of the fictional universe, thus displaying a world that create an atmosphere appropriated to the player [Fairchild 2007]. The traditional RPG players have great freedom of interaction with the plot and the outcome within the scene due to the extensive ambiance elements and rules that model the workings of the world. It is important to recall that the players' access to the game universe is interfaced by the master, who will try to adjust the actions within the planned plot. Such concept of freedom in the game matches terms from IS. It is worthy to mention that a challenge is posed to the master: her role is to develop, tell the story and administer the whole scenario. Usually the game master prepares an adventure beforehand and presents “hooks” that should direct the player characters through the adventure.

2.2 Interactive Storytelling Models

Tales-Spin [Meehan 1976] and Universe [Lebowitz 1984] are IS models that address issues from specific narrative genres, more specifically fables and soap-operas, respectively. In that sense, Suspenser [Cheong and Young 2015] improves the generation of stories as a whole. This latter model has intelligent characters and uses heuristics to estimate the quality of narrative that the generated plot aims to provide in terms of reader experience. What these three models have in common is a character modeling, so that characters have the possibility of taking decisions to meet their own goals. The work of Brewer and Lichtenstein [1980] had already predicted that IS models should have agents capable of taking action goals, as well taking subgoals.

Barbosa et al. [2010] presented a model for the decision-making process which includes multiple interest spectra of the characters. This model divides the decision-making process into three stages: goal selection, plan selection and commitment. Each character is represented by a vector set corresponding to attributes that describe the character's guidelines and motivations. Those attributes are used to ponder about the possible actions and guidelines available to emerging situations. Therefore, every situation gives rise to a set of possible actions with attributes related to the character's specific trends, so that the latter can act in a coherent way.

On the other hand, another common feature shared by the general IS models analyzed in this literature review is the adoption of STRIPS for tackling planning tasks. Notwithstanding, an out-of-the-box STRIPS implementation becomes inadequate for real-time interactive applications because it only allows for atomic actions that are forcibly performed in sequence.

Finally, other works on IS tackle problems related to the narrative and discursive elements. However, such topics are out of the scope of the present work since we focus on character action and interaction.

2.3 Interactive Storytelling and RPGs

Electronic RPGs simulate certain rules of their traditional counterparts, especially with respect to: character building, progression systems, adventure and exploration theme. However, electronic RPG presents an usually limited scenario with a predetermined plot since these must suit to the plans elaborated by writers and game designers. Therefore, artistic efforts on building such detailed games try to build an ambiance that promotes immersion in the game's context and atmosphere already do have complex questions on the product itself [Mateas and Stern 2003].

Few productions, such as Dragon Age [2015] strive for obtaining a design and storyline open enough to consider the effects on the plot caused by a wide range of player's decisions. Such concept of plot interference provides an aesthetic quality to the plot, so called as *agency* [Mateas and Stern 2005]. In that sense, there are another two aesthetic categories for interactive stories by these authors: immersion and transformation.

On the other hand, interactive stories can be grouped according to their plots. Ryan [2008] defines three genres in which plots can be categorized:

- **Epic plot**. The protagonists survive in a hostile universe. Epic plots are very common on *Massive Multiplayer Online Role Playing Game* (MMORPG);
- **Epistemic plot**. These plots emphasize the content elements inside the narrative, *i.e.*, the plot gives rise to the explanation or discovery of something. Epistemic plots are usually found in stories about mystery and investigation;
- **Dramatic plot**. Narratives that exhibit strong interpersonal relationships. These plots are considered the most complex to implement from the developer's perspective.

The criteria of plots applied to traditional RPGs would point to heterogeneous approaches even in genres with well-defined styles due to the adaptability of the plot according to the agency ideally performed by players. As an example of this, titles like Forgotten Realms [2015] make use of the D&D system and have strong characteristics of the epic plot for its adventurous approach. However, such titles do not necessarily refrain from epistemic plot to investigations or from dramatic plot for situations requiring further interpretation, especially political issues. Other titles, *e.g.*, Call of Cthulhu [2015], invest in approaches closer to epistemic plot than the dramatic plot because of its basic nature of investigative horror. Consequently, traditional RPG does not necessarily limit gameplay approaches. It is possible to adopt a behavior characterized by either intense action and a shallow plot, or by the other extreme where the player considers interpretation as the most important aspect in the game.

3. Proposed Model

A digital game usually specifies the environment, the characters and the objects which are essential to define actions and their effects in the game. The proposed model in this section considers the freedom and customizations of the traditional RPG, primarily in creating non-player characters and rules that define their interaction with the world. Therefore, this model aims to implement an RPG system, along with part of a decision-making model in order to get a connection between the electronic and the traditional RPG.

3.1 Overview

The model was implemented in JavaScript for use in both web browsers and modern game engines. This also enables future uses of multimedia technologies, as well facilitates code testing and reuse. The project was developed in object-oriented programming (OOP) and and implements part of the D&D system because of its popularity and its open license [OGL 2015]. The following elements are supported by the proposed model:

- **Objects**. Items that characters can carry along themselves. This includes weapons. Each object has the following attributes: name, weight, default value in currency, durability, armor and repair difficulty level. Weapons

have additional attributes, *e.g.*, inflicted damage, damage bonuses, damage reductions and attack range;

- **Character Model**. The most complex element in the model. Each character has its own variables referring to physical attributes, mental attributes, goals, alignment, actions to be performed, skills and the inventory she carries along;
- **Action Models**. Structure responsible for storing and invoking a collection of functions that are used as actions by the characters;
- **Places**. Each place has informations about its length in terms of a radius, its central position in the map, the altitude and the values of average, maximum and minimum temperatures and humidities throughout the year. The places also have a definition of their types, *i.e.*, deserts, valleys, mountains etc, accompanied by a illustrative picture. In addition to the data classifying the place, each specific place also points to the bordering places and eventually to places in which they are contained in. These data are interesting when applying a population inside these places by PCG techniques and also as a reference for geographic actions such as travel, pursuits and generic movement. Using this model, even unlikely environments can be represented without great worries about the detailed layout of each place due to its flexible characterization in relation to space and its features.

Each of the aforementioned elements are discussed in detail through the following subtopics. These elements will be used in a case study. The object model is considered superficial for the purposes of this work and will not be detailed any further. Moreover, we also present a detailed description of the character state model.

3.2 Character Model

As mentioned before, RPG has peculiar means to model and compute both characters' physical and mental capacities. The D&D system features rules regarding not only such states but also expected behavior like the character's tendencies. In D&D, these tendencies are described by two independent alignments: moral and order. The moral tendency is defined by the concepts of good and evil to other characters despite the character itself be following or nbot the rules defines in the fictitious universe. Hence, this alignment can be defined as Good, Neutral or Evil. The order alignment concerns about ethics, that is, how the character tends to follow the defined rules independently from being good, neutral or evil with respect to other characters. Therefore, characters' ethic can assume one of the three following values: Chaotic, Neutral and Lawful. It can be easily seen that characters have nine different tendencies [Cassaro et al. 2005]. In this work we consider a continuous interval ranging from -1 (Evil, Chaotic) to +1 (Good, Lawful) for such alignment attributes, in which 0 means Neutral. This allows for subtle variations that can lead to interesting situations as the narrative evolves.

Character abilities in RPG systems are defined by various attributes. The most important attributes in D&D are: strength (Str), dexterity (Dex), constitution (Con), intelligence (Int), wisdom (Wit) and charisma (Cha). Besides these there are the life points and skill points. In this work we use these attributes as the basis to develop the formalism for action tests and competitions between characters. More complex systems consider other factors that are intrinsic to the attributes in D&D or that were not modeled in terms of them. Examples of these are appearance and sanity. Appearance and sanity can be interpreted by charisma in D&D. Not every character with high Charisma is beautiful, but somehow such characters are pleasing to the others and this may somehow reflect in its beauty. However, sanity is also described by the order alignment, when there is no clear line separating the sane from the insane. Other systems such as *Call of Cthulhu* define charisma, appearance and sanity as independent attributes.

3.3 Action Model

Concerning behavior modeling, some works are devoted to the decision-making process and plan selection [Ware et al. 2014; Barbosa et al. 2010]. In this work, we adopt hierarchical selection for decision-making. Hence, there are major guidelines that have lower guidelines. In their turn, lower guidelines have a state machine implementation of their own actions.

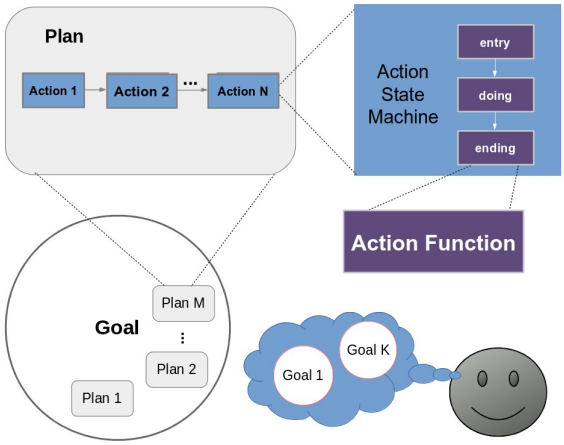


Figure 1. Decision-making process. Each NPC has goals it might achieve by means of different plans. Each plan is composed by actions to be performed in sequence. Finally, each action is performed in three steps. This allows to interrupt actions at anytime, except when the action is explicitly defined as atomic.

In our model, NPCs do not possess complete knowledge about all the possible decisions to make. A number of works from IS assume total knowledge in order to enable the development of prototypes and to build suitable case studies. The actions of our model are not atomic, therefore these can be interrupted at anytime. Our model is depicted by Figure 1. Each character has goals to be selected. Each goal has a list of plans to be considered when the NPC commits itself to achieve that specific goal. Each plan has an action set corresponding to temporary states in which the NPC executes the foreseen actions as functions. This structure is similar to that proposed by Barbosa et al. [2010]. However, our action model suits better to the needs of game developers than a logic definition because actions can be customized in an explicit manner and this process is useful for actual project management purposes.

General goal selection is performed using the concept of *purusharthas* [Barbosa et al. 2010] for defining the fundamental characters' needs and, consequently, their motivations. Four numeric attributes belonging to the [-1,1] range are defined for this purpose, as follows:

- *Duty* describes the sense of having a duty to accomplish. Negative values such as -1 denote the character is inclined to do evil. Conversely, positive values are assigned to benevolent characters;
- *Material* defines how much the character considers material gain in his conduct;
- *Pleasure* tells whether the character seeks for pleasure or self-punishment;
- *Spiritual* describes the level of spiritual or religious commitment from characters.

For plan selection purposes, our model builds on top of the attitude attributes proposed by these authors: *pleasing*, *adaptable*, *outgoing*, *careful* and *self-controlled*. However, these attributes were adjusted in order to adapt them to the character model we propose based on traditional RPG. Therefore, the plan model has the following attributes, all of them belonging to the [-1, 1] range:

- *Alignment_moral* defines how good a character is. This means how much she is willing to help others over herself;
- *Alignment_order* defines the character's tendency to obey rules and norms;
- *Pleasing* determines how much a character is inclinable to perform activities considered unpleasant to herself;
- *Cost* determines the extent to which a character is disposed to spend time and resources in order to accomplish an activity;
- *Risk* defines how much a character can expose herself to danger, harm, or loss.

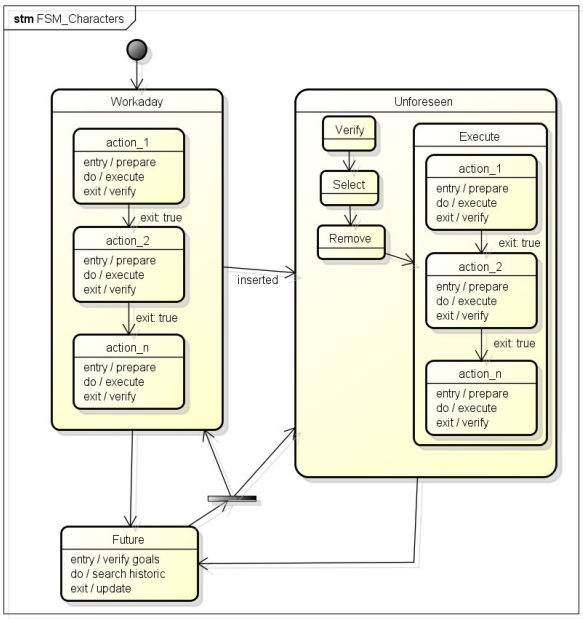
Pleasing was kept from the original model. Careful was replaced by cost and risk since the "carefulness" of a character reflects in her capacity to handle the trade-off between costs and risks when she is selecting actions to be performed. *Self-controlled* is represented by *alignment_order*. The attribute *adaptable* does not possess a direct relationship with the other variables since this variable is intrinsic to the caracter choices. Similarly, *alignment_moral* does not possess such relationship. However, this latter attribute describes a fundamental characteristic for characters' motivation.

We argue that this definition is more suited for NPCs in electronic RPGs, because it has direct influence from models similar to D&D characters in the decision-making. Therefore we advocate that this model better suits to the needs of writers and character designers already familiar to traditional RPGs. These attributes are evaluated by a similatiry function computed between the character's attribute, the goals and the selected plans. This is performed as a sum of products, yielding a inner product as seen in (1). This computation estimates how suitable is an action or goal for a given character.

$$coef = \sum_{i=1}^{n} attrPlayer_i \times attrPlan|Goal_i$$

Equation (1)

3.3.1 Character State Model



other characters. For example, a typical villain will bring forth problems for other characters, i.e., accomplices or the victims of an evil plot.

Finally, there is the intermediary *Future* group. This macro state handles goal updates and the character's internal control variables. *Future* has an entry state that verifies its current goals and claims, checks the the action history for NPCs and performs modifications to the character's state. The FSM model adopted in this

work follows the standard proposed by Buckland [2004]. Therefore, all states have well-defined transitions and each state provide support for *entry*, *executing* and *exit* events. Moreover, our model takes reuses the goals' state implemented in each goal as a bigger state, as can be seen in Figure 2. Hence, a NPC keeps performing daily actions at his Workaday state until being interrupted by another character that puts the NPC in an unforeseen situation which exposes the NPC to the unusual. Consequently the NPC acquires news goals from Unforeseen. Thus a goal shall be selected in order to solve the corresponding new problems.

3.3.2 Character Pseudocode

```
class Character
    // Identifies the Character itself
    String name;

    // Used to simulate actions
    Vector physic_attributes;
    Vector mental_attributes;

    // Used to goal and plan selection
    Vector attributes_select_goals;
    Vector attributes_select_plans;
    Vector emotions;

    // Controls goals, plans and inputs
    Goal workaday, temporary, goal_list;
    Plan current_plan;

    // Social metadata
    Vector relationships;
end
```

Listing 1. Attributes used in the prototype implementation of the character model.

Model implementations are recommended to follow the high-level character structure shown in Listing 1, which is written in pseudocode similar to C++ and Java.

3.4 Environment and Interaction Model

As mentioned previously, the game scenario is designed to support a variable set that defines the environmental features and the localization of each place. These data are a fundamental prerequisite for executing some kinds of actions, and are particularly useful in order to determine the time interval needed for a character to travel between two given locations. Places are interconnected using a graph as aforementioned.

In the proposed model, interactions are performed by passing parameters. Every action referring to two characters require a mutual state check. There are three possibilities in which a given action cannot be performed and consequently is considered unfeasible:

- The two characters are located in different places;
- The target character is in the same location as the other, but the first is out of range;
- Both characters are in the same location but one of them is hiding.

Characters can confront themselves in combat and in skills tests. It should be mentioned that these tests are relatively simple but extensible enough to be used in virtually any kind of interaction. Results form character actions and how well succeeded the characters were will influence their emotional attributes and relationships. These attributes are useful to update the attributes concerning plan and goal selection: thus characters are not immutable. However, the present work does not concern about emotional control since this task is far too complex to be tackled in the scope of this paper.

3.5 Data Structures and Controls

We implemented the decision-making process depicted in Figure 1. Daily goals are stored in a list that is used by each character's actions. Such actions are invoked from a specialized *Method* object implementing methods required by the prototype. For the sake of organization, action execution is broken down into three specific methods responsible for input, execution and output, respectively. Moreover, *methods* are categorized into two types:

- *Action*. These methods are aimed at instilling an action in the world. That is, the character can perform interactions such as talking, fighting, buying, resting etc. These actions take time to be executed, so the corresponding time interval is computed in terms of the prototype system update time;
- *Control*. This type of method handles updates concerning emotions and goals. Control methods must be atomic and immediate since they are effects arising from actions and reactions.

It is worthy to note that, by design, output methods are atomic by default because any performed action may lead to adjustments in the characters' behavior. Moreover, there also intermediate methods linking atomic actions as a series of effects caused from other actions.

4. Experimental Evaluation

A prototype implementation of the model proposed in this work was built using JavaScript. We also developed a case study in order to evaluate how our implementation can be used in practice to endow a plot

with interaction. An epic plot entitled "Dilemma of the Assassin Ninja" was elaborated with this purpose, in which an NPC called Skurai is assigned to kill a warrior called Lebowitz, another NPC. The latter is busy performing his usual activities and goals when he is abruptly interrupted by a surprise attack.

This prototype also implements the D&D combat system in order to simulate interactions between the aforementioned main characters and illustrate that the proposed model is extensible. Moreover, this test plot is populated by secondary NPCs besides creatures and entities imported from the Andargor [2015] database.

4.1 Character Setup

The two main characters were defined according to the following descriptions and attribute sheets.

Lebowitz, the "Warrior Prince":

- He is one of the heirs to the throne, being known as a demanding and cruel tax collector. He is frowned upon by the population for his severity. Lebowitz avoids to commit successive abuses solely because he is afraid of a popular uprising;
- His attributes are **Str** 15, **Dex** 14, **Con** 20, **Int** 9, **Wis** 13, and **Cha** 8;
- He is a Lawful and Evil character;
- His plan selection attributes are **Moral** -0.3, **Order** 1, **Pleasing** 0, **Cost**: 1, and **Risk** -1;
- His purusharthas for goal selection are **Material** 0.8, **Spiritual** 0, **Disposition** 0.4 and **Duty** 1.

Skurai, the "Ninja Assassin":

- A skillfull killer, she trains hard everyday waiting for new missions. She is a mysterious, reticent woman that currently has no worries besides her work;
- Her attributes are **Str** 15, **Dex** 16, **Con** 12, **Int** 10, **Wis** 15, and **Cha** 12;
- She is Lawful and Neutral;
- Her plan selection attributes are **Moral** 0, **Order** 0.5, **Pleasing** -1, **Cost** 1, **Risk** 1;
- Her purusharthas for goal selection are **Material** 0, **Spiritual** 0.2, **Disposition** 1 and **Duty** 1.

4.2 Environment and Initial Setups

In this case study we used a simplified map composed by three places: City A, City B and a road that interconnects these cities. Each main character handles a different situation. The warrior selected the "tax collection" action from his daily routine, therefore he travels from City A to City B in order to collect taxes from another NPC, whose actions are hereby omitted for the sake of simplicity.

In her turn, Skurai was in her daily routine composed by training, feeding and resting when she is assigned to kill the warrior. Consequently, three possible goals come forth in the Unforeseen list, as seen in Table 1. The last column "Res." corresponds to the similarity estimation of how well that plan fits to Skurai's characteristics.

Title	Moral	Order	Pleasing	Cost	Risk	Res.
To kill warrior poisoned	-1.0	-1.0	-1.0	1.0	0.5	**2.0**
To kill warrior lurked	-1.0	-1.0	-1.0	0.8	1.0	**2.3**
Not to kill	1.0	1.0	0.5	0.0	0.0	**0.0**

Table 1. Plan list corresponding to the goal "to kill the warrior" for Skurai. The last column "Res." is the result of inner product used for plan selection.

As shown in Table 1, the maximum value obtained for that specific goal is *2.3* and it corresponds to the plan "to kill warrior lurked". The following matrix expression defines how this result is found,

$$arg_{max}(Plans \times character'_{plans})$$

Equation (2)

where

$$Plans_{3,5} = \begin{pmatrix} -1 & -1 & -1 & 1 & 0.5 \\ 1 & 1 & 1 & 0.8 & 1 \\ 1 & 1 & 0.5 & 0 & 0 \end{pmatrix}$$

$$character'_{plans} = (0, 0.5, \quad 1, 1, 1)$$

It may observed that, if Skurai were more cautious and less confident about her abilities, then she would have different values assigned to her *cost* and *risk* attributes. For example, her plan selection attribute vector could be *[0.0 0.5 -1.0 0.5 0.10]*. As a consequence of this setup, the similarity measure computed for the plans "To kill warrior poisoned" and "To kill warrior lurked" would return *1.05* and *1.0*, respectively. A coherent plan is selected in this case, because there is less risk and more time consumption in the "To kill warrior poisoned" plan.

4.2 Results and Discussion

The prototype produces a detailed text output describing each action taken by the NPCs in their current places. In spite of this test plot having other characters, only the output corresponding to Skurai and Lebowitz were enabled for analysis. These actions are performed at different moments considering the global time passing in the game prototype in terms of updates, as can be seen in Table 2.

At the beginning of the simulation, Lebowitz makes his way to the Road. At the same time, Skurai decides to kill him ambushed. When Lebowitz arrives at the road, Skurai performs a sneak attack. At that moment, a test is performed comparing the warrior's Observe skill against the ninja's Hide skill. When Skurai wins this test, any damage inflicted by her is multiplied by three. Lebowitz gets a goal in *Unforeseen* to protect himself. Since he is put in danger, he must select a plan from "fight back", "escape" and "try to bargain". Accordingly to the many simulations carried out, the warrior usually fights back when he escapes from the sneak attack. Finally, the NPC goes back to its daily routine after winning the struggle.

Update #	Actions
1- 3	Lebowitz walks from City A to Road Skurai hides in Road waiting Lebowitz - cannot attack Lebowitz because he is out of range
4	Lebowitz arrives at the Road Skurai performs a surprise attack - can attack Lebowitz - Skurai hides (18) - Lebowitz tries to observe (12) Skurai and Lebowitz start a combat - Skurai successfully performs a sneak attack - Lebowitz takes 26 of damage - Lebowitz is dead
5	Skurai kills Lebowitz - Skurai returns to her daily routine. Skurai walks from Road to City B
-	Skurai is training
-	Skurai is eating
-	Skurai is sleeping

Table 2. Action log for the case study taken from the moment Skurai hides and waits to kill Lebowitz. In this simulation Skurai successfully kills Lebowitz with a sneak attack. The update numbers for training, eating and sleeping are omitted since these actions take a long time to execute.

It is important to highlight that Skurai is also prone to fail in her task. There are many outcomes possible from this confrontation, especially when she is detected or when she cannot deliver the fatal blow as the combat starts. In fact, different simulations showed such variability that we consider fundamental for electronic games, particularly when the player decides to play again and begins a new adventure. It is also worthy to notice that the proposed model have a more wide range of potential applications.

The prototype implementation does not consider the character's emotional state when performing combat tests, as this may can influence how accurately a NPC can perform her actions. However this prototype allows for plausible, complex agents capable of choosing goals and action plans to achieve them. The experimental results show significant coherence between actions performed by NPCs in the context of an electronic RPG. Moreover, this particular application corroborates that IS modeling techniques can be applied to electronic RPG systems. Therefore, we can conclude that the proposed model can be effectively adopted in games with narrative emphasis.

5. Conclusion and Future Work

In this work we presented a decision-making IS model for NPCs on electronic RPGs and its prototype implementation based on a popular RPG system, along with its combat system. The proposed model supports complex, autonomous characters capable of selecting goals, plans and actions considering global time lapses. This is shown through a study case built on top of our prototype. Moreover, we also implemented the D&D combat system in order to simulate the interaction between two NPCs, which corroborates the extensibility of our prototype.

More specifically, we tried to scrutinize the potential of the decision-making model using an extensible FSM without analyzing post-conditions attributes and preconditions for seeking solutions in the NPC context. We showed experimentally that plausible characters can be modeled using this approach.

There are a number of research opportunities made possible from this work, such as validation and extension. PCG techniques can be investigated in order to populate scenarios with coherent elements, such as places, roads, fauna, vegetation, objects and also characters. The prototype implementation aimed to keep itself as extensible and cross-platform as possible. In fact, we already obtained some preliminary results concerning integration of elements imported from domain-specific databases such as Andargor [2015]. Further investigations on emotional control models like the OCC model [Steunebrink, Dastani, Meyer, 2009] were made possible but have not yet been explored in our research work.

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