

Heroes, Villains, Magicians, ...: Dramatis Personae in a Virtual Story Creation Environment

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ABSTRACT

One difficulty in creating synthetic characters for interactive stories is that these characters must convey their role in the story in a believable way. However, the relation between believability, on one side, and the role a character plays in a drama, on the other, has not yet been fully addressed. In this paper we will present a view on how to develop believable synthetic characters whose behaviour is based on a set of predefined functions (Propp's functions) associated with the role they play in the story. To illustrate the approach, we will present a collaborative virtual environment, *Teatrix*, designed for children to build their own stories-fairy tales. In *Teatrix*, virtual actors play roles (such as villain, hero, magician, etc), which are functional for the development of the story. Such roles have pre-defined goals and plans, allowing the story to flow and climax situations to arise. *Teatrix* is already in use by children ages between 7 and 9, in the context of a Computer-Integrated Classroom scenario.

Keywords

Intelligent agents and agent-based interaction, application-specific intelligent interfaces.

INTRODUCTION

Children as young as three engage in the art of make-believe, exploring the boundaries between the real and the fantastic. The transition from the make-believe play of the preschooler to more structured theatricals is evident in children's efforts to set up little plays [28]. One of the most important aspects of drama is that it provides a type of activity where children engage in a play actively, with several senses. Aristotle refers to this as "enactment", which means to act rather to read [15]. And enacted representations involve direct sensing as well as cognition.

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However, due to its physical grounding, acting is often seen as an activity done independently from the creation of stories and the writing processes. Merging acting, reading and writing into a single virtual environment, and supporting it, was one of the main goals of the research presented here.

The product of such research is a collaborative virtual environment for story creation, *Teatrix*, which provides effective support for young children (7-9 years old) developing: (1) their notions of narrative, through the dramatization of several situations; and, (2) their ability to take a 2nd and 3rd person perspective across the experience of a wide range of situations.

In this paper, we discuss the dramatic personae (characters) within *Teatrix*, a collaborative virtual environment that provides the children with the means for collaboratively creating a story on a virtual stage. The children will create the stories using a set of pre-defined scenes and the defined dramatic personae. Children may control the personae to a certain extent (although some of the characters may be system controlled), and each child expects the story to evolve in reaction to her/his character's actions. However, their characters must act in a believable way according to their role, in order for the story creation environment to engage the children in an entertaining experience, which can meet the child's cognitive needs to interpret, understand and interact with the world in terms of stories [9].

This paper is organised as follows: first we will give a summary of *Teatrix*, then we will present the concept of a "Virtual Dramatis Personae" explain and discuss its implementation in *Teatrix*. Then we will discuss some issues on the control of the personae and the preliminary results of the evaluations being carried out, draw some conclusions and present future work.

THE DESIGN OF TEATRIX

The design of *Teatrix* (see [19], [20]) was grounded on a set of experiences run in the school "*O Nosso Sonho*". During the experiences we observed children of several ages performing fairy tales in different settings: theatre and puppet scenarios. From these experiences we designed *Teatrix*, in such a way that it follows a theatrical metaphor. With this design approach we aimed not only to introduce a completely

new story telling activity but also to support children’s dramatic games and pretend play in a computerised environment. Similarly to [7], we did not want technology to determine the way children performed their make-believe activities but instead to give support to children’s voices. So, the environment is divided in three steps strongly related with children’s dramatic performances (see Figure 1).

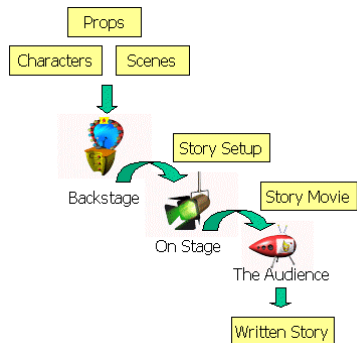


Figure 1 - Phases in Teatrix

A typical interaction with *Teatrix* involves the preparation of a story (*Backstage* option), the acting of the prepared story in a game-like manner (*On Stage* option) and the watching and writing of the created stories (*Audience* option).



Figure 2 – Backstage Option

To prepare a story using the *Backstage* option, children have to:

- (1) Choose the scenes they want to include in their story and link them using what is called an “exit”. To create such links the child just has to connect the exits of two different scenes with a line. For example, Figure 2 shows two linked scenes: *in the forest* and *inside the granny’s house*.
- (2) Choose the props –props have an important role in *Teatrix*, since it is through their use that characters can perform more complex actions in the story world. For this particular example the child dragged

a stick, a basket and some mushrooms into the scene “*in the forest*”.

- (3) Choose the cast – that is, the characters that are going to play in the story. To do this, the child must pick from the list of actors available the ones she wants (Figure 3). In addition to this, the child must also assign a role for the each character. Figure 3 shows a cast composed by: a granny, a girl and a wolf. The girl is the heroine, the wolf is the villain and the granny is the family. (for further details, see section **Functions of the Dramatis Personae**).



Figure 3 - Choice of the Cast for the Story

The result of the *Backstage* phase is a file that contains all the necessary definitions and ingredients for a play to be built. Everything is ready for the acting part (*On stage* option) which will be done in a collaborative 3D world. But, before starting to act out the story or playing the game, as children call it, they have to choose their characters to direct. For example, a child named Paulo is controlling the *wolf* and Sara is controlling the girl (dressed as *Red Riding Hood*). Since three characters compose the cast of the story and there are only two children to play it, the third character - the granny - will be automatically directed by the system.

Before starting the story, and with the teacher’s help, the two children establish an initial situation for their story: “Once upon a time there was a little girl that every day had to go into the forest and pick some mushrooms for her granny’s soup. But the forest was a spooky place where there was a wolf ...”.

When the story starts each child has a different perspective of the scene (see Figure 4). However, if the children’s characters are in the same scene they can see each others’ characters and actions.



Figure 4 – Story world from children’s different point of views (top – Paulo’s point of view; bottom – Sara’s point of view)

The story emerges from the interactions and actions of the characters. The environment establishes a set of 6 actions for all characters: get *item*; drop *item*; talk; walk; activate *item*; and, use *item*. As one can realize, these actions are highly dependent of the objects or props, which means that in order to achieve more interesting interactions, the characters have to find the props that would help them to achieve their goals. The metaphor used is based on the concept of “the character’s bag”, where the character stores the props that it gathers from the world. A character can only use objects stored in its bag. For example, in our story the girl has in her bag a *stick* and when endangered by the wolf, she can use it to hit the wolf (see Figure 5) - the visual effect of such action is provided through the use of a special animation. Meanwhile, the system controlled character (the granny) can be in a different scene and, based on the available predefined actions, the props placed in that scene and her role, will perform a sequence of actions in the story.



Figure 5 – Story scene – the girl hits the wolf with a stick

The story creation process evolves if the children work together to achieve a common goal: their story.

From the story creation process a “film”-like object is created (a file is stored in their workspace). This “film” offers the children with a product, which they can analyse and even to reconstruct in future performances (see Figure 6). Furthermore, the children get much more from an interaction or experience if in the end they will create a meaningful artefact, that they can exhibit as a proof of their individual or collaborative work [22].



Figure 6 – Watching the Story

Therefore, the third phase is based on the artefact produced from the story creation processes. Now, children can be the audience of their own stories and watch their previous performances (as being the *audience or the public* in the theatre). It is also in this option that children have the possibility to write about the stories previously performed. The writing activity is done with the support of some snapshots taken from the story performance. These snapshots are organized in sequence and may also contain some words associated with the story, in order to help the children to write about it (see Figure 7).

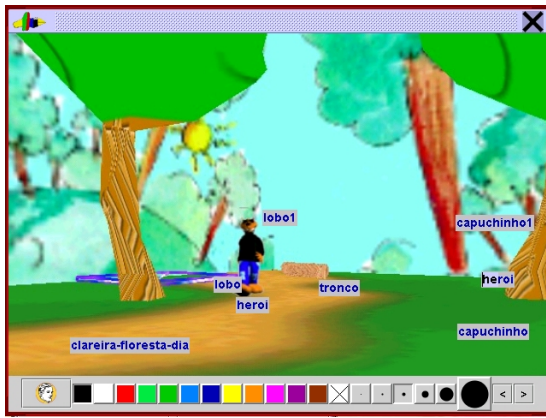


Figure 7 – Story Writing

With this part we want to provide the children with the opportunity of watching and discussing what they've produced. By supporting the discussion of the story we aim to promote a better understanding of the characters interactions, and maybe to encourage the reflection of the children about the emotional and intellectual parts of the story [4].

DRAMATIS PERSONAE IN *TEATRIX*

Interaction with computers should be grounded on the way people interact with each other and with the environment [23]. This goal is driving the research on new types of interfaces and new types of interactions. Indeed, for the past few years we've been witnessing the emergence of a new trend in the interaction between user and Intelligent Interactive Environments: the inclusion of embodied life-like characters and conversational characters (see [6], [17], [18], [25], [29] and [2]). The goals behind this inclusion are, amongst others, the following:

- an animated and personified agent can support in a more active and friendly way the activities of the user;
- the believable-enhancing behaviour can complement other behaviours performed by the agent providing a more human like interaction;
- the animated character can take advantage of its body movements (making explicit references to the world) and expressions, to convey in a more effective way an explanation or an advise to the learner;
- the animated character can, more easily provide an emotional dimension to the interaction;
- the embodied life like character can be the representative of the user to explore a virtual world

In general, work on synthetic characters as believable agents aims at providing characters with a rich personality and emotional states as a way to convey to the user the "suspension of disbelief" [3]. The great master of believability in animation, Walt Disney, once said: "*I think that we must know these fellows (characters in the story) definitively before you can draw them*" [30]. Their physical appearances, their personality, the way they behave, walk and

talk, all are fundamental aspects to make the viewer engage in a truly captivating experience. Indeed, emotion and personality seem to play important roles in the character development. But one must not forget that in stories, such emotional expression also arises from believable "situations". The 7 dwarfs crying for Snow White in the Walt Disney film (see [30]) is an emotional experience, not only because of the characters personalities, behaviour and expressions, but also because of the situation and the function that such scene stands for the development of the story.

The actions of the characters in a play flows from a starting point where an initial complication is established, goes through the climax point, down to the conclusion of the story. In drama studies these three points are part of the Freytag's triangle, which was proposed as the structure of a dramatic incident. In fact, the functions of the actions of the characters and their causality, is according to many writers, one of the most important aspects of a story.

However, if one considers the big computer game industry we realize that many games suffer from a major criticism that their characters are too shallow and not rich enough to lead to an interesting narrative in the story. According to Brenda Laurel "characters are lame in most boys games (...) they are so lame you can't even make up an interesting story about them" [16]. Such lack of depth is related not only with the lack of personality and emotional behaviour of the characters, but also the lack of functionality in the actions of the characters (killing aims only at getting points) and causality of such actions. Previous work on believable characters has focused the need for providing the characters with emotions and personality as a way to achieve more believable interactions and representations. For example, the research conducted within the context of the Improvisational Puppets System showed that children are able to create collaborative fantasy plays by using and controlling different characters with different personalities [11]. However, in interactive stories, the clear role and functions that the characters play in such story must also be considered in order for more captivating interactions to be experienced.

To do that, we developed the concept of "virtual *dramatis personae*" which is a virtual actor with an associated role to play. A role, according to [10] is a class of individuals whose prototypical behaviours, relationships and interactions are known both to the actors and the audience. To develop such notion of a role in an interactive virtual environment, we relied on the seminal work by Propp [24] on folk tales. One of the most important developments of Propp's theory was the description of functions for the characters in fairy tales. By function is meant "*as an act of a character, defined from the point of view of its significance for the course of action*". And, according to Propp: "*functions of characters serve as stable, constant elements in a tale, independent of how and by whom they are fulfilled.*" That is, the functions constitute fundamental elements of a tale.

Based on this, we have created the following roles in *Teatrix* (see Figure 8):

Villain- the role of the villain is to disturb the peace of the happy family, to cause misfortune, damage or harm. The villain may be a dragon, a devil, a witch, a stepmother, or even a little boy or a girl. One of the functions of the villain is the “villainy”. In our example, the villain is the wolf.

Hero/Heroine- introduced in the initial situation. Although Propp considers two types of heroes: the seekers, which go in search of a loved element; and the victimized heroes, whom are themselves the victim of the villainy, in *Teatrix* we do not make that distinction.

Magician (or magic element) - has special functions in the story and it can be represented in many forms. For example: (1) an animal (a horse; a bird; etc); or (2) objects out of which the magical helpers appear (a ring; a lantern; etc); (3) objects with magical properties (a ring; a sword; etc) or (4) qualities or capacities given directly to the hero/heroine.

Beloved one and Family - Usually described in the initial situation, and is often subject to harm by the villain.

Donor (or the provider) - It is from this personae that the hero obtains some agent (sometimes magical), which allows the hero to eliminate the misfortune.

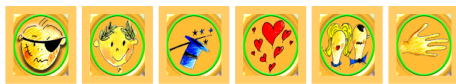


Figure 8 - Icons representing the roles

Functions of the Dramatis Personae

Each role has a set of functions associated to it (see Table 1 for an illustration). For example one of the most important functions of the villain is the *villainy*- that is, the villain causes harm or injury to a member of the family. And this function of villainy is performed independently from actor (that can be a dragon or a even a prince). The actions of the characters are therefore driven by the role that such personae have in the story. However, the characters’ attributes, such as age, sex, physical appearance and physical capabilities are also important, not so as a function in the dramatic sequence (they are used to achieve the functions), but also to convey interesting and captivating interactions. For example, a witch can fly using a broom, independently of being a heroine or a villain, and flying may be an action needed to achieve a goal established by the role of the character.

Role	Functions	Goal	Example
Hero	<ul style="list-style-type: none"> departure on a search reward 	<ul style="list-style-type: none"> find the mushrooms arrive to granny’s house reward=happiness of granny 	Girl
Villain	<ul style="list-style-type: none"> villainy pursuit 	<ul style="list-style-type: none"> to do some actions in order to injure the other characters (in particular the hero) to enter in direct fight with the hero to pursue the hero 	Wolf
Family	<ul style="list-style-type: none"> ask the hero for a difficult task 	<ul style="list-style-type: none"> ask the girl for mushrooms 	Granny

Table 1- Roles, Functions and Goals

The Architecture of the Dramatis Personae

The *dramatis personae* in *Teatrix*’s stories are implemented as intelligent agents inhabiting and interacting in 3D worlds (scenes of the play), which result from the *Backstage* phase. Each of these *dramatis personae* is the conjunction of an **actor** and a **role**. An actor is the physical representation or appearance of a character in the 3D world. From this distinction between actor and role a set of combinations can be achieved, and a wide variety of possibilities can happen.

The architecture to implement these personae is composed of five components (see Figure 9)[19]: the *mind*, the *body*, the *sensors*, the *effectors* and the *inventory*.

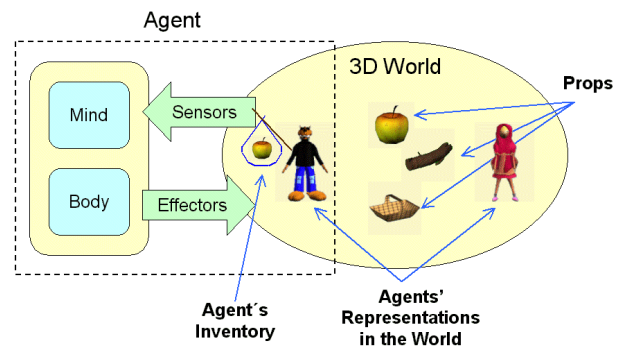


Figure 9 - Characters’ Architecture

Mind

The mind keeps the agent’s knowledge about the *world* (the *world model*) and about itself: the *actions* it can perform, their consequences, its *goals* and its *emotional state* (see Figure 10).

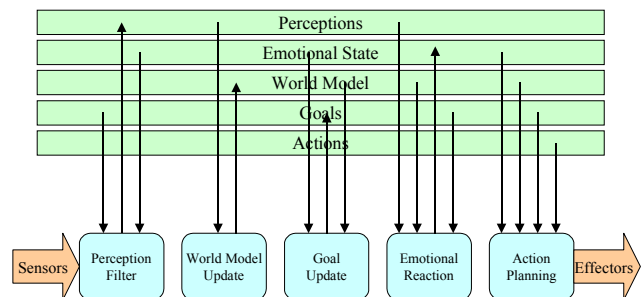


Figure 10 - The Architecture of the Mind

There are five modules manipulating the *mind* knowledge, and the rules defined in each one of them depends on the *actor* and on the *role* chosen. The five modules are:

- **Perception Filter** – determines if a *perception* received from a *sensor* is relevant to the *agent* at a particular moment. If so, the information is recorded in the *current perceptions* component. This process uses information of the current *emotional state* and *goals*.
- **World Model Update** – every time a *perception* about a change in the *world* reaches the *mind* this component assures that an update of the *world model* is done. The *world model* also contains common knowledge about the *world* and its *props* (e.g. the consequences of a *prop's(item)* use).
- **Emotional Reaction** – a change in the *world model* or in the *agents' goals* can cause a change in the *emotional state*; some *perceptions* can also do it (e.g. when the *agent* achieves a *goal* it becomes happier).
- **Goal Update** – the *goals* can change when his vision of the *world* changes. The *emotional state* also influences the current *goals*. For each *role* there is a set of predefined *goals* according to the *role* functions (see Table 1).
- **Action Planning** – The *action planning* component of the architecture is responsible for the decision of which action the *agent* should perform. Planning takes into account the current *goals*, *world state*, the *actions* that can be performed and the *emotional state*. The *emotional state* allows the *agent* to have preferences between actions in certain circumstances. There are two modules in this component: 1) a monitor and 2) a planner. The monitor is responsible for controlling the planning by choosing a goal, searching for a plan, verifying if it has been executed and if needed, build a plan by invoking the planner. The planner uses a partial order planning algorithm together with a set of pre-defined plans associated with each role and function of the personae.

When the mind decides which action to perform it informs the corresponding *effector* to start the execution of that action. If a child controls a character, the mind of the agent has a more passive role. The agent will not act by itself and thus the action planning will be inactive. However, all other components will still be active and the agent will continue to have an emotional state and its own goals. For example, the child may force her/his character to do something against its current goals, and although it performs it, its emotional state will change into a more negative one.

Body

The body controls the representation of the agent in the world, and also its “physical” state, which includes properties such as its height, weight, position in the world, etc. The important properties of the physical state are those, which define the agent movement in the world, its position, velocity and acceleration.

Characters are represented in the world as “sprites”, that is they don't have 3D representations but animated 2D representations. For every action there is an animated sequence of images that represent the agent's action in the world. This representation changes with the actor and the current emotional state.

Sensors

Sensors detect world changes and inform the agent's mind about such changes. An agent knows the effects of its own actions by means of its sensors.

A sensor can filter a world event and not deliver it to the mind. This process simulates the “physical” limitations of the agent. This is different from the perception filtering process of the mind (in this later case filtering means a verification if the agent is “interested” in an event, or not).

Effectors

An *effector* is the component of the agent that knows how to perform an action. So, each action has a corresponding *effector* that contains all the information about the execution of that action.

Actions are executed in three phases. In the first phase the *effector* verifies if all preconditions are fulfilled. This verification is necessary because the world model of the agent can be different from the world, and thus, although the agent believes he can perform an action, that may not be possible in the world.

After such verification the action execution starts. Each step in the execution has a partial effect in the world and is represented on it through the *body*. When the execution ends the *effector* makes sure the action is finalized, performing the correct changes on the *world*. When the performance of an action needs an item to be performed, the *effector* can use the *inventory* contents to fulfil that requirement.

Inventory

The inventory can be seen as a bag where the agent keeps all its objects (props that s/he collects from the scenes). For the active object, the metaphor of *object in hand* is used. If an agent as an *object in hand* and decides to execute the action *use*, the result of that execution is directly defined by the type of the *object in hand*.

Example of Character's Decision Making Process

In our previous example, two of the characters (wolf and girl) were controlled by the children. Consider now a different situation where the wolf was controlled by the system. The wolf is in the forest when the Red Ridding Hood comes in. The wolf agent *Sensors* will capture the information that another agent is in the forest, that is, the Red Ridding Hood. Such information will be send to the *Mind*; it is relevant for the agent because it concerns the hero and the wolf is the villain. The information is stored in the *Perceptions* knowledge component; as the *Perceptions* contents change, the *World Model Update* becomes active and introduces a fact in the *World Model* that states the presence of the Red

Ridding Hood in the forest. The *Emotional Reaction* and the *Goal Update* will see this change in the *World Model*. On one hand the presence of the red Ridding Wood brings excitement in the wolf this change is the responsibility of the *Emotional Reaction*. On the other hand the *Goal Update* computes a new goal for the agent, the wolf is the villain and he has the goal of harm the hero (Red Ridding Hood) so a goal “harm Red Ridding Hood” is produced. As a new goal emerges the *Action Planning* algorithm will try to accomplish it. In the *World Model* there is information about the presence of a stick in the forest (from a previous perception) and that the stick can harm another agent (this knowledge is associated with the stick and its use, and all agents have this global knowledge). From this information the *Action Planning* computes a sequence of sub goals and actions to accomplish them, the current plan: “use stick on Red Ridding Hood” (use action), “get stick” (get action), “go to stick”, (walk action), etc. The action “walk to stick” is chosen so the *Walk Effector* is activated. When the action is finished with success a new perception is generated from the *Sensors* and the mind is informed. Then a new action is chosen and the process continues until the main goal is achieved.

Implementation Details

Most *Teatrix* modules were built in Java, namely the user interface and the core of the agent architecture. The 3D engine of the ‘*On Stage*’ and ‘*The Audience*’ modules was built using the Java 3D [13] library from Sun Microsystems. All 3D *scenegraphs* (e.g. story scenes and items) were modelled in 3DStudio Max [1] and exported to VRML, our elected 3D data format. The mind modules of the agent architecture (see Figure 9) are in JESS [14], which is a Java implementation of CLIPS. The representation of the agents in the 3D world is accomplished by showing some animations on 3D sprite which were created using CharacterStudio [8]. *Teatrix* data productions (e.g. story setups, plays and writings) are stored in XML format, VRML and JESS format.

FIRST RESULTS

Teatrix is already installed in the context of a Computer-Integrated Classroom scenario, and as part of the NIMIS project¹ [12]. Since the middle of March, children with ages between 7 and 9 work together in a distributed environment (see [19] for more details on the distribution mechanism) each one controlling his/her own character.

From the first informal experiences (done with 24 children) we realized that the roles of the characters are well understood, as well as the whole creation metaphor. In general, children like to play with it (they see it as another game they can play together).

This fact is expressed by children’s comments about *Teatrix*:

- *It’s funny, instead of doing the drawings to use in the story we can pick them from a list of characters, things and scenes and in the end we build the story.*
- *It’s a fantasy of heroes and princesses. It’s entertainment in the computer!*
- *Teatrix is a like a theatre, where we can play together. What I like most is the feeling of being inside the characters. In Teatrix we can do things that all others can watch, and that is very important because by this way everybody can participate in the stories.*

They can control the characters using mainly the actions the characters can perform which are selected from the control window (see Figure 5). Using that control, the character will perform the action, even if it is against the goals established by the role (a child controlling a villain may not want it to harm anyone). Although positive, these first informal evaluations also showed that children got a bit disappointed with the control they had over the characters since it did not provide them with the means to develop deeply their character’s performances.

The problem of controlling characters at different levels has already been addressed by [5] and recently by [27]. Similarly, and to overcome our particular problem, we designed another type of control (the “Hot Seating”) that can be seen as a kind of mental control of the character.

The “Hot Seating” method is based on research by Dorothy Heathcote on acting in classroom drama. The idea is that a child is seated on a “Hot Seating”, and she is asked to freeze her character’s actions. She should step out of the character’s behaviour and justify why the character is acting in that way. She can also inspect the emotional state of the character, its role and change the behaviour accordingly.

CONCLUSIONS AND FUTURE WORK

In this paper we’ve presented the concept of dramatis personae as a combination of actors and roles in a virtual theatre. We’ve illustrated such concept within a collaborative virtual environment, *Teatrix*, designed for children to build their own stories-fairy tales. In *Teatrix*, virtual actors play roles (such as villain, hero, magician, etc), which are functional for the development of the story and based on Propp’s morphology of folk tales. Such roles have pre-defined goals and plans, allowing the story to flow and climax situations to arise.

During the month of July another experience was conducted. The results of this second experience are still not completed analysed but our aim is to identify if the children reflect on what they do during the performance and also if the results are reflected in the classroom dramatic games.

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