Ruth Aylett   Mei Yii Lim
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LNCS 6432

# Interactive Storytelling

Third Joint Conference on Interactive Digital Storytelling, ICIDS 2010
Edinburgh, UK, November 2010
Proceedings

Springer

# Lecture Notes in Computer Science 6432

*Commenced Publication in 1973*
Founding and Former Series Editors:
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Library of Congress Control Number: 2010936986

CR Subject Classification (1998): J.5, H.3, I.2.1, H.4-5, K.8.0, K.3, I.7.2

LNCS Sublibrary: SL 3 – Information Systems and Application, incl. Internet/Web and HCI

ISSN 0302-9743
ISBN-10 3-642-16637-7 Springer Berlin Heidelberg New York
ISBN-13 978-3-642-16637-2 Springer Berlin Heidelberg New York



springer.com


Printed in Germany

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India
Printed on acid-free paper 06/3180

# Preface

Novel pervasive, mobile, and interactive graphical technologies underlie a new mode of storytelling—interactive digital storytelling (IDS)—whether in interactive entertainment, computer games, education, therapy or other interactive digital applications. This raises the possibility of redefining the experience of narrative through interactive simulations of computer-generated story worlds. The wide range of papers at ICIDS 2010, held in Edinburgh November 1–3, 2010, was testament to both the number and variety of researchers now investigating this field.

Some papers addressed key theoretical problems in the field: how to reconcile interactivity and narrative structure; how to make complex digital systems accessible to the creative author; what processes and metrics are needed to evaluate the outputs of IDS systems. Others addressed IDS in specific domains: in education; enhancement of automated sports commentary; therapeutic approaches to trauma; location-aware presentation of culture and history; computer games. IDS systems now employ not only conventional desktop systems, but also large-scale immersive display systems, and mobile devices; as well as modalities such as film and video, which remain important sources of knowledge and experience. In a truly inter-disciplinary field, ICIDS 2010 served as a forum for the discussion of ideas, experiences and achievements of researchers with very different ideas and assumptions.

The ICIDS 2010 acceptance rates were 24% for long papers and 46% for both long and short. This reflects the high standards applied by the members of the Program Committee. Posters and demos rounded out the conference to create an atmosphere of interactivity. In addition, seven pre-conference workshops and tutorials allowed more intensive discussion of specific themes.

Three keynote speakers supported the inter-disciplinary range of ICIDS 2010 and the field's natural ties between academic research, the arts and industry. Michael Mateas, from the University of California in Santa Cruz, is author of the ground-breaking interactive story Façade. He addressed how to open up authoring to storytellers who do not want to have to master the detail of a complex computer-based system. Alex Whittaker, a long-standing computer game-developer, now at WeRInteractive, discussed how far interactive storytelling ideas and technologies have penetrated commercial digital entertainment. Finally, Carl Heath, Creative Director of the Swedish organization GR Experiential Learning, presented key elements in the design of the rich and complex social worlds that can be found within live action role plays (LARPs) in the Nordic countries.

We would like to acknowledge and thank the UK AI and Games Research Network and the Scottish Informatics and Computer Science Alliance (SICSA) for their financial support and sponsorship of the event. We would also like to thank

colleagues at Edinburgh College of Art, Edinburgh University Informatics, and in particular Inspace for their unique contribution through the pre-conference event showcasing artistic contributions *Inspace Nobody Can Hear You Scream*, presented on October 31.

ICIDS 2010 was another landmark in a dynamic and expanding research area. We all look forward to ICIDS 2011.

November 2010

Ruth Aylett
Mark Riedl
Paolo Petta

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# The Authoring Challenge in Interactive Storytelling

Michael Mateas

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**Abstract.** Artificial Intelligence methods open up new possibilities in interactive storytelling, enabling the creation of believable characters with rich personalities and emotions, interactive story systems that incorporate player interaction into the construction of dynamic plots, and story generation systems that capture large and well-formed collections of potential stories. The goal of these approaches is not to replace human authorship, but rather to move human authorship to a meta-level, and thus to support a richness and depth of player interaction that is not otherwise possible. However, there are significant authoring challenges in creating AI-based interactive stories. This talk will describe current research efforts to support authors in telling stories in this new medium.

## Biography

Michael Mateas's research in AI-based art and entertainment combines science, engineering and design into an integrated practice that pushes the boundaries of the conceivable and possible in games and other interactive art forms. He is currently a faculty member in the Computer Science department at UC Santa Cruz, where he holds the MacArthur Endowed Chair and co-directs the Expressive Intelligence Studio. With Andrew Stern, Michael released Façade, the worlds first AI-based interactive drama. His current research interests include game AI, particularly character and story AI, intelligent authoring support for interactive experiences, and procedural content generation, including game generation. Michael received his Ph.D. in Computer Science from Carnegie Mellon University.

R. Aylett et al. (Eds.): ICIDS 2010, LNCS 6432, p. 1, 2010.

# From a Winter's Night to a Dragon Age

Alex Whittaker

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**Abstract.** Interactive storytelling has been present at the heart of digital entertainment media for over thirty years, however the breadth of its narrative scope has remained stifled. As computational boundaries are eased, so are many of the perceived technical obstacles to generated narrative content. Furthermore, there is a sense that notable commercial successes are thawing the professional bias towards authored content. Powerful tools that permit vast and complex worlds to be built have mined gameplay in the sandbox genre. With much of the content generated procedurally the designers have still maintained a strong authorial voice. Presenting similar solutions within the narrative scope can win further converts provided that they are sensitive to the commercial requirements. In this presentation we will explore what the digital entertainment industry has done in the field of interactive storytelling, explore where successes might be reinforced and imagine what it might achieve in the immediate future.

## Biography

Alex Whittaker completed a BSc in Genetics at UCL in 1989, he then moved into bioinformatics working with the Cancer Research UK and then Glaxo SmithKline. He completed an AMSc in Artificial Intelligence at QMUL in 1998 and then moved into the games industry working first with Sony Psygnosis on Playstation titles. He went on to work with several other developers including a significant amount of time with Eidos on the Championship Manager franchise. Alex has maintained a strong interest in games and interactive storytelling and is now working in that field for WeRInteractive.

R. Aylett et al. (Eds.): ICIDS 2010, LNCS 6432, p. 2, 2010.

# Designing Social Worlds - On Intrigue and Interaction in Live Action Role Playing Games (LARPS)

Carl Heath

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**Abstract.** The past 20 years have seen Live Action Role Playing evolve to become a complex scene of games in the Nordic countries. The Nordic LARP scene has been a creative, dynamic and experimental environment where questions regarding the design of intrigue and interaction have been explored from many perspectives. Over the past years the knowledge within this subcultural context has spread into several academic fields, into the schools of the nordic countries, to the national theatre stages, into other types of games and also into mainstream media. During this keynote Carl Heath will take us on a journey into this subculture, on an exploratory path aiming to explain key elements in the design of the rich and complex social worlds that can be found within LARPs in the Nordic countries.

## Biography

Carl Heath is the Creative Director of GR Experiential Learning, a part of the Gothenburg Region. He has designed Live Action Role Playing games since the early 90s in genres ranging from fantasy and science fiction to historical to modernistic drama. Among the works produced, of special note is the LARP version of Hamlet, produced in 1999 together with the Swedish National Theatre and the game OB7 in 2003 delving deep into the depths of Swedish cold war politics. Since 2003 Carl Heath works at the Gothenburg Region, where he has lead a team designing educational LARPs and games in general, the last one being an interactive narrative drama within the field of Human Rights Education. During these years he has produced a number of games for organisations such as the Swedish National Parliament, The European Parliament, The European Commission, The Council of Nordic Ministers, as well as several municipal and regional organisations in Sweden.

R. Aylett et al. (Eds.): ICIDS 2010, LNCS 6432, p. 3, 2010.

# MIST: An Interactive Storytelling System with Variable Character Behavior

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**Abstract.** Despite advances in game technology, most stories constructed by game designers remain inherently linear in nature, and player actions often have limited impact on the central story. In interactive storytelling approaches, an important challenge is the creation of stable yet dynamic environments to allow the emergence of unscripted stories involving both human-controlled characters and autonomous non-player characters (NPCs). In this paper, we present an architectural design for creating open-ended, interactive storytelling systems in which story structure emerges in real time and in response to player actions, thus providing a greater variety of game experiences than more scripted approaches. We present a partial implementation of the approach in a virtual environment populated by multiple NPCs that exhibit stable but interesting autonomous behavior. Finally, we present experimental results that demonstrate the scalability of the approach and variability of NPC behavior that it produces.

**Keywords:** multiplayer games, interactive storytelling, virtual worlds, autonomous agents.

## 1 Introduction

During the Artificial Intelligence Summit at the 2010 Game Developers Conference it was suggested that there are three different categories of games: rollercoaster, experimentation, and challenge [1]. Each game category provides players with opportunities to experience stories. Traditional challenge games such as Nintendo's *Tetris* typically contain minimal, designer crafted stories, while recent rollercoaster games such as Activision's *Call of Duty: Modern Warfare 2* and Sony's *Heavy Rain* illustrate the importance of story in modern game design. However, the stories used in rollercoaster games often provide only an illusion of choice and freedom. Typically they are based on linear progression, and player interaction has limited impact on the main story. First person and third person action-orientated genres naturally belong to the rollercoaster category and often use movie-like cut scenes to progress their stories, again in a linear fashion. Experimentation games such as Rockstar's *Grand Theft Auto IV* and Ubisoft's *Assassin's Creed II* often have more open game play, referred to as *sandbox* play.

R. Aylett et al. (Eds.): ICIDS 2010, LNCS 6432, pp. 4–15, 2010.

Players often have plenty of opportunities to make choices in experimentation category games but the choices that they make tend to have limited effect on the game's central story. Typically, branched or layered techniques are used to provide structure to non-linear storytelling [2]. Branched storytelling is a variation on linear approaches whereby players are given choices that affect the direction of the narrative at certain points in the game play, and may enable different endings to be reached. Recent role-playing games (RPGs) tend to use a layered storytelling approach that comprises a central linear or branching story line alongside a range of side stories. Layered stories provide players with a sense of empowerment over the direction of the story. However, the side stories used in this approach often have little or no relevance to the main story, and typically require a large amount of authoring.

In Massively Multiplayer Online Role Play Games (MMORPGs), it is common for many players to experience exactly the same story; for example, a villain is slain by one group of players during a quest, and then revived for a new instance of the quest so that another group can slay the villain again. While there are obvious practical reasons for designing games in this way, the result of allowing resources to be re-spawned is that player actions may have little influence on the main story [3].

Various approaches to maintaining plot coherence have been proposed by interactive storytelling researchers. In *Opiate* [4], for example, players interact with a three dimensional (3D) virtual world, talking with other characters and interacting with objects. The system uses case-based reasoning (CBR) to select the most appropriate arrangement of plot elements for a given story instance, which players must then follow in a linear fashion. *Haunt 2* [5] is a 3D interactive storytelling game in which heuristics are used to guide user interactions within a plot that is abstractly authored in advance. NPCs sometimes carry out plans to satisfy their own desires, while at other times they are assigned tasks by a *story director* in order to progress the plot.

*GADIN* [6] is a text-based interactive system that automatically generates narrative while focusing on dilemma situations between characters. If choices made by the user make the story goal improbable, then the system randomly selects a new story goal that does not involve any further player actions. *Mimesis* [7] provides intelligent narrative control over a 3D world space. A narrative planner generates a plan to satisfy a set of story goals, and player actions that threaten the plan's integrity are either incorporated into the plan or prevented from succeeding by the activation of pre-authored events (e.g., a gun jamming when the player tries to kill a central character). In *I-Storytelling* [8], the user interacts with the system either by influencing NPCs through voice recognition or by hiding objects. Plot coherence is ensured by allowing only NPC actions related to the ongoing story.

The goal that motivates the work presented in this paper is to develop an approach to interactive storytelling in which non-player characters (NPCs) behave autonomously and (multiple) player choices can be supported without compromising the coherence of the plot. In Section 2, we present an architectural design for building dynamic and stable game worlds to support an approach to interactive storytelling in which story structure emerges in real time and in response to player actions. In Section 3, we present a partial implementation of the proposed architecture in a virtual environment populated by multiple NPCs that exhibit stable but interesting autonomous behavior. In Section 4, we present the results of experiments to investigate the scalability of the approach and variability of NPC behavior that it produces. Our conclusions are presented in Section 5.

## 2 Interactive Storytelling in MIST

In this section we describe our approach to the design of MIST (Multiplayer Interactive StoryTelling), a system for interactive storytelling in a dynamic virtual world where NPCs can perform tasks autonomously to satisfy their internal motivations as well as interacting with each other in various ways. An important goal in our approach to interactive storytelling is to provide human controlled characters with greater freedom in the interactions that they choose to perform in the world than would be possible in a strictly plot based approach, particularly with many players logged on to the system.

**System Design.** As shown in Fig. 1, our approach is based on a two-tiered architecture. The lower tier is a virtual world consisting of locations and game objects and populated by players and autonomous NPCs. However, fully autonomous behavior is unlikely to provide sufficient dramatic interest for the user and may result in stories with limited narrative potential. A second tier therefore consists of a Drama Manager which is responsible for ensuring the enactment of stories that it generates by assigning story-related tasks to NPCs. The Drama Manager injects narrative into the game, re-planning in response to world state changes, and generally keeping the game moving towards a valid conclusion. As in *Opiate* [4] and *Haunt 2* [5], stories are represented at an abstract level, enabling them to be applied in different ways depending on the world state. Our approach also allows stories to be personalized by incorporating past player actions (e.g., making friends or enemies). The abstraction of story events helps to provide variability in the plans generated by the system.

**Drama Manager.** The Drama Manager uses an artificial intelligence (AI) planner to generate story plans in response to world state changes. It also uses its (complete) knowledge of the world state to assign tasks to NPCs to assist in story progression. Initially the Drama Manager has a hierarchical network of story elements, which can be pieced together in different ways to form a story. Each story element has a set of preconditions that determine whether or not it is valid for a particular game context. The current state of the game world is passed to the Drama Manager periodically by the game engine. The Drama Manager then attempts to build a story that fits the current world state using its AI planner and network of story elements (e.g., by checking if the preconditions of each story element are satisfied). In the event that no story is valid for the current world state, the Drama Manager assigns special tasks to characters with the aim of reaching a new state in which a valid story can be created.

**Virtual World.** The virtual world contains characters, locations (e.g., lake, forest, shop) and game world objects (e.g., matches, fires). NPCs are instances of professions such as thief, hunter, and woodcutter from which they inherit different behavior profiles. The virtual world is controlled by a game engine that is responsible for displaying the world, updating game world objects, and managing NPC states.

**Non-Player Characters.** NPCs operate under a Belief-Desire-Intention (BDI) framework [9]. One reason for this choice is to promote variability in NPC behavior. An NPC acquires its knowledge about the world from sensors. Internal sensors provide the NPC with knowledge about its possessions, affiliations to other NPCs, current desire, and current location. External sensors provide additional knowledge related to game world objects (e.g., knowledge about items for sale in a shop) and the locations of other NPCs. Knowledge is represented as a list of facts (e.g., *Bob has matches*, *Sam is at the forest*). Facts have different lifetimes depending on the types of knowledge they represent, after which they are removed from the NPC's knowledge base. As shown in Fig. 2, each NPC also has its own AI planner.

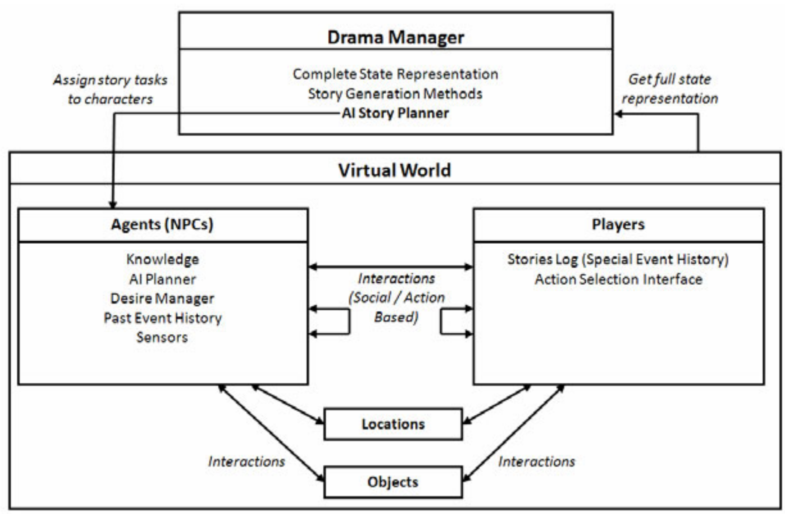



**Fig. 1.** System Architecture

**Character Desires.** Each NPC has the following desire types in order of decreasing priority: get warm, drink, eat, rest, make money, increase safety, socialize, reproduce and increase respect. The priorities are loosely based on Maslow's [10] hierarchy and ensure that an NPC can only have one active desire at a given time (i.e., the desire with the highest priority). Desires are realized as NPC attributes (e.g., heat, thirst, hunger), and each attribute has a current value and a threshold for activation of the desire. As the game progresses, the value of each attribute is modified according to a *decay rate* that depends on the attribute and results in a desire being triggered when the value falls below the threshold. Initially, attribute values and thresholds are set randomly to increase variability in behavior. Also, an attribute's decay rate can be increased (or decreased) to trigger NPC desires more (or less) frequently, for example to prevent NPCs from being stuck in a particular state for too long. Each NPC uses different methods to satisfy its desire to make money depending on its profession (e.g., a thief knows how to steal money or items). As we show in Section 4, this helps to provide variation in NPC actions and movements.

**Character States.** Each NPC is always in one of three states: *exploring*, *relaxing*, or *executing*. We now discuss these states in relation to the AI planner that an NPC uses

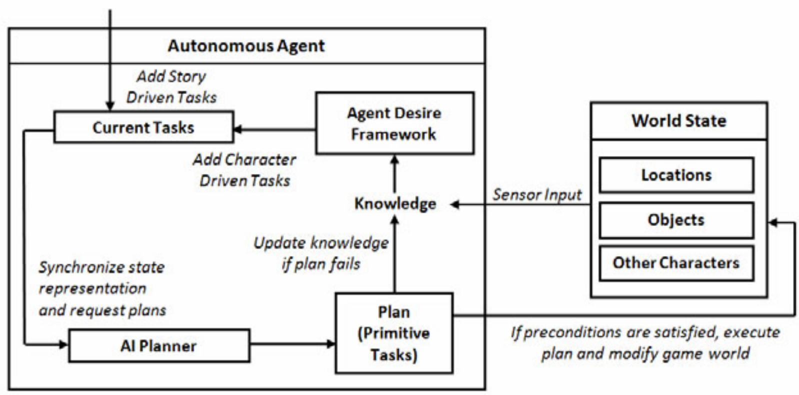



**Fig. 2.** NPC architecture

to generate a plan to satisfy its current desire (if any). Plans are created based on the NPC's knowledge of the world. A plan consists of one or more plan steps. Each plan step is a primitive task that the NPC attempts to carry out (e.g., *walk to campsite*). An NPC generates a new plan to achieve its current desire when one of the following events occurs:

- A desire is triggered by an attribute falling below a threshold value
- An NPC already has a desire and a new fact is added to its knowledge base, or an existing fact is removed
- A plan step fails because of a change of state that is unknown to the NPC

For example, an NPC's plan might be to buy matches from a shop in order to light a fire (e.g., to satisfy a desire to get warm). The NPC knows from a previous visit to the shop that it sells matches. When it reaches the shop, however, the NPC discovers that the shop is sold out of matches and its knowledge is updated accordingly. This triggers a re-planning process, based on the NPC's updated knowledge, which may result in a new plan being generated. While executing a plan, an NPC is in the *executing* state. If an NPC has a desire but does not have sufficient knowledge to generate a plan to satisfy its desire, it adopts the *exploring* state to gather more facts about the world, which should eventually lead to a plan being generated. An NPC that does not have any current desire is in the *relaxing* state. Eventually a desire will be triggered by changes in the NPC's attributes, which are continuously updated by the game engine according to the *decay rate* for each attribute.

**Knowledge Sharing.** Socializing (or conversation) between characters is managed by the game engine. Every six seconds there is an 80% chance that a character will share a fact not already known by another nearby character and a 20% chance that the two characters will say goodbye and depart. This basic mechanism helps to ensure variability in character behavior as well as enabling characters to share knowledge.

## 3 Implementation

In this section we describe our implementation of the two main components of the architecture, namely the AI planner used by each NPC (and also by the drama manager) and the virtual world.

### 3.1 The AI Planner

NPCs in the virtual world use hierarchical task network (HTN) planning [11-12] to create plans to satisfy their desires. In HTN planning, the planner is provided with a task to be performed (e.g., *make money*, *have drink*) and a set of manually authored *methods* for decomposing tasks into subtasks. Initially the main task is decomposed into subtasks according to the methods available for the task. A method can be applied only if its *preconditions* are satisfied. Each subtask is decomposed, if necessary, into a further set of subtasks. This process continues until only *primitive* tasks that can be executed without further decomposition remain. On successful completion of the decomposition process, the list of primitive tasks that have been generated provides a possible plan for performing the main task.

In our approach, all possible plans are generated by the planner and ranked in order of decreasing plan cost. If there is more than one possible plan, the planner returns one that minimizes the total cost of all the primitive tasks in the plan. For example, the cost of walking from one location to another is proportional to the distance between the two locations. Fig. 3 shows a simplified HTN for the task *have drink* that an NPC in the virtual world needs to perform because it is thirsty. Tasks shown with dashed boundaries (e.g., *go to well*) are primitive tasks that can be used as plan steps without further decomposition. Other tasks (e.g., *purify water*) need to be further decomposed. Initially, the items that the NPC has in its possession include a rope, a bucket, a bottle, matches, and sticks.

In this example, the planner has two methods for decomposing the *have drink* task into subtasks. The preconditions of the first method (shown as bullet points in Fig. 3) are *has rope* and *has bucket*, both of which are satisfied. So one possible plan for having a drink is: (1) go to well, (2) fill bucket, (3) drink water. The second method decomposes *have drink* into the subtasks *get some lake water*, *purify water*, and *drink water*. The planner has one method for *get some lake water* and one for *purify water*. As the preconditions of both methods (e.g., *has bottle*) are satisfied, another possible plan for having a drink is: (1) go to lake, (2) fill bottle, (3) go to campsite, (4) make a fire, (5) boil water, (6) cool water, (7) drink water. As the well is close to the NPC's location, the cost of the first plan is less than that of the second plan, so the planner returns the first plan to the NPC.

The HTN planner used in our work is written in Prolog, and the system is implemented with many instances of the planner (i.e., one for each NPC) running in the background and executing on separate threads. The Prolog code is linked with the game engine through DLL calls that allow strings to be passed as input and output.

### 3.2 The Virtual World

Fig. 4 shows a 2D realization of the virtual world. The main window is where game objects in the environment are rendered and NPCs can be seen performing actions to complete their tasks. As each task is completed, an appropriate message is shown near the NPC. A map below the main window shows the current view relative to the rest of the world. Symbols above NPCs indicate the states they are in (e.g., relaxing or exploring). Information about the currently selected game object (if any) is displayed in the pane to the right of the main window. For a selected NPC, it shows the NPC's current knowledge, attribute values, and current plan (if any). Below the main window to the right of the map is the event history for a selected NPC or a global event history if no NPC is selected.

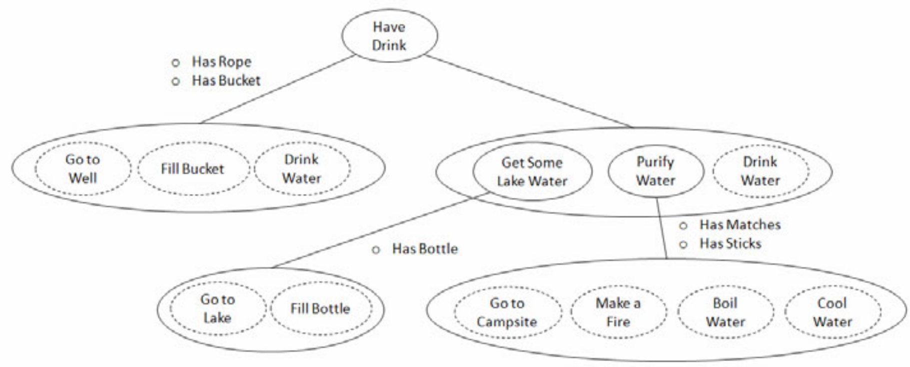



**Fig. 3.** Possible decompositions of an example task in an HTN

## 4 Empirical Study

In this section, we present the results of an empirical study in which we investigate NPC behavior in MIST under various conditions. Our experiments are based on simulations parameterized by the world size, the number of NPCs, and their assigned professions (e.g., woodcutter, berry picker), and the numbers of items and locations in the world. At the start of a simulation, items are distributed randomly throughout the world, either on the ground or in an NPC's possession. Some items can be spawned in the world through actions such as a woodcutter cutting wood or a berry picker picking berries. To satisfy their desire to make money, NPCs often collect these items and sell them to shops, thus creating a supply chain. Other items, such as matches and bottles, are regenerated by restocking shops at regular intervals.

We monitor population behavior in terms of NPC states (i.e., relaxing, exploring, or executing). NPCs relax if they do not have a current desire for anything, they explore if they have a desire but cannot generate a plan with their current knowledge, and they execute plans to satisfy their current desires once they have succeeded in generating a suitable plan.

**Experiment 1.** First we examine the proportions of NPCs in the relaxing, exploring, and executing states for 3 population sizes (100, 200, and 300) in a virtual world with numbers of items and locations fixed at 100. The world is square with a fixed size in the experiment of $10^8$ pixels. The results shown in Fig. 5 are averages over 5 simulation runs. With 200 characters, the *relaxing* state is most prominent as the simulation converges to a stable pattern. However, it does not particularly dominate the other two states. With fewer NPCs (100), the relaxing state tends to dominate as the simulation settles. This indicates a simulation in which NPCs are able to carry out plans to satisfy their desires. For the largest population size (300), the distribution of NPC states tends to be more even, with *exploring* beginning to emerge as the dominant state. Although the distributions of NPC states are different for the 3 population sizes, NPC behavior can be seen to quickly stabilize in all three simulations.

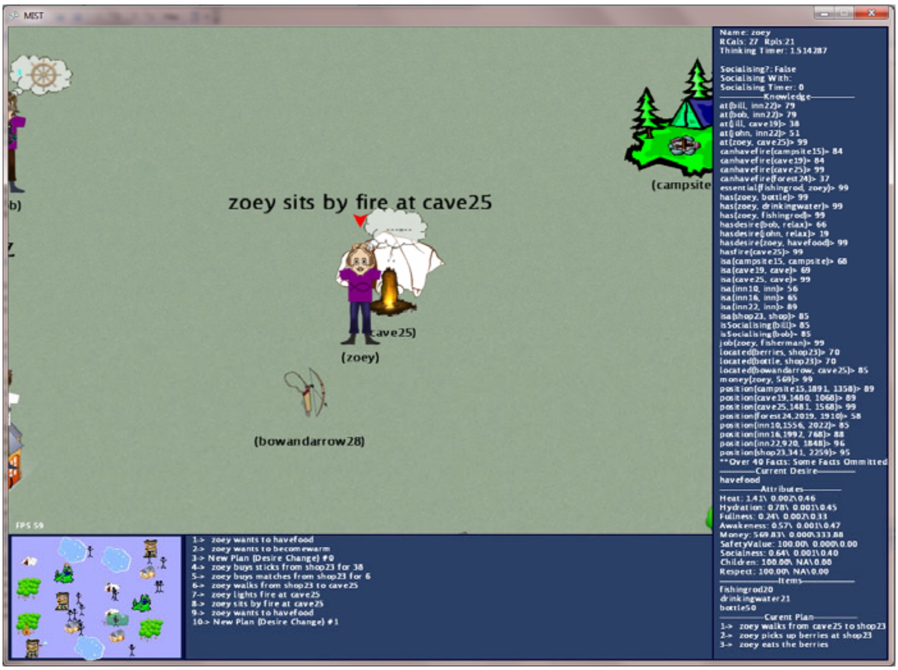
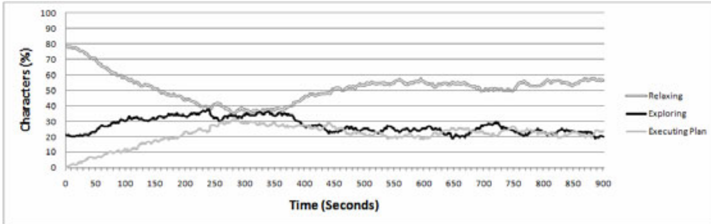


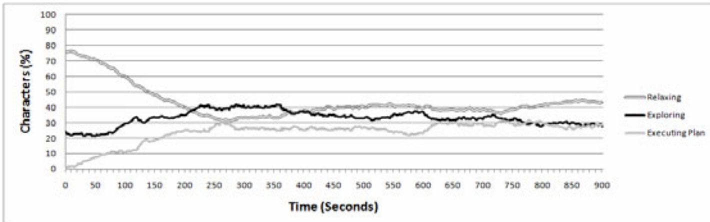

**Fig. 4.** Virtual world in MIST

**Experiment 2.** In this experiment, we investigate population behavior in world sizes of $2 \times 10^8$ and $4 \times 10^8$ while keeping the other world parameters fixed (i.e., 200 NPCs, 100 items, and 100 locations). The results are shown in Fig. 6, again with results averaged over 5 simulation runs. It can be seen that the *exploring* state becomes more dominant as world size increases. This is to be expected as there is more space to cover between locations in the larger world, so that facts used to generate plans may no longer be true on arrival at the final destination. However, population behavior stabilizes quickly for both world sizes.

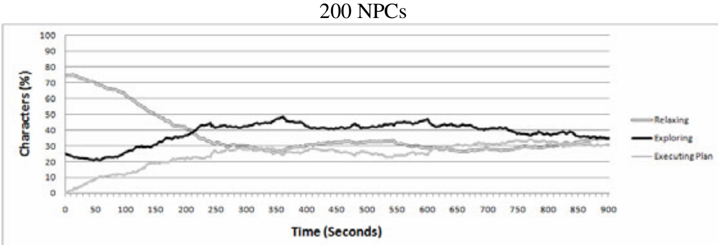
**Experiment 3.** Fig. 7 shows the results of a third experiment in which we vary the number of locations in a world of size $10^8$ from 25 to 125 while keeping the other world parameters fixed (i.e., 200 NPCs, 100 items). Again the results are averaged over 5 simulation runs. When the number of locations in the world is low relative to




100 NPCs

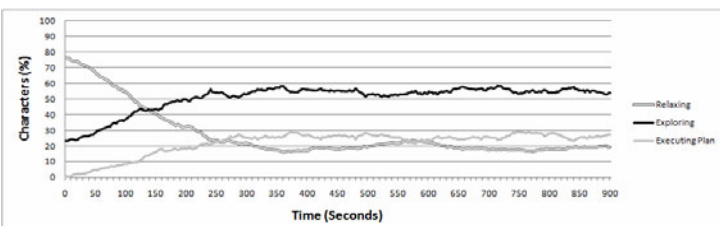



200 NPCs

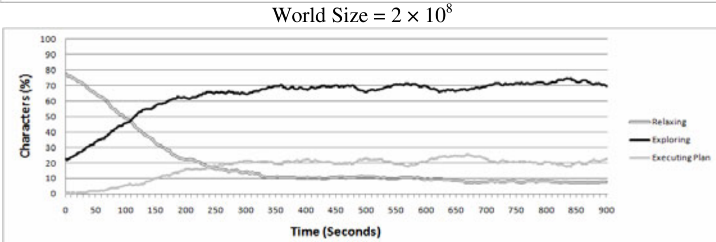



300 NPCs

**Fig. 5.** Percentages of NPCs in relaxing, exploring, and executing states in virtual worlds with 100, 200, and 300 NPCs

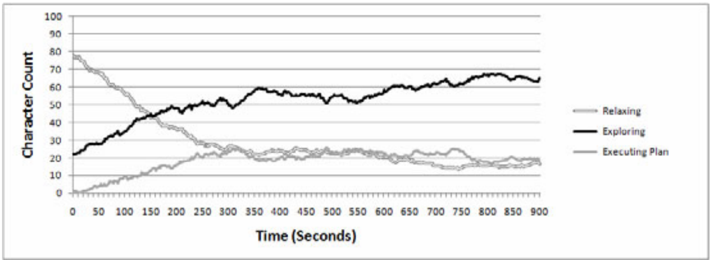



World Size = $2 \times 10^8$

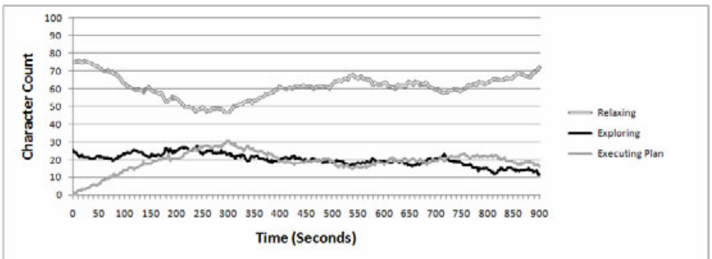



World Size = $4 \times 10^8$

**Fig. 6.** Percentages of characters in relaxing, exploring, and executing states in virtual worlds of sizes $2 \times 10^8$ and $4 \times 10^8$




25 Locations




125 Locations

**Fig. 7.** Percentages of NPCs in relaxing, exploring, and executing states in virtual worlds with 25 and 125 locations

the size of the world, as in the first configuration, most NPCs in the population tend to be in the *exploring* state. However, when the number of locations increases, the pattern of population behavior changes to one in which most NPCs are in the *relaxing* state. Again this is not a surprising result as NPCs can solve their planning problems more easily when there are more locations to choose from.

**Experiment 4.** In a final experiment, we examine the distribution of the number of state changes that NPCs make, as a percentage of the overall population, in a 20 minute simulation with 200 NPCs, 200 items, and 25 locations. The world size in this experiment is $25 \times 10^6$ and results are averaged over 5 runs. The observed distribution of state changes among NPCs in each profession (e.g., woodcutter, fisherman) is shown in Fig. 8. The results provide clear evidence of the variability in NPC behavior; there is some variation between professions and in each profession there is a close-to-normal distribution of the state change count across the full population. Table 1 shows the state change statistics obtained by repeating the experiment with equal numbers of NPCs and items ranging from 50 to 250, the same world size ($25 \times 10^6$), and the same number of locations (25). It can be seen from the results that the distribution of state changes is consistent for all these configurations of the virtual world.

**Discussion.** Our experimental results show the robustness of our simulation for large world sizes populated with many autonomous NPCs. The results also highlight some of the effects of resource levels (i.e., locations / items) available to NPCs on their behavior in large virtual worlds. Too few resources can lead to situations where

NPCs are continually trying to achieve goals. For example, if the world has too few locations for its size, then by the time an NPC has satisfied one desire, another desire may be activated, so that it seldom gets a chance to enter the *relaxing* state. In our storytelling system, we aim to reduce the time spent by NPCs in non-relaxing states (i.e., *exploring*, *executing*) to a reasonable level to avoid the world becoming too chaotic for stories to be effectively conveyed. On the other hand, if the virtual world has too many resources, this may have the effect of reducing the variability of NPC behavior within the population. For example, if a shop always has an item in stock, an NPC that plans to buy the item from the shop will never be forced to generate an alternative plan (except for reasons unrelated to the item's availability).

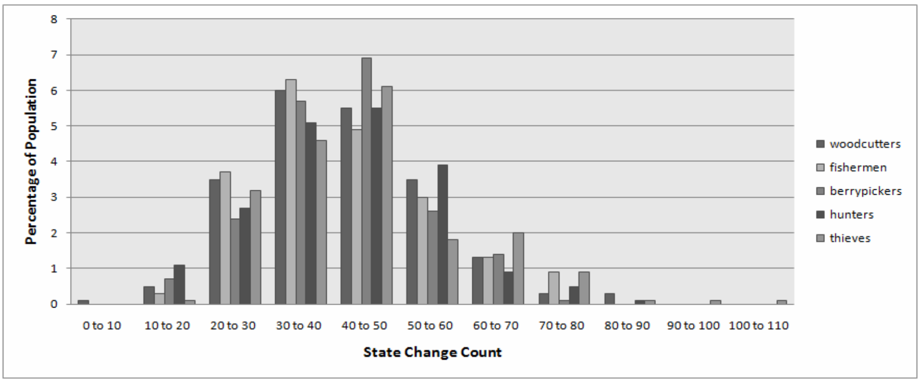



**Fig. 8.** Distribution of state changes in a population of NPCs

**Table 1.** Statistics of state changes for virtual worlds with equal numbers of NPCs and items

| | No. of NPCs/Items | | | | |
|---|---|---|---|---|---|
| | 50 | 100 | 150 | 200 | 250 |
| **Average** | 45.0 | 43.5 | 49.0 | 39.9 | 42.6 |
| **Standard Deviation** | 13.6 | 14.6 | 14.9 | 13.4 | 14.4 |
| **Kurtosis** | 0.54 | 0.60 | 0.99 | -0.003 | -0.43 |
| **Skew** | 0.54 | 0.67 | 0.77 | 0.23 | 0.30 |

## 5 Conclusions

Most game stories are inherently linear in nature, often with plot coherence maintained by restricting player choices and re-spawning resources. The result is that player interactions may have little effect on the central story. In this paper, we presented an approach to interactive storytelling in which story elements change dynamically in response to run-time events in the game world. We also presented experimental results that demonstrate the scalability of the approach and its ability to support autonomous NPC behavior that is stable and consistent with respect to world and population sizes. Multiple player characters will be introduced in future work, and we expect that their actions, like those of NPCs, will have direct consequences in the virtual world, thus enabling stories to be generated and plot coherence to be maintained with no need for re-spawning game objects or constraining player choices.

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# Importance of Well-Motivated Characters in Interactive Narratives: An Empirical Evaluation

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**Abstract.** In order for the author to create his/her intended effects using interactive narratives, the user has to be able to understand his/her experience as designed by the author. In this paper, we argue that a key desideratum for interactive narrative frameworks is to model the characters' motivational consistency during the interaction. This work reports an empirical study for evaluating the importance of using well-motivated characters in interactive narratives. The results demonstrate that inconsistency in the characters' motivations can confuse the user and affect the user's expectations and interpretations of the events in the story.

## 1 Introduction

Narrative is a central part of the human experience. Its power to shape people's minds and affect people's behavior has been recognized throughout recorded history. With the rapid development of computer technology, a new form of media – computer aided interactive narrative has received increasing attention. It allows the user to take a role in a story and interact with other characters controlled by the system. The user's experience forms a unique story based on his/her interactions. The design of interactive narratives is often facilitated by authoring frameworks which can automatically generate the characters' behaviors during the interaction.

In this paper, we argue that a key desideratum for interactive narrative frameworks is to model the characters' motivational consistency during the interaction. In order for the author to create his/her intended effects, the user has to be able to understand his/her experience, i.e. what happened and why it happened, as designed by the author. The coherence of narrative, which refers to the sequence of events in the story having meaningful connections in both temporal and causal ways [11,1], has been identified as a crucial factor for ensuring that people understand their narrative experiences [17,2,8,10]. In the context of social interaction, a story being coherent usually requires the characters in it to be well-motivated. Thus, the characters' behaviors are interpretable to the audience/users.

Thespian is an interactive narrative framework designed with the characters' motivational consistency as a central concern. Thespian uses a two-layer system to drive the characters' interactions with the user. At the base is a multi-agent system comprised of goal-oriented autonomous agents that realize the characters in the story [13]. The

R. Aylett et al. (Eds.): ICIDS 2010, LNCS 6432, pp. 16–25, 2010.

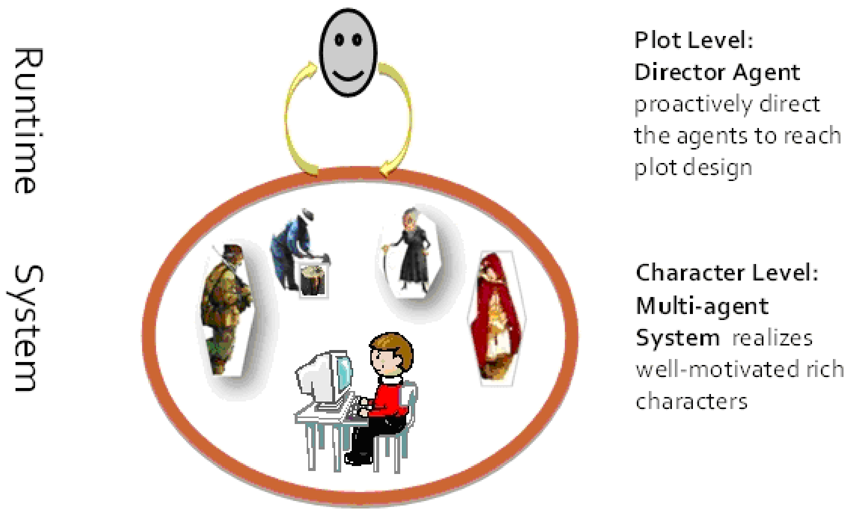



**Fig. 1.** Two-layer System for Interactive Narrative

characters' motivations are encoded as the agents' goals. Above this layer is a proactive director agent that continuously monitors the progress of the story and directs the characters toward the author's directorial goals [14]. Directorial goals are used by the author to indicate how he/she wants the story to progress, such as when an event should happen, or a character should change its belief about another character. Thespian supports directorial goals expressed as a combination of temporal and partial order constraints on the characters' actions and beliefs (including the user's).

A key aspect of Thespian's directorial control layer is that the director agent has access to models of the agents and the user. Automated approaches have been developed to model the characters' motivational consistency during the interaction and prevent broken characters from being created for reaching the directorial goals. Of course, the author can always specify the situations where the characters' motivations change.

In contrast, much of the computational approaches to interactive narratives does not directly address the characters' motivational consistency during the interaction [7,3,9,12,16]. As a result, the author has to either manually exam the huge amount of paths through the story to ensure that the characters' actions are consistent with their motivations, or bear the risk of having inconsistent characters interacting with the user. However, there is no trade off between using well-motivated characters and achieving event design goals – forcing a character to act inconsistently with its motivations to create events in the story will not lead to the author's desired effects. In this work, we report an empirical evaluation on the importance of well-motivated characters in interactive narratives and demonstrate this effect. The stories used in this study were prepared using the Thespian framework. The details of the study and its results are presented in this paper, followed by discussion and future work.

## 2 Empirical Evaluation

This study is designed to exam the effect of having inconsistent characters in interactive narratives. In particular, it evaluates how inconsistency in a main character's motivations affects the user's experience and understanding of the story.

The Little Red Riding Hood story is used as the example domain. The story is implemented using the Thespian framework. The user's role is the wolf.

This section starts by giving a brief description of the event design goals supported by Thespian, which is necessary for understanding the design of the stores used in the study. The rest of the section presents the study's design, procedure, hypotheses, and how the materials for this study are prepared.

### 2.1 Thespian's Support for Directorial Goals

Currently, six different types of goals are supported as listed in Table 1. The author can combine any number of goals defined using this syntax to specify his/her designs of the story. The events in the syntax can be either an action, e.g. "wolf-eat-Granny" or a character's belief, e.g. "wolf: wolf's hunger = 0 (the wolf believes that the value of the wolf's state feature hunger is 0) ". "anybody" can be used in defining actions in directorial goals. It indicates that the corresponding field of the action can be filled with any character, e.g. "anybody-kill-wolf". The approach used by Thespian for achieving directorial goals are discussed in [14], and [15] presents an evaluation of the effectiveness of the approach.

### 2.2 Experimental Design

The study utilized a 2 by 2 between-group design. Two factors were varied: what the author wants the user to experience and whether all characters have consistent motivations

**Table 1.** Syntax for Specifying Directorial Goals

| | |
|---|---|
| orders = | [$event1$,$event2$]<br>$event2$ should happen after $event1$ |
| earlierThan = | [$event$,$step$]<br>$event$ should happen before $step$ steps of interaction |
| laterThan = | [$event$,$step$]<br>$event$ should happen after $step$ steps of interaction |
| earlierThan2 = | [$event1$,$event2$,$step$]<br>$event2$ should happen within $step$ steps after $event1$ happened |
| laterThan2 = | [$event1$,$event2$,$step$]<br>$event2$ should happen after $step$ steps after $event1$ happened |
| NoObjIfLater = | [$event$,$step$]<br>if there is a constraint that requires $event$ to happen, and $event$ hasn't happen after $step$ steps of interaction, the constraint is not valid any more |

during the interaction. Each of the independent variables had two variations. The virtual characters' motivations were either kept consistent or allowed to be inconsistent during the interaction. The two sets of directorial goals listed in Tables 2 and 3 were used for defining two different target effects of the story, as illustrated in Figures 2a and 2b respectively. The first set of directorial goals ideally will create stories in which the user's dramatic experience contains multiple exciting moments, and the climax is reached at the end of the story. The second set of directorial goals tries to restrict the user's experience of dramatic moments to two instances – a smaller spike at the beginning and the climax at the end of the story.

**Table 2.** Directorial Goals I

| | |
|---|---|
| orders = | [[wolf-eat-Granny, anybody-kill-wolf],<br>[Red-giveCake-Granny, wolf-eat-Red]<br>[Red-giveCake-Granny, wolf-eat-Granny]] |
| earlierThan = | [60: [anybody-talkAboutGranny-wolf], 90: [wolf-eat-Red], 120: [wolf-eat-Granny]] |
| earlierThan2 = | [(wolf-eat-Granny, 30, [anybody-kill-wolf])] |
| NoObjIfLater = | [95: [wolf-eat-Granny] |
| laterThan = | [wolf-eat-Granny: 90, wolf-eat-Red: 60] |
| laterThan2 = | [(wolf-eat-Red, 10, wolf-eat-Granny)] |

**Table 3.** Directorial Goals II

| | |
|---|---|
| orders = | [[wolf-eat-Granny, anybody-kill-wolf],<br>[Red-giveCake-Granny, wolf-eat-Red]<br>[Red-giveCake-Granny, wolf-eat-Granny]] |
| earlierThan = | [30: [anybody-talkAboutGranny-wolf], 120: [wolf-eat-Red], 120: [wolf-eat-Granny]] |
| earlierThan2 = | [(wolf-eat-Granny, 30, [anybody-kill-wolf])] |
| laterThan = | [wolf-eat-Granny:90, wolf-eat-Red:90] |
| laterThan2 = | [(anybody-talkAboutGranny-wolf, 50, wolf-eat-Granny)] |

The dependent variables are the type of the story experienced by the subjects and their understandings of the characters' motivations and relationships. To simplify the data collection process, the subjects did not interact directly with the interactive narrative system. Instead, they watched animated interaction histories, and were instructed to imagine that he/she is the user. The subjects' answers of what they think are the user's experience is used as the estimation of the real user's experience. The data were collected through a post-test survey. $\chi^2$ tests were used for examining whether the subjects' answers in different conditions are statistically different[1].

[1] Alternatively, the subjects could directly interact with the interactive narrative system. However, in that case a subject's data would only be valid when the interaction is consistent with the directorial goals; but directorial control does not always succeed (see [15] for details).

**Table 4.** Conditions

| | Directorial Goal I | Directorial Goal II |
|---|---|---|
| Consistent Motivations | Condition I (76) | Condition II (69) |
| Inconsistent Motivations | Condition III (67) | Condition IV (74) |

### 2.3 Procedure

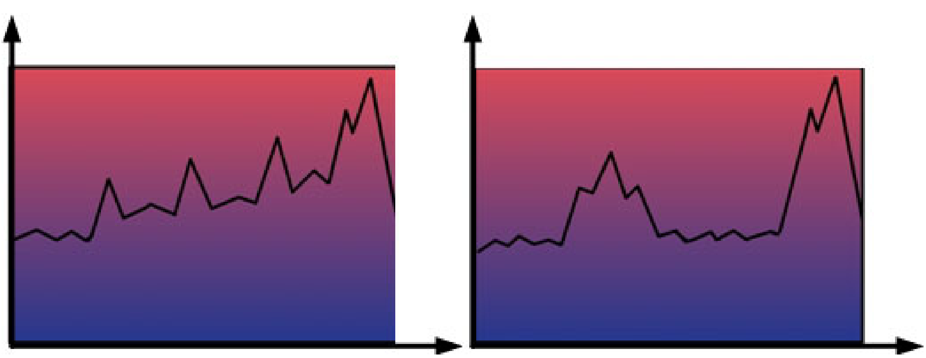
This study was conducted online. Subjects between the ages of 18 and 40 were recruited via the Internet. The recruiting ad was posted at Craglist.com and other similar advertising websites. The subjects were informed that one winner will be automatically selected from every 40 subjects. The winner was awarded a $50 gift card.

The whole study takes around 15 minutes to complete. Subjects were randomly assigned to one of the four conditions, as listed in Table 4. In all the conditions, the subjects first read a background story, then read/watched an animated story, and finally filled out a questionnaire. The subjects were instructed to imagine that he/she is the user, who plays the character wolf, while reading/watching the story. The background story was the same for all the conditions, and the animated story varied for each condition.

### 2.4 Materials

The background story provides the subjects basic information about the characters' motivations and abilities. In particular, it informs the subject that the wolf wants to eat Red and Granny, both the hunter and the woodcutters are capable of killing the wolf. Further, the woodcutter will only kill the wolf if he sees the wolf eating people.

The stories used in the consistent character motivations conditions (Conditions I & II) are recorded histories of human users interesting with Thespian. The director



(a) Curve I (b) Curve II

**Fig. 2.** Event Design of the Story

agent was given the goals listed in Tables 2 and 3 respectively for generating the stories needed for Condition I and Condition II. One interaction history, where directorial control succeeds, is used for each condition. The stories used in the inconsistent character motivations conditions (Conditions III & IV) are replications of the corresponding stories used in the consistent character motivations conditions, with the actor of one key event replaced with another character whose motivation is broken by conducting the action. More specifically, in this experiment the event of Red telling the wolf about Granny's location is replaced with the hunter telling the wolf the same information.

Outputs from Thespian are text-based story composed of dialogue acts. To make it more natural for the user to read, a Java applet was developed to automatically convert dialogue acts to surface sentences, show the story, and illustrate the story with pictures, i.e. show texts with their corresponding pictures.

The post-test questionnaire contains two parts. In the first part, the subjects were asked to choose from the two curves (Figures 2a and 2b) the one that better describes the protagonist's – the wolf's – dramatic experience during the story.

In the second part, the subjects need to fill out a short survey consisting of eight questions based on what they have been shown so far – the background story and the animated story. These questions are designed to collect information on the subjects' comprehension of the story – their beliefs of the motivations of the characters, the relationships among the characters, and the characters' predictions about other characters' behaviors which inform the subjects' understanding of the characters' relationships. Each question is a statement, such as "the hunter will kill the wolf whenever he gets a chance." The subjects need to indicate whether the statement is true, false, or they cannot decide based on what they know.

### 2.5 Hypotheses

The main hypothesis of this study is that the users' experiences and comprehensions of the story are affected by the consistency of the characters' motivations. More specifically, it is hypothesized that regardless of the intended design of the story, in the inconsistent conditions (Conditions III & IV) more subjects will choose the two-spike curve (Figure 2b) to describe the wolf's experience. This is because when the virtual characters' motivations are inconsistent, the event that reveals the inconsistency becomes a significant event of the story. Together with the final scene, in which a character dies, this leads to two major dramatic moments in the story.

The above hypothesis is made based on the assumption that the subjects will notice the inconsistency in the hunter character's motivations. However, it is not uncommon for the audience to be tolerant to broken characters [6]. Therefore, the post-test survey tests whether the inconsistency is detected by the subjects.

The survey contains eight questions, which can be divided into two groups. The baseline questions (questions 2, 4, 5, 6, 8) ask about the relationships between the wolf, the woodcutter, Red and Granny. Their answers should be the same across all conditions. The rest of the questions (questions 1, 3, 7) are the "experimental" questions. They ask about the relationships between the wolf, the hunter and Granny. In the inconsistent conditions (Conditions III & IV), the hunter voluntarily provides Granny's location to the wolf. If the subjects paid attention to this unusual event, they are likely to feel confused about the characters' relationships, and believe that the hunter has a wrong expectation about the wolf or the hunter has a bad relationship with Granny. Therefore, the subjects' answers to the "experimental" questions inform whether the inconsistency in the hunter's motivations is noticed, which would affect the prediction of the main hypothesis.

Finally, no hypothesis is made about how the design of the story (the directorial goal) affects the subjects' understanding of the characters' motivations and relationships.

## 3 Results

The data for this study were collected from 286 internet users in the United States over a 4-week period. Table 4 lists the conditions in this study and the number of subjects assigned to each condition.

The results of this evaluation confirm the hypotheses. The subjects did notice the inconsistency in the hunter's motivations. Further, when the characters' motivations are inconsistent, more subjects chose the two-spike curve (Figure 2b) to describe the wolf's experience regardless of the design of the story. The details of the results are presented below.

### 3.1 Subjects' Experiences of the Story

Table 5 summarizes the subjects' choices of dramatic experience in each condition. It can be observed that inconsistent character motivations lead to more subjects choosing the two-spike curve (Figure 2b) regardless of the design of the story. The subjects' choices in Condition I and Condition III are significantly different ($\chi^2$ = 4.445, p = .04). Similarly, their choices in Condition II and Condition IV are significantly different ($\chi^2$ = 10.285, p = .00).

**Table 5.** Subjects' Choices of the Wolf's Experience

| Condition | Choose Curve I | Choose Curve II |
|---|---|---|
| I | 66% | 34% |
| II | 55% | 45% |
| III | 54% | 46% |
| IV | 36% | 64% |

The results in Table 5 also show that when the virtual characters' motivations are kept consistent during the interaction, the first set of directorial goals realized the author's design of the story better than the second set of directorial goals. In Condition I, significantly more subjects chose Figure 2a ($\chi^2$ = 7.579, p = .01, compared to a 50% - 50% distribution). In Condition II, the subjects' choices were rather random ($\chi^2$ = 0.71, p = .40, compared to a 50% - 50% distribution). Both sets of the directorial goals were designed to create the corresponding dramatic experiences. Multiple reasons may contribute to this result. One possibility is the second set of goals is simply not designed well for creating that experience. It is also possible that because the curve in Figure 2a is a common view of story – Aristotelian tension curve, people may tend to believe or expect that most stories have that structure.

### 3.2 Subjects' Comprehension of the Story

In reporting the results, the data from the two consistent character motivations conditions (Conditions I & II) are merged into one group, and the data from the two inconsistent character motivations conditions (Conditions III & IV) are merged into another group.

**Experimental Questions.** The results of the "experimental" questions are exactly as expected. In the inconsistent character motivations conditions, the hunter not only did not kill the wolf, but also informed the wolf of Granny's location. As a result, more subjects were confused about the relationships between the hunter, the wolf and Granny.

Question 1: "The hunter will kill the wolf whenever he gets a chance."

In the inconsistent conditions, more subjects chose "cannot decide", and fewer subjects chose true. The difference is significant ($\chi^2$ = 371.47, p = .00).

Question 3: "The hunter and Granny don't get along well."

In the inconsistent conditions, more subjects chose true, and fewer subjects chose false or "cannot decide". The difference is significant ($\chi^2$ = 18.37, p = .00).

Question 7: "The hunter knows the wolf will always eat people whenever it gets a chance."

In the inconsistent conditions, more subjects chose "cannot decide", and fewer subjects chose true. The difference is significant ($\chi^2$ = 26.05, p = .00).

**Baseline Questions.** It has been hypothesized that the subjects' answers to the baseline questions are the same regardless of the experimental conditions. This hypothesis is confirmed in the subjects' answers to two questions: questions 2 and 5.

Question 2: "The wolf and the woodcutter are friends."

Overall, the subjects' choices in the consistent conditions do not differ from those in the inconsistent conditions. Most of the subjects chose "cannot decide" ($\chi^2$ = 0.05, p = .98).

Question 5: "Red didn't expect the wolf to eat people."

Overall, the subjects' choices in the consistent conditions do not differ from those in the inconsistent conditions ($\chi^2$ = 3.17, p = .21). The majority of the subjects chose true.

For questions 4, 6 and 8, the subjects' answers in the inconsistent conditions are in fact more consistent with Thespian's model of the story. These results could simply be an artifact. It is also possible that a more deliberate decision-making process was involved in the inconsistent conditions because the subjects felt confused [5,4]. None of these questions directly asks about information provided in the background story or in the animated story. To answer the questions, the subjects need to make inferences based on the information they know. A more deliberate decision-making process can help the subjects to understand the story better and therefore, make more correct choices. Following are the details of the results.

Question 4: "Red doesn't like Granny. She went to visit Granny just because her mum asked her to. She would rather Granny die."

In this story, Red is not modeled as disliking Granny. In the inconsistent conditions, more subjects chose false and fewer subjects chose "cannot decide". The difference is significant ($\chi^2$ = 10.36, p = .01). In addition to the two possible explanations listed above, the fact that Red told the wolf where Granny lives in the consistent conditions may also cause this effect.

Question 6: "The woodcutter didn't expect the wolf to eat people."

In the inconsistent conditions, more subjects chose true, and fewer subjects chose false or "cannot decide". The difference is significant ($\chi^2$ = 17.83, p = .00).

Question 8: "The wolf didn't eat Red at the first place because the woodcutter is close by."

In the inconsistent conditions, more subjects chose true, and fewer subjects chose false or "cannot decide". The difference is significant ($\chi^2$ = 6.63, p = .04).

## 4 Discussion and Future Work

In this study, we used a simple example to demonstrate how broken characters can hurt the achievement of the author's desired effects. The broken character is easy to fix in this case. The author can simply add a special rule in the directorial goals to prevent the hunter from telling the wolf Granny's location. However, to detect all of such broken cases is a difficult problem. Because of the support of user interactivity, there are a huge amount of paths through the story. It is impossible for the author to follow each path and check whether the characters behave appropriately in it. Further, as more behavior rules are added by the author, they may start to conflict with each other. As a result, the author has to either sacrifice the richness of interaction or spend extensive effort to define the characters' behaviors. Therefore, it is a better design of the authoring framework if it contains sophisticated character models that can automatically reason about the characters' motivations while generating their behaviors.

On the other hand, people are also known to be tolerant to broken characters [6]. People may either ignore the inconsistency in the characters or use their own imagination to bring the gap. The latter case may or may not be what the author wants since once the user's interpretation of the story deviates from the author's design, the user's experience is less controlled by the author.

Thespian's default design enforces the characters to always behave consistently with their motivations. The author is allowed to set a threshold for the degree of inconsistency allowed in each character (see [14] for details). In the extreme case, the author can let the director agent ignore the constraint of maintaining consistent character motivations completely. However, currently there is no metrics for computationally assessing what degree of inconsistency in the characters can be allowed for a story. The author has to set the threshold based on experience or trial and error. In our future work, we plan to develop automated approaches and heuristics for helping the author set this threshold.

## 5 Conclusion

This work provides an empirical evaluation on the importance of using well-motivated characters in interactive narratives. In particular, it demonstrates that inconsistency in a main character's motivations affects the user's experience and understanding of the story, and therefore hurts the achievement of the author's desired effects. This result supports the design decision we made in Thespian: modeling well-motivated characters as the basis for generating the interaction and constraining the characters' behaviors with the event design of the story.

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# "I Want to Slay That Dragon!" - Influencing Choice in Interactive Storytelling

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**Abstract.** In this paper we consider the issues involved in influencing a user in an interactive storytelling context using results from the social psychology's area of persuasion. We hypothesize that it is possible to use these results in order to influence the user in predictable ways. Several important concepts of persuasion, such as how people make decisions, and how can we influence that process are discussed. We describe a proposal on how to apply these results in an interactive storytelling setting and describe a small study were we have successfully influenced the players of a story in following a specific path by using an expert source manipulation.

**Keywords:** Interactive Storytelling, Persuasion, Interactive Narrative.

## 1 Introduction

The area of Interactive Storytelling has focused on methods that allow users to experience a story that they feel in control of, while still experiencing it in an author's idealized way. To achieve this goal, most of the work focuses on dealing with user intervention, either by accommodating users' actions into the story, when that is possible, or by disallowing or even changing the expected effect of a user's action to guarantee that the flow of the story as imagined by the author is not disrupted.

One of the central goals for every Interactive Storytelling system is to provide the user with the feeling of *Agency*. Agency "is the satisfying power to take meaningful action and see the results of our decisions and choices" [22]. If we look carefully at this definition, we can arguably conclude that for agency to be truly experienced the user has to be given a choice. Furthermore, the user has to have the intention of pursing a particular course of action over another. Yet, simply providing the user with the opportunity to choose amongst different options does not necessarily guarantee agency. Imagine the extreme situation where each time the user is given the opportunity to choose between different courses of action he/she always chooses randomly without giving any thought to his/her choice (e.g. because he/she does not understand it or because he/she is unmotivated to do so). In that case, even if the user's action shapes the

R. Aylett et al. (Eds.): ICIDS 2010, LNCS 6432, pp. 26–37, 2010.

development of the story, it will look random to the user since he/she did not have any expectations at the time of performing the action.

The time prior to making a particular choice is then critical for the user's feeling of Agency. It is at that time that the user forms the expectations that, if fulfilled, will result in the experiencing of agency.

Imagine now that you could build a system that could influence the user's choices in such a way that the user would not only choose the author-idealized path for the story but would also have the intention to do so. Such a system would have to provide specific stimuli to the user prior to each of his/her decisions that would have a specific impact on which cognitive content was generated by the user at that time. That specific cognitive content would have to be the one used to make the decision on how to act. Such a system would have the added benefit of providing the user with a feeling of *Agency* while having the user act in a predictable way. Furthermore, it could be enhanced with all the existing techniques used to handle unaccounted user intervention [34] [13] [19] since all those methods are employed after the user acts.

As such, we can think of a perfect scenario where a system could dynamically provide the necessary motivations to the user in order for him/her to act in accordance with the story's goals in an interactive story, and in that way mold the user's experience accordingly to the criteria encoded in the system by the author.

In the remainder of the paper will try to provide evidence that this kind of approach is possible and can be applied in the area of Interactive Storytelling.

## 2 Related Work

Research in interactive storytelling focuses on ways to incorporate the user as an active element of the story. This raises many technical challenges, such as the need to maintain a coherent story that conveys an author-idealized message while accommodating the user's actions, even when these do not resonate with the intended story path. This has been described as the *boundary problem* [18].

There are several approaches that have been pursued to tackle this problem. For example, in Mimesis [37] a story is the output of a planner that takes both into account the user and the characters' actions. Each time the user deviates from the plan the system tries to accommodate the user's action by creating an alternative plan that still conveys the author-intended story while incorporating the new action. If that is not possible the system intervenes by changing the incompatible effect of the action [34]. This procedure was coined as *Mediation* of user's actions.

Later, the Mediation procedure was further enhanced by actively searching where the user could break the story in order to adapt the story plan in such a way that those disruptions ceased being possible [13].

In Façade [19] the story is authored in the form of a collection of beats. A beat is an enclosure for a collection of behaviors that describe how the characters will perform throughout its duration. For each beat it is possible for an author to specify how the characters will react to the user. Each user action is interpreted as one of several possible *discourse acts* where each represents a class of possible user actions (e.g. agree, disagree, thank, etc). Additionally to handling the discourse act in a specific beat, the author can also define a global rule to handle the discourse act in a story-wide fashion.

In FearNot! [8] the user interacts by giving advices to one of the characters. The story in FearNot! is represented through a collection of episodes, where in each the content displayed emerges [2] through the interactions between the characters. In between episodes the user can interact with one of the characters by providing advices on how to cope with previous events. The advices influence the behavior of the character which in turn will affect the development of the story.

Research developed in Mark Cavazza's group [7] allows the user to interact with the characters by manipulating resources in the story world or by using natural language to alter the characters' behaviors by proving relevant information.

All these approaches focus on coping with user action in order to incorporate it in the story world. The only exception is Mimesis' pro-active mediation [13] where possible harming paths that can be triggered by the user are disabled by reformulating the story plan.

An alternative approach which focuses on influencing the user by manipulating the perception of scarcity was shown successful in increasing the likelihood of the user following a particular path in a branching story [32].

The approach we propose here involves subtly influencing the user before he/she acts so that when reaching a point where he/she has to make a decision he/she will likely choose the one the author idealized for the story.

## 3 Choice, How Do We Do It?

The area of Persuasion in social psychology focuses on understanding how a message can be made in order to produce attitude change in a particular direction. It can be roughly described as the presentation of a fabricated set of stimuli that will have a predictable effect on the receiver's attitudes (attitudes usually mean general evaluations that are capable of guiding behavioral, affective and cognitive processes).

By changing the attitude of an individual towards performing a particular behavior we can increase or decrease the likelihood of the user performing that behavior [9].

If these processes could be brought to the area of interactive storytelling we would have a way to influence how the user acts in such a way that he/she would more likely comply with the systems's intended course for the story. With the added advantage that if these processes fail, we could still rely on all conventional methods for dealing with improper user action.

One important result in the area of persuasion that is directly related with how we make choices has to do with the cognitive processes elicited by the exposure to a persuasive message (e.g. written, oral, visual, etc). At first it was thought that the effectiveness of attitude change was directly related with the retention of the content of the message [15] [21] [36]. However, this was later disproved by showing that learning does not necessarily produce attitude change (memorizing a persuasive message does not necessarily lead to attitude change in its direction) [14].

As an alternative to attitude change being related to the retention of the content of a persuasive message, it was shown that the change in the direction of the persuasive message is in all related to the cognitive responses elicited by the message. Each time a subject is exposed to a message which requires him to make a decision he/she will employ cognitive effort that will result in the generation of supportive or unsupportive thoughts regarding the position advocated in the message [11] [4]. These thoughts are determinant of the subject's final attitude and can be tested without changing the effect of the message [23].

There is a common technique used in the area of persuasion named thought-listing technique [6] [11] [23], that allows for the assessment of the effects of a persuasive message in terms of attitude change. The procedure involves exposing subjects to a persuasive message and asking them to list the thoughts that were elicited during the exposure. The thoughts are then classified as being in support of, in opposition of, or neutral towards the advocated position. If a message generates predominantly favorable thoughts it is likely to produce attitude change towards the advocated position; if it produces mostly negative thoughts it is likely to produce attitude change contrary to the advocated position.

This technique allows us to produce messages that have a predictable effect on the user, and can be made in such a way that they are employed in important decision points in the story to increase the likelihood of the user complying with the goals of the story. Although the results from social psychology are encouraging with respect to this technique [23] [11], there are other results that are complementary, and demonstrate that it is possible to enhance the effectiveness of this approach. These results will be addressed in the next section.

## 4 Different Cognitive Processes Involved in Decision Making

Initial research in the area of persuasion was marked with disappointment as seemingly all variables tested were shown to have contradictory effects in different studies [14] [20]. The independent variables typically addressed manipulations to source (e.g. credibility, attractiveness, etc), message (e.g. number of arguments), recipient (e.g. prior knowledge) and channel (e.g. written, oral communication). Even variables that intuitively should work (for example, associating a persuasive message with an expert source) produced increased persuasion in some situations [16], had no effect on others [31] and even resulted in decreased persuasion on others yet [35].

Later research was able to incorporate the different results under the same conceptual umbrella by realizing that there are two different cognitive processes that can be used in the decision making process [26]. The first one involves deeply scrutinizing the arguments in a persuasive message and requires that the individual is *motivated* and has the necessary *ability* to do so. In the second, attitude change occurs without the individual looking carefully at the true merits of a message, either because he/she lacks the ability or motivation to do so. In this second process, peripheral cues (such as the expertise of the source of the message) are determinant of the attitude change.

For the first process to occur we need to be both able and motivated to process the message that is relevant to our decision. Imagine you are playing a storytelling game where you have to make a decision that may lead to the main character's wife dying, and consequently you losing the game and having to start over. Imagine that the choice was about which medicine bottle to give her among several choices, and that each medicine bottle had information that you had to understand in order to choose the right one. Because it is a decision with a considerable impact (if done wrong we have to start over) we are likely to truly consider all the arguments that are relevant for our choice amongst our options.

The second process occurs when we lack the motivation or ability to process the relevant arguments. Imagine the decision process employed by a child of young age in deciding about a new toy. Lacking the cognitive skills to truly grasp the benefits of a particular toy over another he/she will rely on cues to make his/her decision, such as which one feels "good" or "bad", or the one that has the most appealing visual characteristics. Surprisingly adults also apply this process. If we had to deeply scrutinize all the arguments in favor and against every decision we make, we would have severe difficulties in handling the demands of our everyday life (cf. [20] "lazy organism"). Returning to the storytelling game example, imagine that we lacked the motivation to deeply consider the arguments in favor of each option, for example, because we could save the game and try each medicine until we got the right one (and therefore avoiding the hassle of having to start over). Since in that situation the importance of making the wrong choice has no considerable impact, we are more likely to base our choice in other factors (cues), if they are presented to us. For example we would probably follow the advice given by a character presented to us as a healer (expert source in medicine) without giving much thought about it.

The theory that first explicitly identified these two different processes is named Elaboration Likelihood Model of persuasion (ELM) [26]. Accordingly to ELM, when we are likely to scrutinize the aspects relevant to the object of our decision, we say that the *elaboration likelihood* is high. Contrary, if we are unlikely to attend to the relevant aspects of the object of decision we say the *elaboration likelihood* is low.

Having this in mind it is important to note that even though we might be able to produce messages (e.g. using thought-listing) that have predictable cognitive responses, they may still be ineffective in gearing the user towards the author's intended direction. To be truly successful in persuading the user it is necessary that he/she not only is motivated but has the ability to process the message or, in the case where he/she is unable to do so, there is a cue (e.g. associating the message with an expert source) that still leads the user to decide in the author-intended direction [33].

### 4.1 Affecting Elaboration Likelihood

As mentioned earlier the effect of the quality of the arguments contained in the message is directly influenced by our ability to understand them and the amount of cognitive effort we are willing to employ to process them. One straightforward manipulation that can be used to affect motivation and therefore the likelihood of the user processing the message is to manipulate the perceived personal relevance/involvement of the advocacy contained in it [24]. For example, in [24] the authors were able to show that personal involvement can be used to manipulate motivation and consequently the likelihood of the message being scrutinized, and therefore enhance the effects of a message when involvement is increased (e.g. a message eliciting favoring thoughts will elicit even more; a message eliciting unfavorable thoughts elicits even more unfavorable thoughts) or decrease the effect of the message by decreasing involvement. In the context of interactive storytelling this could be achieved, for example, by increasing or decreasing the perceived consequences of a decision.

Another way of affecting motivation is through the perception of personal responsibility [30] [17]. Personal responsibility is related to the degree to which the responsibilities concerning a task are shared. This effect manifests itself in most individuals even if the shared responsibility is only illusional [12]. When responsibility is perceived as being shared, people have a tendency to employ less cognitive effort.

There are other ways to affect the amount of scrutiny performed when a subject is exposed to a persuasive message, namely it was shown that moderate message repetition [5] can be useful when the ability to process the message is limited. Also, distraction has been shown effective in diminishing the amount of thought employed in assessing a persuasive message [1] [28]. Distraction has this effect even in moderate amounts (where the subjects can recall as many arguments as if not distracted) [28].

### 4.2 Using Cues

When we have limited ability or lack the motivation to attend to all the arguments in a persuasive message, we rely on cues [26]. For example, if we are expected to make a decision about a subject we know nothing about, but that is presented to us by a source that we identify as an expert, we are likely to report more positive attitudes towards what he/she is advocating [29] [27].

As like source expertise, source attractiveness [29] and the visual prominence [3] have been shown to effectively affect the perception of the message in low elaboration conditions.

Anther useful cue is related to the form of the message itself. By increasing the number of arguments (without conveying more information) it was shown that when motivation and/or ability to elaborate on the message was low, attitudes were more favorable [25].

There are other additional less straightforward cues that can influence user's decisions in an interactive storytelling context. For example, social dynamics such as reciprocity and patterns of behavior that can be elicited by using identifiable social roles have been shown to successfully influence behavior [10] and have been inclusively explored in a storytelling context [32].

## 5 Using Persuasion in Interactive Storytelling

These mechanisms of persuasion can be explored in a system that dynamically selects persuasive manipulations (which can be performed by characters, events in the story, etc) in order to lead the user through a certain path. In its simplest form this approach could be employed in a branching narrative story with several decision points. In each decision point several manipulations can be prepared so that they can be applied in run-time according to some author-defined criteria. For example, where possible, two messages can be created in each decision point, one strong (that generates mostly favorable cognitive responses regarding choosing a particular option) and one weak (that generates mostly negative cognitive responses). Also several other manipulations can be added, such as manipulations of personal relevance/involvement, source and responsibility. As a general example, imagine a story whose decision points could be described by Figure 1. Each node represents a particular point in the story where several decisions can be made, where each decision (arc) leads to another point in the story (node).

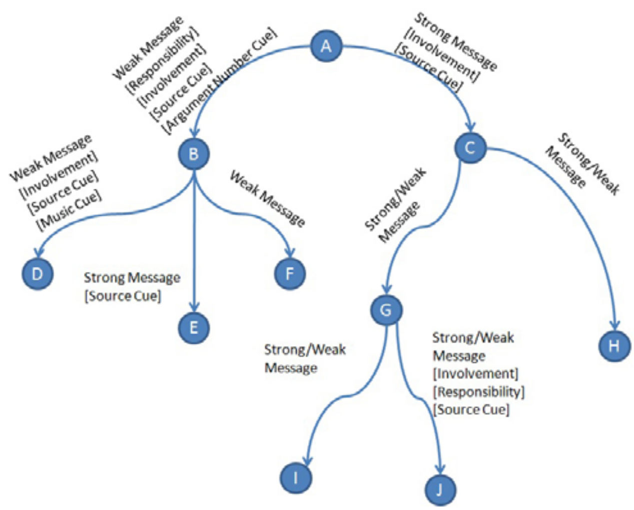
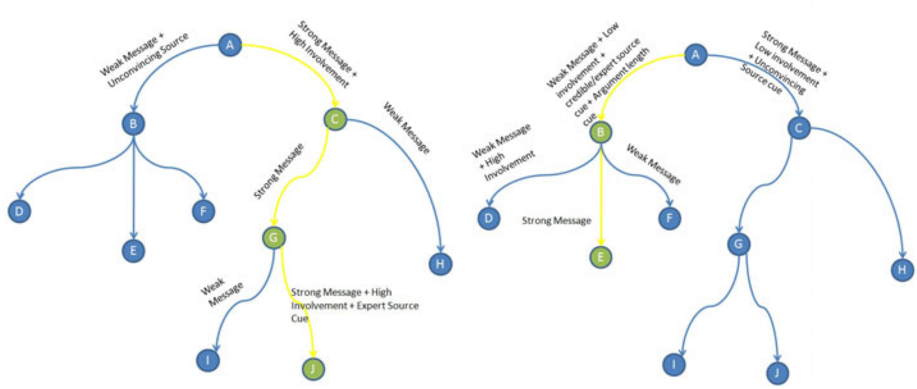



**Fig. 1.** A branching story and persuasive content at each decision point

Imagine we would be interested that the user would choose path ACGJ. To achieve this we could make the system choose the persuasive manipulations at each decision point depicted in Figure 2(a). For example, in decision point A the system having available a *weak message* regarding decision point B together with a *responsibility*, *involvement*, *source* and *argument number manipulations*




(a) Author-defined path (b) Alternative author-defined path

**Fig. 2.** Two possible paths through the story

could choose to present the user with the *weak message* together with a *unconvincing source manipulation* in order to discourage the user in choosing this particular path. Because the intended path requires the user to choose C in node A the system could select the *strong message* together with the *increased involvement manipulation* to increase the likelihood of the user choosing this path. In contrast, imagine that instead of ACGJ we were interested that the user would choose path ABE (Figure 2(b)). In this case, because we only have a *weak message* available for decision point B we can pair it with a *low involvement/relevance manipulation* (to decrease the likelihood of the message's scrutiny) together with an *expert source* and *argument number cue* (alternative version of the weak message with more lengthy wordy arguments [25]) and to persuade the user into not choosing the decision that leads to C, the system could pair the *strong message* with *low involvement* (to lower the likelihood of scrutiny) and an *unconvincing source* (that should be determinant of the decision when the likelihood of scrutiny by the user is low [27]).

### 5.1 Pilot Study

As a first step in assessing the applicability of the aforementioned ideas in a interactive storytelling context, we created a branching story (comparable to a choose your own adventure story) with 8 decision points. The story takes place in the medieval era, where the main character is an adventurer whose goal is to save the people of a small town named *Oakbridge* from a tyrant that lives in a dungeon nearby (typical setting for this genre). As in the choose your own adventure books, each node is a descriptive text that presents the user with several options. Each option has a number that identifies the node that it leads to. The user advances in the story by making a choice in each node until he/she eventually reaches a node which represents a goal state.

The study involved 16 computer science graduate and undergraduate students, with mean age 25 years. The subjects were divided in a control group (6 male, 1 female) that played a version with no manipulations and a test group (7 male, 2 female) that played a version with manipulations. Each subject reported their choices at each decision point and at the end, each filled a questionnaire based on [6] where they listed their thoughts while making the particular decision that was manipulated in the test group.

Our intent was to influence the user in choosing a particular option in a critical part of the story by employing a source expertise manipulation [29]. Source expertise is a peripheral cue [27], so it is likely to be effective under situations where motivation and/or ability to process the relevant arguments for the decision are low. The message was purposely made ambiguous (generating sensibly the same number of thoughts in favor as against as confirmed by thought-listing) that way creating a situation where the subject's ability to choose the right option was low. The non-manipulated message was:

"...There's a dark passageway there, and someone is hidden inside! With fear that the guards take notice of you, you enter it. Inside there's a man who's whispering come here! He says that you should go to the armory where there are magical items that can help you. He then describes the path from there to the armory. As he finishes, you hear footsteps and before you know it he is gone. You wait silently until you cannot hear footsteps anymore. While you wait you ponder on what the man has told you. Will you:
Go back and attack however is walking along the passageway (turn to 4), Try to silently pass through the guards (turn to 7), Try the path to the armory (turn to 5), Carefully retrace your steps back (turn to 3)"

The source expertise message included this additional information, that establishes the man in the story as an expert source:

".... Inside there's a man who is whispering come here! You go to him and he says he's from Oakbridge and that he was an adventurer like you, he says he's been trapped inside for a very long time, more than he can remember. He says that..."

In the control group subjects option were not consensual, 62,5% chose option 5 (which was the advice given by the "neutral" character) and 37,5% chose some other option. The results of the thought-listing questionnaire indicate that when people follow the advice from the character they choose to do so because they infer that "he must not be an enemy or else he would have called the guards". When they choose not to trust the character they report thoughts such as "he might be an enemy" or that they "feel unsafe". It is interesting to mention that the author of this story did not consider that the players would speculate that the man would certainly not be an enemy. Another interesting result is that in all cases the thoughts reported were in accordance with the option taken or were irrelevant to the story, which is an encoraging result regarding the production and testing of messages that the author expects to have a particular effect.

In the test group, where the character in the story was described as an expert source, 88,9% of the subjects followed his advice and 11,1% did not (only one individual), which represents a 26,4% increase with respect to the control group. The thought-listing results indicate that the vast majority of subjects did not raise any suspicions about the advice given by the character. Also the only individual that did not follow the intended path listed only thoughts that were unrelated to his/her choice, sugesting that the choice might have been random or there was some misinterpretation of the text.

In sum, although not sufficient in number to be significant, results are promising with regards to the expert source manipulation being effective in steering the user to the intended option.

## 6 Conclusions and Future Work

In this paper we have focused on how user's choices can be influenced in the context of interactive storytelling using results from the social psychology's area of persuasion. We describe the cognitive aspects of choice and address the issues involved in influencing them. We describe a small study were we have successfully used a expert source manipulation to increase the likelihood of the user following a particular path in a branching story.

As the next step in our future work we plan to develop a computational version where we can not only test other manipulations (such as personal relevance, responsibility, repetition, distraction, etc) and how well they interact, in order to define a criteria for combining them dynamically. We also plan to test author-defined criteria to guide the story, such as adjusting the path the user is pursuing accordingly to the nature of his/her actions. For example, an interesting hypothesis to explore that might lead to increased user satisfaction is to provide persuasive manipulations that resonate with previous player's choices, such as, if the player has shown an incline to choose to do good instead of evil, the system can encourage that behavior through correspondently chosen persuasive communications in the decision points where that is possible.

Our ultimate goal is to provide a model that allows a system to dynamically select previously fabricated content capable of steering the user through a path that is defined by some criteria established by an author.

## Acknowledgements

This work was partially supported by a scholarship (SFRH / BD / 31362 / 2006) granted by the Fundação para a Ciência e a Tecnologia (FCT). The authors are solely responsible for the content of this publication. It does not represent the opinion of FCT, which is not responsible for any use that might be made of data appearing therein.

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# Measuring User Responses to Interactive Stories: Towards a Standardized Assessment Tool

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**Abstract.** With the increasing number of prototypes and market applications of interactive storytelling, the understanding and optimization of how end users respond to computer-mediated interactive narratives is of growing importance. Based on a conceptual model of user experiences in interactive storytelling, a measurement instrument for empirical user-based research was developed. We report findings from an initial test of the self-report scales that was conducted with N=80 players of the adventure game "Fahrenheit". Interactivity was manipulated experimentally in order to validate the measures. Results suggest that the scales will be useful for comparing user responses to 'real' interactive storytelling systems.

**Keywords:** Interactive storytelling, user experience, measurement, scales.

## 1 The User Experience in Interactive Storytelling

While much research on interactive storytelling (IS) has been and is still dedicated to issues of technological feasibility (e.g., [1]), acceptance of future IS systems by lay audiences will depend on the satisfaction of expectations and emotional preferences. It is therefore imperative to combine psychological insight on how users respond to IS systems in order to ground design decisions and future technology developments on solid perspectives for user acceptance and market success.

Existing research on user responses to IS systems has mostly been conducted by qualitative means (e.g., [2]). While such qualitative studies have been useful in optimizing system parameters and creating more effective links between the IS world and the individual users of a given system, the measures applied do not allow acquiring standardized data for systematic testing of research hypotheses and comparing different IS systems or system versions. Quantitative measures of user responses to IS systems are thus an important yet missing tool for generating more empirical and conceptual knowledge on audience reactions and preferences.

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A standardized tool for the measurement of user responses to IS must meet two types of criteria. First, the dimensions assessed must be important from a design or theoretical point of view. Second, the measures should meet methodological quality criteria, most importantly, reliability and validity.

In order to establish the theoretical grounds for a measurement tool that meets these requirements, expert interviews and literature research in IS and media entertainment were conducted [3] [4]. As a result, a list of concepts that are proposed to play a key role in users' responses to IS systems emerged. It is organized in three main categories: A) Preconditions of meaningful user experiences, B) Common and frequent experiential qualities, and C) Concepts that reflect system-specific, individual types of responses.

The conceptual work identified five important preconditions of meaningful user experiences (part A):

- System usability, (i.e., interaction with the story must be technically smooth and error-free)
- Correspondence of system capabilities with user expectations (the system needs to convey a reasonable expectation what kind of interactive influence users can exert on the story)
- Presence (users need to establish a sense of 'being in the story world')
- Character believability (virtual agents must not damage users' illusion, e.g., through irrational behavior or poor response to user input), and
- Effectance (users must be able to recognize when and how they have causally affected the story world).

Next, a group of five types of user responses was theorized that reflect 'typical', common patterns which are likely to occur across different IS systems (part B). These frequent modes of user reactions are

- Curiosity about what will happen next,
- Suspense,
- Flow,
- Aesthetic Pleasantness (positive experiences of beauty or artistic impressiveness),
- Enjoyment (an overall sense of positively valenced experiential quality)

Finally, Part C included conceptual elements that mirror the unique characteristics of an IS system, such as the specific story content that may facilitate very diverse emotional experiences or the virtual characters that may evoke very specific user responses. Therefore, users overall emotional condition and the degree of identification with the story's protagonist were included as system-specific user reactions.

Overall, the theoretical foundation of the assessment tool therefore comprised 12 dimensions of user responses that were identified as meaningful and important across 'any' type of interactive story. Part C of the architecture allows to specify additional components that are deemed important for given systems.

## 2 Construction of Measures and Pilot Study Design

The conceptual ground work was translated into empirical measures by construing self-report scales for each of the 12 ‘standard’ dimensions of user responses. Existing measures were screened and adopted or adapted as far as possible. For most dimensions, however, new scales were composed in order to achieve optimal semantic fit with the experiential dimensions and the IS system context. The assessment tool was designed for immediate administration after users’ exposure to an IS system. A pilot study was conducted with these scales to examine statistical reliability (which is an important precondition for valid assessments). Moreover, a check of the scales’ validity was intended that was based on an experimental manipulation of interactivity in the stimulus system.

Overall, $N = 80$ university students (22 males, 58 females; average age M = 20.08 years, SD=1.91 years) with a relatively low average degree of computer game literacy (M=1.60, SD=.84 on a scale from 1-3) participated in the study. The interactive narrative system that was used was the 2005 adventure video game “Fahrenheit” by Atari ®. While this game does not mirror contemporary technological approaches in interactive storytelling, it has been praised for its ground-breaking technology that offers an innovative level of user impact on narrative progress. As it was a ready-made product with high-quality audiovisual features, it was selected over ‘true’ interactive storytelling prototypes in order to avoid biased user judgments due to prototypes’ underperformance in system continuity, visual appearance, or experience length.

Participants were divided into two groups. One group played the introductory sequence of “Fahrenheit” for about 30 minutes and thus actually interacted with the game and the story. The other group, however, only watched a video recording of the same game sequence that the authors had prepared in advance on the same screen. These participants thus had a non-interactive experience with the same story content. The manipulation of interactivity was applied as a potentially strong intervention that could alter user experience in ways that (some of) the instrument’s scales should reflect. In Particular, the effectance scale was expected to mirror the interactivity manipulation. The recruited students were randomly assigned to the interactive or the non-interactive group. After exposure to “Fahrenheit”, participants were kindly requested to fill in a computer-based questionnaire that included the 12 scales on user reactions to IS systems, as well as some demographics items. Some participants breceived credits for a course they were attending, others received 10 Euros for their participation in the experiment.

## 3 Results

Reliability scores of each scale were determined using the Cronbach’s α coefficient for internal consistency. This coefficient indicates the degree to which the items of which one scale is to be composed actually measure the same concept in a coherent fashion. In social science research, a minimum of $\alpha = .70$ is the generally accepted convention of sufficient internal consistency (reliability). All scales met the minimal requirement, with α values ranging between .70 and .91 ($N = 80$).

The second step of analysis was an examination of how the self-report scales responded to the experimental manipulation of interactivity. Interpretable responses of specific scales were considered as initial (partial) validation of the assessment tool.

Analysis of variance (ANOVA) procedures were conducted to examine group differences between participants who had played "Fahrenheit" interactively and participants of the non-interactive condition (see table 1). Interestingly, most self-report scales did not display significant group differences. However, the effectance scale reacted to the interactivity manipulation, as people in the interactive condition reported on average higher levels of effectance than participants in the non-interactive condition. In contrast, participants in the interactive condition found the story characters to be less believable than those people who had been exposed to the non-interactive story. Likewise, participants rated the system usability significantly lower in the interactive condition than in the non-interactive condition, and they also found the experience to meet their expectations to a lesser degree.

**Table 1.** Results

*Means and standard deviations within and significance of difference between interactive and non-interactive experiences. Note: Higher values reflect higher ratings (e.g., greater system usability), except for "correspondence with user expectations", where higher values reflect lower user satisfaction.*

| | Interactive Condition | | Non-interactive condition | | |
|---|---|---|---|---|---|
| User experiences | *M* | *SD* | *M* | *SD* | *P* |
| *Preconditions (Part A)* | | | | | |
| System usability (α = .84) | 3.11 | .94 | 3.69 | .75 | .004* |
| Correspondence /w user expectations (α = .81)* | 3.63 | .56 | 3.38 | .62 | .06 |
| Presence(α = .91) | 2.68 | .98 | 2.62 | .95 | .77 |
| Character believability (α = .76) | 2.98 | .90 | 3.48 | .59 | .004* |
| Effectance (α = .89) | 3.23 | .69 | 2.40 | .97 | .000* |
| *Experiential qualities (Part B)* | | | | | |
| Curiosity (α = .86) | 3.58 | .73 | 3.43 | .64 | .35 |
| Suspense (α = .83) | 3.33 | .72 | 3.44 | .77 | .51 |
| Flow (α =.74) | 2.95 | .71 | 3.00 | .49 | .70 |
| Aesthetic pleasantness (α = .70) | 2.00 | .65 | 2.24 | .62 | .10 |
| Enjoyment(α = .92) | 2.94 | .82 | 2.80 | .66 | .41 |
| *Specific experience measures (Part C)* | | | | | |
| Emotional state: positive (α =.87) | 4.60 | 1.66 | 4.51 | 1.50 | .79 |
| Negative (α = .90) | 2.59 | 1.51 | 2.91 | 1.43 | .33 |
| Role adoption (α = .77) | 2.71 | 1.04 | 2.67 | 1.05 | .86 |

## 4 Discussion

With the present 12-partite set of self-report measures, a first standardized tool for the quantitative assessment of user responses to IS systems has been established based on solid theoretical ground work. The results of the pilot test with 80 players (or viewers) of the "Fahrenheit" video game suggest that the current version of the measurement tool also meets the methodological quality criteria: Internal consistency (reliability) is satisfying, for most scales rather good to excellent. Moreover, some interesting result patterns bound to the manipulation of interactivity were observed.

First, the effectance scale produced outcomes that are conceptually informative. People who were allowed to interact with the adventure game reported higher values of perceived own efficacy onto the story and the system than people who merely watched the recorded show and did not interact. This finding is of particular relevance, because effectance is conceptually very closely linked to interactivity and thus to the very core of what IS is about [5].

Next, participants in the interactive condition found characters less believable than people in the non-interactive condition. It is likely that technological limitations in character behavior produce irritations in users when they interact personally with the agent. In contrast, a video-recording of virtual characters' behavior that users only watch may let the same technical problems appear in a less irritating fashion to users. So the group difference that occurred is interpretable and suggests initial validation of the character believability scale. Similarly, the low values for system usability ratings in the interactive group seem to mirror the fact that in the interactive condition, constraints of the interaction inevitably became salient to participants. In contrast, people in the non-interactive group did not come across any usability issues at all. In that sense, also the usability scale responded in a meaningful way to the on/off-manipulation of interactivity.

And finally, the corresponding result pattern for the scale on the match between system capability and user expectations fits into this perspective as well. With the offering to participate interactively in the story events, expectations towards how the system should respond to inputs are necessarily put relatively high compared to a fully linear stimulus for which participants know that there will not be any individual interaction. Consequently, lower levels of satisfaction with what the system is capable to do are likely for the interactive condition compared to the non-interactive condition – at least as long as users have not much prior knowledge about what to expect from IS systems.

Taken together, these results suggest that the 12 subscales for the assessment of important components of the user experience in interactive storytelling meet the requirements for systematic, comparative research on IS prototypes and systems. With statistical performance values established using the "Fahrenheit" game, further studies on more advanced systems developed in the IS research community will follow to find out more about the reliability and validity of the scales. This way, scales may be optimized (e.g., by removing single items or adding subscales that are found useful completions of the overall set), and benchmarking values will be obtained for the various dimensions of user response that research teams can apply to learn more about the impact of their particular IS environment on users. Similarly, the further-tested scales will be useful for comparing different versions of a given system (e.g., different interface types, different presentation modalities such as text versus 3D imaging) with regard to the impact of the different technological and conceptual building blocks of current and future IS systems on user experiences (e.g., [6]). Ultimately, the measurement kit that is envisioned to grow out of the present research line will then be capable to inform and guide user-oriented system development and refinement in research and application contexts.

**Acknowledgment.** This research was funded by the European Commission (Network of Excellence “IRIS – Integrating Research on Interactive Storytelling” – Project ID 231824). We thankfully acknowledge the Commission’s support.

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# One Tool-Many Paradigm: Creativity and Regularity in Youngsters' Hyperstories

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**Abstract.** We investigated 101 online hyperstories created at school by students aged 4-18 using the same authoring tool, to discover recurring characteristics of youngers' hypermedia narratives and their underlying creative process. The findings of our empirical study offer a contribution to the digital storytelling field from a conceptual and a practical perspective. They provide a deeper understanding of digital storytelling activities performed by youngsters in educational settings, highlighting a tension between regularity and creativity that has some correlations with authors' age and school context. In addition, the discovered recurrent features can be used as classification means for digital stories and can be translated into guidelines to support the authoring process and to improve the functionalities of storytelling tools.

**Keywords:** Multimedia storytelling, e-learning, structural analysis, pattern, children, teen-agers.

## 1 Introduction

A number of works in traditional and digital storytelling have pinpointed that creativity is an essential constituent of storytelling [1][2]: Humans can create widely different stories using the same communication medium/a, narrative components, or linguistic structure. At the same time, it seems possible to discover recurring, regular "patterns" in human stories, at least in specific domains. For example, Propp identified a set of irreducible narrative and morphological elements that are common in Western folk stories [3], while Levi Strauss [4] explored the invariant constituents of myths and mythological stories. From a more general perspective, structuralism in literary theory claims that there must be some way in which different narratives unify themselves into a coherent system defined by their underlying unchanging structures.

The purpose of our research is to empirically investigate this tension between creativity and regularity in a specific domain: Online hyperstories created at school by young people using the same authoring tool. The stories we consider in our study were created by Italian students– from pre to high school – participating to a national storytelling competition. They were all developed using the "1001stories" authoring tool [5], a web based system built at our lab in the context the national project "Policultura" on the educational use of interactive stories (www.policultura.it). The competition requires participants to submit a multimedia, non linear narrative created

R. Aylett et al. (Eds.): ICIDS 2010, LNCS 6432, pp. 44–49, 2010.

as whole class activity. The narrative format supported by 1001stories is based on a two levels structure: a *short* story, consisting of any number of *Topics*; a *long* story, consisting of Topics plus their Sub-topics. Each Topic or Subtopic is composed by a text, an audio, and a slideshow of images with their captions, which are displayed in sequence synchronized with the audio track. 1001stories supports the use of multiple media but imposes a relatively rigid information and navigation architecture. Still, students used the tool in a very creative way, resulting in a surprising array of different "interpretations" of the format imposed by the tool. At the same time, their stories reveal some recurring regularities that go far beyond the information and navigation architecture imposed by the authoring tool.

The main focus of our research is to unveil these "patterns" within the wide range of creative variants, and to discover correlations with authors' age, school level, geographic area, and the story creation process.

## 2 Method

Since the birth of Policultura in 2006, 1001stories has been used by over 9,000 students from pre to high school in Italy. During our research period (September 2009-May 2010) the Policultura online repository (where school classes can publish the artefacts created using 1001stories) included *381* hyperstories submitted to the competition plus over 100 narratives not officially proposed for the competition.

Our work focused on the 381 competing stories and analysed a sample of them, to limit time and effort of our research. We used statistical analysis methods to determine from the whole population size of completed stories, the dimension of a representative sample, calculated as $n=101$ (preserving population characteristics, like school level distribution and other characteristics). To identify the sample, we randomly chose 101 stories from the set of 381, assigning a uniform probability to each one in the population.

Then we defined a *classification scheme*, which provides the conceptual tool to extract and categorize different features of our universe of "raw" data, i.e., of our stories sample. The scheme consists of classes of story features we are interested to and a set of values (attributes) for each class. Initially, we created a preliminary classification containing all classes of story features that we thought were meaningful. Then we inspected manually each story in the sample in order to complete and refine the classification scheme. We establish which attributes each story matches for each class and identified new relevant classes and attributes, progressively including them in the scheme, in order to ensure that also characteristics only present in a small subset of stories can be identified by our model. The final scheme was then translated into a feature extraction form (Fig. 1). The form covers profiling data as well as attributes to classify the characteristics of the story in terms of media used, characteristics of visual contents, different roles that sound can play in the narrative, morphological aspects of the stiry, literary genre, subject, and narrative style. As many stories include information about the storytelling process followed by the class, some features are related to this aspect, e.g., the role of the teacher in the process; who is the narrator (teacher or children); if the story is anchored to an existing project or activity in the classroom.

Once the classification schema was ready, *all the stories in the sample were inspected again* using the form, in order to instantiate the scheme, defining which specific attributes matches each story. After the analysis of the data collected using the above form, we iterated again the inspection of all stories to identify morphological patterns of stories and their relationship with the school level and the structure of the storytelling process.

| | |
|---|---|
| | **Story ID: <Id number of the story-generated by 1001stories engine> - Name: <Story Title>** |
| 1 | **Author:** <School Name and class code> \| **Region:** \| **Language:** IT ☐ EN ☐ Dialect ☐ \| **Target Audience Level:** Kinder ☐ Primary ☐ Sec I ☐ Sec II ☐ |
| 2 | **Multimedia tools used:** ☐ Text ☐ Images ☐ Sounds (mp3) ☐ Animation \| **Number of:** Pages:…. Audios: …. Pictures:…Animations… |
| 3 | **Image type:** ☐ Downloaded pictures ☐ Original pictures ☐ Scanned drawings ☐ Graphs ☐ Slides ☐ Maps |
| 4 | **Literary genre:** ☐ Traditional fantasy ☐ Modern fantasy ☐ Historical fiction ☐ Realistic fiction ☐ Science fiction ☐ Mystery ☐ Poetry ☐ Picture book ☐ Informational – Nonfiction ☐ Other: —— |
| 5 | **Story subject:** ☐ Historical event ☐ Science experience / Lab activity ☐ Local myths ☐ Origins of cities ☐ Games ☐ Historical character ☐ Popular character ☐ Other: —— |
| 6 | **Sound role:** ☐ Background music ☐ Complementary information ☐ Synch with images ☐ Synch with text |
| 7 | **Who speaks:** ☐ Teacher's voice ☐ One voice per page ☐ Many voices per page ☐ Guests |
| 8 | **Narrator's perspective:** ☐ First-person ☐ Third-person ☐ Third -person omniscient |
| 9 | **Storytelling experience:** Documented in the story: ☐ Yes ☐ No<br>If *yes*: The experience is explained by: ☐ Teacher ☐ Children<br>The experience is: ☐ Originated by a pre-existing class project ☐ Triggered a new class project |
| 10 | **Teacher role:** ☐ Companion ☐ Guide ☐ Evaluator |
| 11 | **Teamwork approach:** ☐ Whole class ☐ Subgroups |
| 12 | **Communication goal:** ☐ Informative ☐ Persuasive ☐ Educational ☐ Prevention ☐ Other: —— |

**Fig. 1.** Classification Scheme for Feature Extraction (Form)

## 3 Main Results

Before any further study, we performed a correlation analysis on the collected data to validate the classification scheme, detecting the absence of redundant sections and confirming that our attributes are measuring different characteristics. Then we analyzed the data to highlight regular characteristics in the hyperstories sample and to discover intrinsic relations between recurring features of the narratives and their creation process. For lack of space, the rest of this section presents here only the main findings of our work. The following diagrams highlight how narrative solutions differ between younger and older students. Fig. 2 pinpoints that children at *preschool (kindergarten)* or *primary school* use a *variety of narrative genres*, including those more imaginative (fiction, fantasy), while higher education students are more conservative and tend to embrace an informative, more serious style of storytelling. Fig. 3–left relates *image types* to *school level,* showing that younger students use much more "original" content, i.e. scanned drawings and pictures they created specifically for the storytelling project, while older students tend to reuse more intensively downloaded visual material. Therefore, high school stories are much richer of images compared to younger students' stories while, in average, they do not differ for quantity of text and audio (Fig. 3–right).

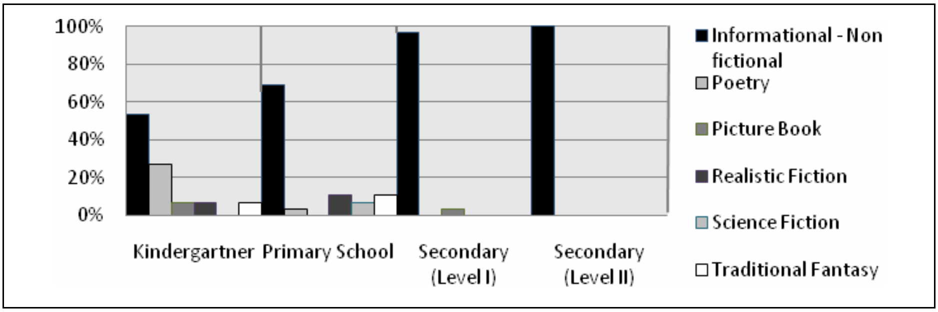


**Fig. 2.** Literary genre vs. school level

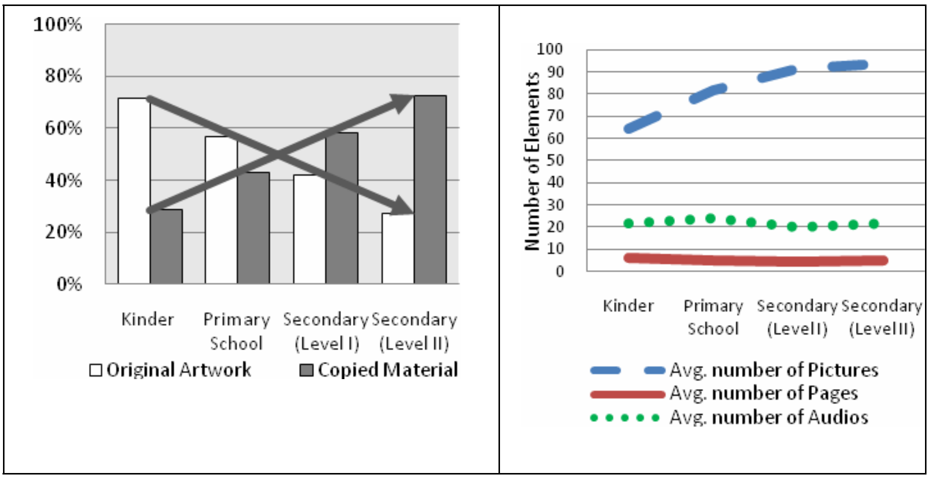


**Fig. 3.** Image type vs. audience level comparison (left); Average amount of multimedia elements used per story at different education levels (right)

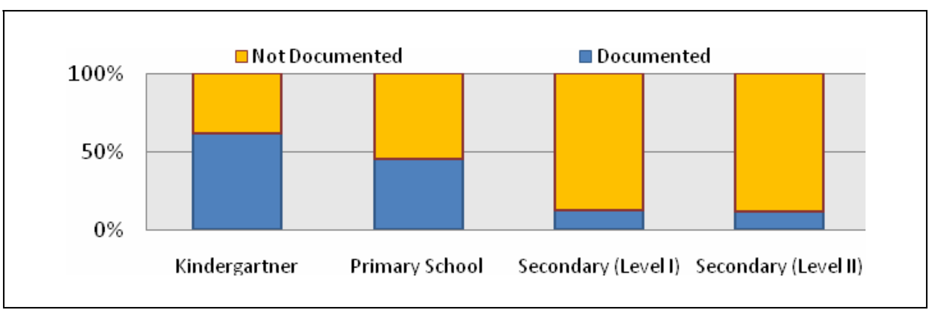


**Fig. 4.** Process description and reflection as part of the story content

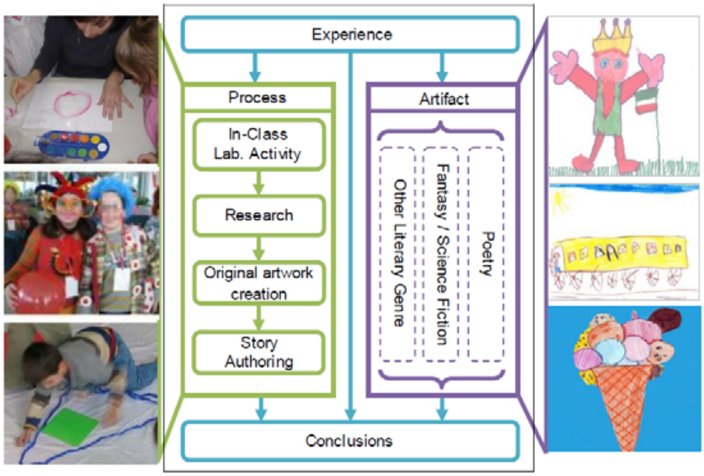


**Fig. 5.** Pre and primary school content-process pattern

Regarding the storytelling process, Fig. 4 shows that young children tend to document their storytelling experience as part of the story, while this attitude decreases as the age increases. Further findings not shown in the previous diagrams pinpoint that the role of teachers significantly differ in the various school contexts: they act as companions or guide in 98% of pre and primary schools, but only in 20% of high school, where they mainly revise and evaluate students' contents. Finally, in lower level education storytelling is truly a whole class collective activity: In 95% of projects documented in the stories, children are organized in small groups and cooperate within and across groups on all aspects of story creation. In contrast, in 87% of high-schools team-work is organized so that each sub-group has a specific assignment and work largely independently.

We could identify some morphological patterns of stories in relationship to school level and to the structure of the storytelling process. For lower school levels, for example, the process is strongly anchored to class or laboratory activities, it proceeds with the research of material and the creation of original content (texts, images, drawings), and digital authoring is the last step. The experience of story creation is perceived as important as the artefact itself, and the description of the experience is included in the story, typically as the conclusion of the narrative (Fig. 5). For high school, we could not detect any similar "pattern" (we could only discover that students did a preliminary research before working with the authoring tool). Still we identified recurrent structures in stories where the literary genre focuses on an informational topic, common to 80% of the narratives. For example, we noticed a frequent combination of historical content (i.e., about an historical character or event) with content related to science or to lab activities.

## 4 Conclusions

To our knowledge, this is the first work that attempts to identify regular structures in hyperstories created by youngsters in educational contexts and adopt a methodological framework also embracing a socio-cultural perspective [6]. Our research has its limitations, most notably in its focus on hyperstories generated with a specific tool, in the subjective dimension of features detection and in the lack of a uniform sample of data regarding the authoring process in the different schools levels. Still, the wide size of the sample partially compensates these drawbacks and strengthens the reliability of our results. Our work shows that a systematic feature extraction analysis can be applied to classify youngsters' hyperstories and to discover underlying non-trivial regularities in the narratives and correlations with the authoring process followed. In particular, our results highlight that the degree of creativity and engagement, as well as the variety of story subjects, narrative styles and genres, are significantly higher in the lower levels of education than in high schools, where the role of teachers in the storytelling process is also quite different. These findings are not fully surprising and reflect the different pedagogical approaches of the different school levels [7]. At pre and primary school, constructivism and active learning are typically much more widely adopted than at high school, and in the former the teacher's role switches from a 'sage on the stage' to a 'companion and guide on the side'. This may have facilitated children's attitude towards perceiving the cooperative experience of story authoring as important as the story itself, stimulating young students to include the presentation of the process followed as part of the story.

Our findings provide a deeper understanding of digital storytelling processes of young people in educational settings. Furthermore, the procedure reported in the paper will help other researchers to perform their own analysis on their stories and to discover if the regularities we discover hold also in different cultures or contexts, or created using a different authoring tool. Regularities can be used as classification means for hyperstories to define meta-data and support advanced search and retrieval mechanisms in story repositories. In addition, they can play a role similar to pedagogical patterns in learning [8] and software patterns in computer science: they can be incorporated into an authoring tool as built-in primitives, empowering the system and making story production more efficient.

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# Exploring Narrative Interpretation and Adaptation for Interactive Story Creation

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**Abstract.** Adaptation of stories – as a translation between media, such as literature and film – is explored for genres of interactive storytelling that make use of highly-interactive and user-adaptive technology. A concrete case study of transforming and abstracting a Hemingway short story is discussed in detail. The conclusion is that even though Interactive Storytelling content has to follow formal models, these cannot be derived from a written narrative alone and need story creators' input in order to work for interactivity.

**Keywords:** interactive storytelling, adaptation, authoring, creation process.

## 1 Introduction

In recent years, the research community in Interactive Digital Storytelling (IDS) has been investigating methods and technologies for semi-automatically controlling the flow of a dramatic plot. On behalf of an author – or substituting an author, story events can be 'generated' by a story engine or a drama manager. There is a variety of approaches claiming several degrees of generativity. While some engineers argue that their product creates 'new' events [21, 6], others delimit the generative functionality to adapting the order of predefined events [14, 15] in the process of coping with user interactions that otherwise would break the originally designed story. Especially in the latter case, Interactive Storytelling heavily relies on previously authoring a storyworld as an initial base for possible events.

The current state of the art shows that there is still a gap between intuitively understandable methods for the authoring of interactive storyworlds and the currently accessible database of existing examples running with story engines as demonstrators [18]. Many demonstrators have been authored by engineers, using pre-existing story material that was initially meant for linear forms of presentation in other media, such as literature or film. Examples for these kinds of adaptations are the Emo-Emma demonstrator [3] based on Flaubert's novel "Madame Bovary", or various demonstrations using the "Little Red Riding Hood" tale as a basis [11, 16]. These exercises illustrate how stories have to be formalized in such a way that they can be processed by the engines. Porteous et al. [13] modeled the "Merchant of Venice" and "Goldfinger" [14] as a planning domain with STRIPS-like propositions with operators, after extracting actions, initial/goal states and predicates directly from the original artwork.

R. Aylett et al. (Eds.): ICIDS 2010, LNCS 6432, pp. 50–61, 2010.

Bosser et al. [2] have modeled "Madame Bovary" as a network of linear logic operators in order to prove causal integrity.

Automation in future interactive story engines requires the technical formalization of stories at a high abstraction level, which is currently perceived as a burden for non-programming authors [6, 17]. There seems to be a gap between a written representation of authored concepts and their formal implementation. Investigations undertaken in the IRIS network of excellence [18] have suggested several creative principles for the creation of interactive storytelling experiences with generative engines, one of which is the requirement for 'abstraction' also at the creative conceptual level [19], even before 'mathematical' abstraction [6, p. 101] for the purpose of implementation occurs.

In projects like those mentioned above, there seems to be an underlying assumption that the extraction of logical operators from written stories can be a straightforward process done by knowledge engineers, making creative authors obsolete apart from delivering the initial story. We claim that this is unlikely to be successful, and that the extraction of suitable logical operators is a creative process similar to the undoubtedly creative process of a film adaptation of such literature works. The formalization of existing stories, undertaken to meet needs of story logic, causal models or plans, imposes the necessity of a-priori interpreting the narrative from its representation level – all the same as it is experienced and interpreted by an audience – except in rare cases when original authors unveil planning material [2]. The result is an essence of possible and required actions and world states that make up the 'gist' of the story experience. The result of this interpretation then needs to be translated into a completely different medium – here, an interactive medium, which requires the inclusion of a human participant, situations for interaction, as well as the definition of different forms of representation of all participants' actions. We claim that this process of adaptation is not a deductive engineering-like task but an inductive process, affording many creative decisions for omitting existing and inventing new elements. The remainder of this paper illustrates this hypothesis by means of an extreme example: the exercise of using Hemingway's short story "The Short Happy Life of Francis Macomber" as a base for Interactive Storytelling, starting by a formalization of the written story.

## 2 Related Work

Narrative theory – especially in the area of structuralism – has been consulted extensively by Interactive Storytelling researchers in order to either ground the development of story engine formalisms or to understand story structure [4]. These formal descriptions have been used to prove story models as causal chains that can logically operate. Several examples have been contributed (see above), but there have been few attempts to discuss this process of abstraction as an individual or even arbitrary interpretation of a given story being perceived solely from its representational level, and to view the use of literature examples in Interactive Storytelling as an act of adaptation across media.

### 2.1 Interpretation of Narrative

H. Porter Abbott [1] has pointed out that we are as much 'vulnerable' to narrative texts as they are to us as an audience. The narration can manipulate us in our judgment, but as readers, *"we exercise a power over narrative texts that is arguably as great as their power over us. After all, without our willing collaboration, the narrative does not come to life. […] we overlook things that are there and put in things that are not there. We underread and we overread."* [1, p. 86] As an example of a text likely to get 'underread', Abbott mentions the 400-page novel "Madame Bovary" with Flaubert's rich descriptions e.g. of Emma's sophisticated contemplations, some of which readers potentially compress to find 'closure' by asserting an overall meaning. According to Abbott, the issue of 'closure' is as well the motivation for the opposite: overreading. *"If a narrative won't close by itself, one often tries to close it, even if it means shutting one's eyes to some of the details and imagining others that aren't there, underreading and overreading."* [1, p. 91]

Another reason for overreading is the existence of gaps in all narratives. Ernest Hemingway was a master of using gaps, some getting closed less easily than others or even staying wide open throughout the narrative. Wolfgang Iser [10] has pointed out that several individuals necessarily end up with different individual interpretations as they fill these gaps with the help of their own life experiences and attitudes, while no reading can ever exhaust the full story potential lying in a text. Abbott calls unresolvable gaps as some are placed in Hemingway's short stories 'cruxes', leaving interpretation completely open. He also points out that there are at least three different kinds of interpretation. In our paper, we are not concerned with 'intentional' or 'symptomatic' ('deconstructive') readings searching for psychological/ideological/ cultural attitudes of the author or his/her social environment, but instead with the 'adaptive' reading as a kind of interpretation that is immanent to all creative adaptations. A simple example is yet the production of a play from a written script, which is always *"an occasion for enormous creative investment"* [1, p. 109]. More complex examples occur when adaptation across media is involved – as is the case in our example, the attempt of making a written story interactive.

### 2.2 Types of Adaptation across Media

A. E. Hotchner [9], who has dramatized 16 of Hemingway's works for the screen, figures that there are five different possible kinds of adaptations: 'Scissors Adaptation' is a more or less cut-and-paste of a theatre play (e.g., offered by Shakespeare) for a screenplay. Others demand more effort in conversion of a work not written for the intended movie presentation purpose, such as 'Distilled'-, 'Expanded'- and 'Straight Adaptation', the choice of which depends on the source material, in particular its length, scope and characters. Similar to underreading and overreading during interpretation of a work, short works need to be expanded and long works *"boiled down to a manageable length"* [9, p. 2]. Finally, there is 'Wild Adaptation', which means converting a basic work beyond its *"apparent resiliency"*, for example by changing the ending of a story to its opposite, which raises most of the critics as it is often perceived as destructive.

We look at these experiences with the motivation to extract principles for kinds of adaptation to interactive storytelling. We assume that although there are many existing cases of games designed after original written or filmed stories, these mostly have not even tried to use the existing story logic of the source material's actions, events and states for direct interaction, but often separate pieces of linear storytelling and gaming into distinct parts.

On the other hand, it appears obvious that a formalization sticking completely to original written literature must be too short-sighted for Interactive Storytelling; and we assume that there is rather the need for 'Expanded -' or even 'Wild Adaptation' than sufficing with 'Scissors' or 'Straight' methods.

### 2.3 State of the Art in the Interactive Storytelling Community

The experiment presented here has started out from two hypotheses that 1.) during an adaptation process for IDS, it is inevitable to formalize a written story into an abstract form that story engines can causally operate on the material, and 2.) this abstraction is not a merely deductive, straight-forward process, but requires creative interpretation and adaptation for the medium, and therefore has to involve story creators.

Concerning the first hypothesis, there have been examples presented by engine providers (see introduction) to prove and show engine formalisms [2, 13, 14, 16]. However, these works omit to present any decision process involved through interpretation and adaptation, and the field has not yet progressed much beyond an assumption that engineers have to simply derive a formal structure from story outlines created by writers. In practice, the field partly draws from story comprehension research, e.g., [20] by using causal networks to model representations underlying simulations within generation engines. However, in support of the arguments of different 'readings' in narrative interpretation, causal networks have also been used to research differences in individual resulting model representations, assuming that in many cases there is not one 'correct' so-called 'situation model' to achieve [22]. This also supports the conclusion that transfer of an author's linearly written story to a processable model is not only a deductive process. An exemplary illustration of parts of such a process with its limitations is the intention of the remainder of this paper. The work is based on a theoretical abstraction experiment and the analysis of different creative principles in story creation (screen, game, RPG and improv) researched in the IRIS project [18]. It further takes into account considerations by Crawford in formalizing interactive storytelling for the engine Storytron [6].

## 3 Interpretation: Formalization and Abstraction

We chose a Hemingway short story ("The Short Happy Life of Francis Macomber") for our exercise, as it leaves much space for interpretation, and provokes 'overreading' through many gaps and therefore may well illustrate our considerations.

As a start for deriving a causal model, it is first necessary to distinguish between the story and the discourse [5], or the narrated events vs. the referenced events of the reported (diegetic) story or diegesis, which is a general aspect in the adaptation. On the one hand, this refers to the narrated order of events vs. chronological order, the relation of which can be easily mapped out in a table (see Fig. 1). On the other hand, the discourse is made up of the representational level including the choice of the medium. In our case it is Hemingway's characteristic prose with its diction, points of view, tone/voice [8], and for example the existing underlying irony of the implied author. We assume that this representational level is difficult to maintain and has to be sacrificed during adaptation.

At first, we only look at the actions and events. Fig. 1 presents the sequence of narrated events (top to bottom) with indications of their chronological occurrence in the diegetic storyworld. The main characters are: Francis Macomber (FM), his wife Margaret Macomber (MM), and the hunter Robert Wilson (RW).

### 3.1 Summary of the Story

Synopsis (diegesis): 0. (Timeless exposition:) Francis and Margaret Macomber are a rich, unhappily married American couple. Robert Wilson (RW) leads African safaris. 1. RW takes Mr. and Mrs. Macomber out to hunt lion. Francis Macomber (FM) proves to be a coward in the lion hunt. 2. Margaret (MM) reacts obnoxiously, putting him down and flirting with RW. 3. After FM has enough of it, with anger he overcomes his fear and succeeds at shooting buffalo, which makes him happy. He gains RW's appreciation and independence of his apparently long suffering from his wife's behavior. 4. Suddenly he gets shot by his wife, and the story leaves open if that happened by accident or on purpose.

The written narrative begins 'in medias res' (at 2.) after the first lion hunt, when MM picks on FM. The reader is left alone with unclear insinuations about things that might have happened (at 1.), before they are told as a report of the past events triggered by FM's thoughts in the night. When the story continues in the 'present time' (at 2. and 3.) leading to its climax, many gaps are left open, which can later only partly be filled by the reader's interpretations of the author's hints and ironic overtones. The most important examples are the event of adultery that is never explicitly reported but implied, and the exact conditions of the killing event in the end. It is notable that events get told from different points of view including private thoughts of RW, FM and even the hunted lion, but not of MM (the woman).

Our creation of the table in Fig. 1 could not be done in a straight-forward way and without long discussions, as we achieved no instant consensus about the ideal selection of those events most important to the story, revealing slightly differing interpretations of the action. In order to give an overview, the list leaves out events that we chose to be secondary for maintaining the 'gist' of the story. This is to conclude that already with the attempt of neutrally describing the reported events in the written text with the need to summarize, interpretation is at work. Most remarkably, the wide open gap at the end presents a 'crux' of which we cannot precisely tell the conditions. Further, only at the end, the story's title can be fully 'understood' by implications: As soon as FM's disdainful life turns into a 'happy' state, it is getting 'short' (the *"short happy life"* lasts from event 13-15 in Fig. 1). This reading of the story influenced the choice of relevant events as those leading to turns in FM's emotional states and relationships.

### 3.2 Extracting Relevant Variable States and Attributes

Our interpretation and event selection was influenced by attributes of the characters that are either explicitly mentioned in the narration, or that we associated with their actions and thoughts described or implied. Looking for 'relevant' events means looking for meaningful changes in the storyworld's states. Although there are action-related storyworld states, such as "lion being alive or dead", "being in or out of the

*Hemingway: "The Short Happy Life of Francis Macomber"*

| | |
|---|---|
| 1 | **Day 1 - lunch time conversation with analepses** RW, FM and MM have drinks, *„pretending that nothing had happened"*. Insinuations about *„that lion business"*: FM had been carried to his tent, he seems to be ashamed of something and in RW's debt, he wants to *"fix it up"*. Character expositions: RW's thoughts, FM's coping, MM's taunt, all through RW's PoV. |
| 2 | **That afternoon, impala hunt** FM succeeds with a good shot, again announces to *„clear away that lion business"* with the buffalo hunt planned for tomorrow |
| 3 | **Night, after dinner, trigger of long flashback** FM lies on cot thinking of lion, feeling shame and fear |
| 4 | **Back to night before and breakfast: That same fear of lion** Lion roars (at night and at breakfast), preparations for lion hunt, wild guesses about lion and increasing fear of FM |
| 5 | **Morning – go out, meet lion and shoot lion** FM shoots at the lion (told from: lion's PoV, FM's PoV), hits twice, lion is wounded but trots away and hides |
| 6 | **Talk about need to search lion – Sitting under tree smoking** RW leads, FM makes ‚unfair'/windy suggestions of leaving the lion, RW expresses his ethics of hunting, FM is scared but pride |
| 7 | **Search and find lion (in group)** Lion is found and charges, FM runs away, RW kills lion and saves everybody, embarrassment FM, *„this was the story of the lion"* |
| 8 | **Timeless exposition concluding "the lion story"** Information about personality and life of main characters |
| 9 | **Back to: that night after day 1 - 3 o'clock** FM wakes up, discovers MM is gone, stays sleepless for 2 hours, then MM returns, resulting argument: FM accuses her to cheat, with insinuations *„you promised there wouldn't be any of that"* |
| 10 | **Day 2 - breakfast, argument** FM starts open accusation, argument between all three, indications of an affair between MM and RW, FM is angry |
| 11 | **Morning, going out for planned buffalo hunt** RW's thoughts, more hints at possible adultery the night before |
| 12 | **Hunting of buffalo, action scene and turning point** FM is fearless, shoots buffalos, teams up with RW on same level |
| 13 | **Dialogue after successful hunt** MM picks on RW (hunting laws) and RW now appreciates FM |
| 14 | **Discover buffalo escape, déja vu situation of lion hunt** FM has no fear this time, feels happiness, eager to go after escaped bull, and RW is moved to see FM *"come of age"* |
| 15 | **Culminating scene, murder/accident** Buffalo attacks again, all of them have rifles, FM shoots bull, MM kills FM surprisingly – by shooting him from the back |
| 16 | **End scene, dialogue** Preparations for aftermath. Ironic dialogue: accident or murder? RW: *„Why didn't you poison him? That's what they do in England."* |

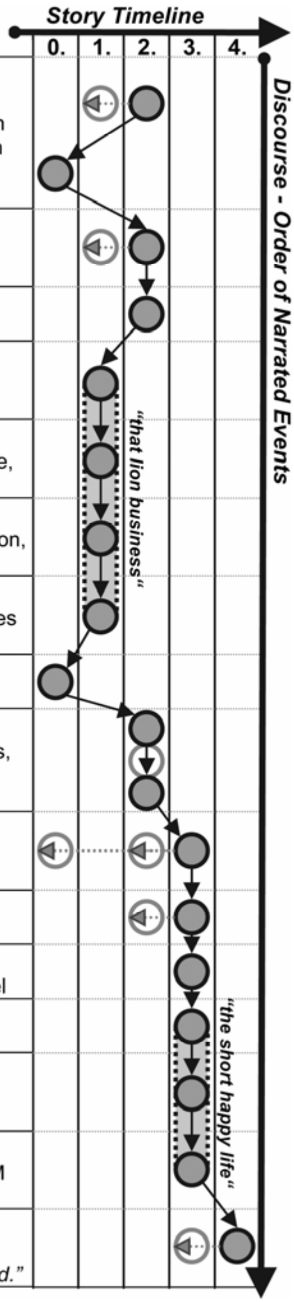


**Fig. 1.** Overview of narrated events (discourse, top to bottom) and timeline of corresponding diegetic events (story, left to right). Filled/dark circles denote explicitly described events; empty/white circles indicate parenthetical hints at something undefined that may have happened in the past. The 'Story Timeline' numbers refer to the description in section 3.1. Timeless exposition descriptions are in the first column (marked '0.').

car", or "having the rifle loaded", we found that these are only of satellite character. The important states (as kernels) that drive the story, for example by representing goals, are character attributes, such as traits, attitudes or emotions. We list the changes in the characters' attributes we observed as being introduced by important events.

- **FM: "Shame"** is the first explicitly mentioned emotion of FM, connected to the incident with the fear of the lion. He wants to be a hero but he is not. He has been repeatedly publicly humiliated by his wife. The situation seems to be even more complex in further interpretation by the reader. FM is aware that he makes a fool out of himself, but cannot do anything about it. His pride makes him go hunting.
- **FM: "Fear"** is the second explicitly mentioned emotion, and as we see by its occurrence in the analepse, it is one of the reasons for the shame. Fear is also complex, as it is being scared of the lion, further the fear to fail and gain disrespect (telling RW he shall finish it up alone because of his fear), and fear of being left by his wife.
- **FM: "Anger"** occurs after MM has obviously been dishonest with him, at the same time he is angry at RW. It is related to a feeling of hate towards RW and partly at his wife. Anger makes him forget his fear.
- **FM: "Happiness"** explicitly appears suddenly as an obvious result of shooting the buffalo fearlessly and successfully. In our interpretation, it is even more complex, as it seems that he realizes that he has lost MM and suddenly feels independent of her, as he lost the fear of being left. It is the state that he missed longer before than he knew about lions. This happiness has to do with his coming of age.
- **MM: "Disrespect"** is shown very often by MM's capricious behavior and is also mentioned in expositional text passages or attributions of cruelty in RW's thoughts. It is at times open contempt towards FM, with one exception as she cries because of his failure. In contrast, she respects RW for his manfulness.
- **MM: "Fear"** of FM's bravery and happiness occurs late in the story and only briefly described. We interpreted that the reason for this fear is that with FM's coming of age, she is not anymore in control, maybe afraid of being left by him.
- **RW: "Contempt"** (implicit) of both FM and MM as a type of rich American clientele he is experienced with, and especially for FM's willful ignorance of hunting ethics. He loses his disrespect of FM at FM's coming of age experience and starts *"to like him"*. We interpret that he keeps the contempt of MM even after their romance. RW has strong ethics and principles, but only his own, disregarding formal laws. RW is the character who undergoes almost no changes, and many scenes are narrated through his PoV and with his appraisal.

The goal of this exercise cannot be to obtain a complete and correct psychological model of a human being, but to extract attributes that we considered as driving the story. Not all of these attributes are explicitly mentioned in the narrative, some have developed implicitly in our understanding of the story.

### 3.3 Abstraction of Events and Actions Existing in the Discourse

In many situations, it is not easy to decide which verbs of Hemingway's delivered prose – representing the narrative discourse – are to be extracted as actions relevant to the story. With the intended adaptation to a different medium in mind, it is important to first abstract these verbs to the level of the situation model, in order to then find suitable new representations in the interactive medium. In comparison, the characteristics of the film medium demand that inner thoughts and states – such as emotions – of characters cannot just be ‘reported’ by language, but have to be represented in the visual ‘mimetic’ medium. Critical design principles (such as: ‘show, don’t tell!’) have been developed over the years [12], for example the claim to have to ‘externalize the internal’ by introducing media-specific events or actions instead of states verbally narrated (e.g., by too much dialogue).

Remarkably, Hemingway uses a mixture of state descriptions, inner monologue of several characters, and at times a style of narration that externalizes the inner states similar to a visual description. For example, after describing the point of view of the lion in the situation in which it was shot, the story continues: *“Macomber had not thought how the lion felt as he got out of the car. He only knew his hands were shaking and as he walked away from the car it was almost impossible for him to make his legs move. They were stiff in the thighs, but he could feel the muscles fluttering.”* In this scene, actions/verbs are used to circumscribe and emphasize a state description of how scared Macomber really was. The words also added to the interpretation of his character, being arrogant and willful ignorant of jungle animals and situations, in contrast to Wilson *(“He’s a hell of a fine lion”)*. Another example: *“Macomber shot again and everyone saw the bullet throw a spout of dirt beyond the trotting lion.”* Making a connection to the previously constructed impression of Macomber suffering from shame and fear to fail, the hint that *“everyone saw”* rather emphasizes interpretations of these states than being important actions of the other characters.

## 4 Adaptation: Adding Interactivity

“Adding interactivity” is not simply providing alternative branches to the discourse’s flow. There have been many discussions and contributions about this topic, ranging from claims that it is not possible to make a linear story interactive by just placing decision points at crucial plot points [6] up to insights that one way of letting users participate in the story is by giving them the same possibilities for action as available for defined characters [21]. The latter means generalizing actions to not be bound to a position in the linear flow, but to be universally usable, and to include situational information, such as conditions for their occurrence and descriptions of their effects. Some engines can process plans based on information of goals, subgoals, operating tasks and other engine-specific elements, for example ‘obstacles’ and ‘values’ in IDtension [21], situational ‘roles’ in Storytron [7], and planning operators in Emo-Emma [3]. Authoring exercises have shown [11] that the way these abstract descriptions have to be conceptualized differ a lot due to the kind of underlying engine, whereas all methods include some way of defining conditions for actions.

Therefore, a crucial step in translation of the described actions into interactive acting potentialities – if at this point, we do not want to specify the engine we use – would be to explicitly tell what conditions were at work in each acting situation. If one works through the presented story from action to action, not only local situations are important, but also global ones (e.g., goals and traits), which the reader is only aware of after having finished the story, possibly after several readings. One crucial consideration e.g. is defining the cause for FM's sudden happiness, that is, the actions or state changes that must have happened in order to let this state turn to 'happy'.

### 4.1 Possible Changes through Interaction

Interactive Storytelling implies that there is the possibility for human participants ('users') to influence aspects of the discourse and/or of the story, for example by deciding between different options for action. In the thought experiment, we brainstormed alternative endings for the story. This is in any case a creative decision. Fig. 2 shows first ideas how players can possibly influence the ending, by permuting the attributes of a 'short' and 'happy' life.

| | short | long |
|---|---|---|
| happy | FM comes of age and is happy<br>→ MM now hates FM, because she cannot dominate him, and fears losing her standard of living<br>→ MM kills FM in the heat of the moment (by accident or on purpose?) | FM comes of age and is happy<br>→ MM fails to further dominate FM and fails to kill him in hate<br>→ FM leaves MM and breaks with his previous life<br>→ FM becomes a hunter like RW |
| unhappy | FM continuously fails<br>→ MM and RW lose all respect for him and he is desperate<br>→ FM commits suicide, OR he is killed by an animal in a hunting accident | FM continuously fails<br>→ MM and RW lose all respect for him, but he survives because they repeatedly rescue him<br>→ FM lives on in coward hell |

**Fig. 2.** Four different endings of the story, permuting the 'short/happy' life attributes (the upper left quadrant is the original ending)

From a mere operational perspective, in order to achieve different story trajectories or even endings, it is necessary to add material, especially definitions of alternative actions and their effects, which then alter conditions for other potential acting situations. At this point, creators must leave the initial story aside and actually put in novel content, which is needed to create enough interesting situations [6]. An example for a boring decision would be to have to decide between "shoot" and "not shoot" – for the absence of alternative 'affirmative' options for action. In order to explore the invention of new actions, a model and its implementation has been tested with the Storytron system [7], where the player plays Francis Macomber (FM).

### 4.2 Model of Relevant Attributes and Possible States

In a conceptual model suitable for interactive changes, more possibilities have to be planted than in the original story. Fig. 3 shows character attributes including their interpreted goals, significant emotional values or attitudes (derived from the list in section 3.2 and by further interpretation). Ideally, such a model enables the outcomes of the original storyline plus alternative trajectories and endings.

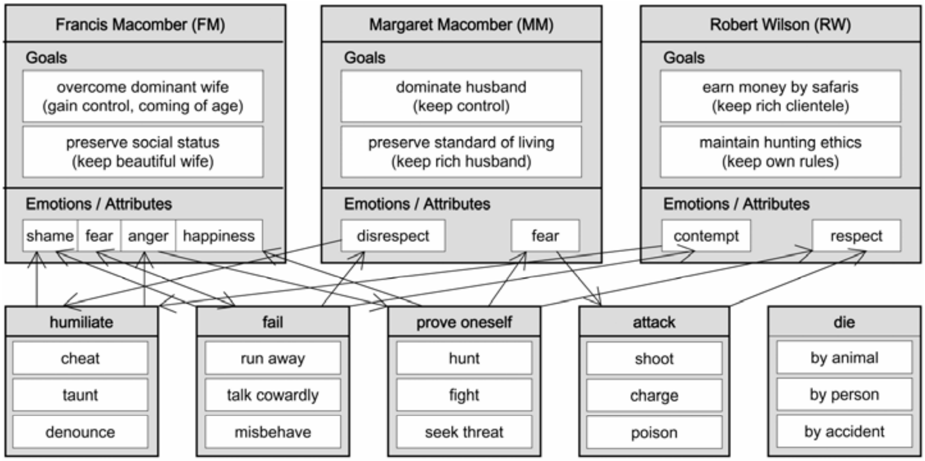


**Fig. 3.** Partial model of the most relevant states of the storyworld, including main goals of the characters (top) and a subset of generalized actions (bottom). The arrows indicate the possible elicitation of relations from the original story (mostly about FM); further details have to be invented, if needed for a balanced and more open-ended storyworld.

As one strategy to introduce variations, events have been categorized according to their effects and pre-conditions, possibly grouping alternative detail actions (see Fig. 3). For example, concrete doings such as ‘cheat’ or ‘taunt’ fall under an abstract action of ‘humiliate’. This simplifies the model, while still providing alternatives and room for newly invented actions, such as several ways of being killed, which by their scope do not violate the philosophy of Hemingway’s storyworld. For example, dying through an animal attack was always a probable event and one reason for FM’s fear, although it did not happen in the narrative.

Another crucial finding was that the character trait descriptions in the original only suffice to explain the existing ending of the short story – even not completely. We interpreted the actual ending of the story – FM suddenly being shot by his wife – as very surprising and a bit irrational (which is a widely shared and discussed experience). A probable reason is that Mrs. Macomber (MM) is not as profoundly described as the two male characters. She appears capricious, which is not a convincing motivation for her doings in an interactive model, because then everything could appear randomly. In an interactive process model, we need attributes of characters that convincingly drive their actions, also for alternative endings. As the player shall choose FM’s actions, the other two characters need a more profound trait description than Hemingway provided us with.

Interestingly, the film adaptation “The Macomber Affair” (of 1947) avoids the surprise effect of MM’s deadly shot by framing the jungle events in RW’s flashback, beginning with FM’s death and pursuing the mystery of its circumstances. The film presents a new, graspable point of view of MM, which is only possible by also slightly changing FM’s character, showing him not only cowardly but also a bit mean.

### 4.3 Additional Requirements

As with adaptations in general, the possibilities for changes and additions are great and a matter of creative work. The invention of more possible actions and therefore also of more character attributes is required. Whether the result is still a 'Hemingway' storyworld is questionable and discussed by Hotchner for film adaptation when faced with a plot only partially developed by the source writer. *"When I carry forward a Hemingway situation, I must consider whether the movement and the people are in keeping with what Hemingway himself would have done… I try to determine this from everything I know about all Hemingway has written"* [9]. A risk may be shown by the incident that the natural absence of the writer's characteristic prose in the film adaptation has led to criticizing the rather blunt core content of that story. In the linear story, FM only comes of age when his anger overgrows his fear and shame. In an interactive version, this is difficult to achieve, as the outcome depends on the player's failures in the beginning. It is rather a case for role-players than for addressing players with a 'gamer' motivation, which has to be represented in the piece accordingly.

## 5 Conclusion

The paper illustrated a process of adaptation of a so-called linear story to abstract models that can further be operated by story engines. In contrast to existing work with a similar motivation and the achievement of a formal logic model, we focused on discussing the fact that individual interpretation is always at work in an adaptation, completed by creative addition of content necessary for the storyworld being processed. The conclusion is that we suggest the impossibility of an authoring process for Interactive Storytelling, in which writers as story creators hand a written story outline to engineers to let them implement it, a consideration still present in the IDS community. The alternative point of view is that responsible interactive story creators have to first model on a less technical but still abstract level, and further participate in the whole process of storyworld implementation in a team, including the tuning phase left out in this paper. There is a necessity for tools supporting that teamwork.

## Acknowledgements

This work has been funded (in part) by the European Commission under grant agreement IRIS (FP7-ICT-231824).

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# Narrative Annotation and Editing of Video

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**Abstract.** Narratives are widespread in multimedia, especially in linear audiovisuals. However, rare are the approaches that deal with video annotation and editing with respect to the narrative content. In this paper, we introduce an annotation schema for the narrative features of media objects, that relies on a formal theory of story and characters, and we describe a software tool, called Cinematic, for the annotation of video objects and the automatic editing of the annotated objects.

**Keywords:** media annotation, narrative annotation, interactive storytelling.

## 1 Introduction

The last decade has seen an increasing interest in the annotation of audiovisuals for use in a number of high-level operations, such as editing, summarization, extraction [17]. One common approach is to combine annotated segments according to principles that range from rhetorical structures (such as in the Terminal Time system [14]), themes (such as the humourous sketches produced by Auteur [16]), film editing rules (such as the LIVE system [5]). Depending on the system, segments are annotated with audiovisual features (such as the dominant color of a shot), structural features (shot type, e.g. close-up or long shot) or semantic features (location of the shot) [3].

Notwithstanding the importance of stories[1] in audiovisuals, narrative information is normally not found in the metadata accompanying media assets (see, for example, [13]). In this paper, we propose an annotation schema for the narrative features of media objects and a software tool, called Cinematic, for annotating these objects and validating the annotation, centered on audiovisual media.[2] The annotation schema is based on a hierarchical segmentation of media objects into story units and provides a character-centered, action-based representation

[1] Paul Schrader (*The Guardian*, Friday 19 June 2009) estimates that a 30-year-old person today has received approximately 35,000 hours of audio-visual narrative. (http://www.guardian.co.uk/film/2009/jun/19/paul-schrader-reality-tv-big-brother).

[2] This work has been partially supported by the CADMOS Project funded by Regione Piemonte, Polo di Innovazione Creatività Digitale.

R. Aylett et al. (Eds.): ICIDS 2010, LNCS 6432, pp. 62–73, 2010.

of the story: for each unit, it describes what actions are displayed in it, the purpose for executing those actions, and how they affect the characters' beliefs and emotional states.

The annotation process relies on formal ontologies to categorize the characters' actions and emotions. The user interface of the annotation tool enforces the annotation schema through the use of templates and guides the user through the navigation of the ontologies for filling the fields in the template [12]. The tool includes an automatic editing function that, given the annotated media objects, automatically produces several linear outputs, thus opening the way to the exploration of the several roles objects can play in a narration.

The structure of the paper is the following. In Section 2, we describe the annotation schema (2.1) and instantiate it on an example (2.2). Then, in Section 3, we describe the system architecture (3.1), the annotation and the editing tools (3.2). An informal evaluation (Section 4) and the conclusions end the paper.

## 2 Story-Based Annotation of Media Objects

Media objects are assumed to be part of a sequence of segments that form a story, be it a linear artifact or, in non-linear storytelling, the output of an interactive session. Each object is a *narrative unit*, that contributes to the story advancement by bringing about changes in the story world and affecting the characters' state. The annotation schema of a narrative unit features three main components: *story structure*, that accounts for the role of the unit in the story; *character*, that represents the state of the characters participating in the unit; *world state*, that declares what are the pre-conditions that must hold in the world for the unit to be displayed (or for the character's actions to be executed) and what are the effects that hold after the unit is displayed (i.e. the effects of the characters' actions).

### 2.1 Annotation Schema

Abstracting from the conventions of specific media, a narrative unit can be recursively expanded into a number of children units, forming the *plot tree*, such that the story advancement provided by a unit is part of the story advancement provided by its parent unit [11]. Elementary narrative units, exposed to the audience, implement the actual changes in the story world. According to mostly accepted conventions of screenwriting (see, e.g., [15]), elementary units, sometimes called *beats*, consist of characters' conflicting actions (conflict may also be caused by unintentional events). The first component of the annotation schema represents the plot tree through the Gorn address notation. There are no restrictions on the number of tree levels and the number of units at each level.

The second component of the annotation schema contains the description of characters (the characters' "bible" in scriptwriting terms). In order to limit the arbitrariness of the description, the template for annotating the characters relies on a well-established formal framework for intelligent agents, the BDI model [4],

**World War II. 1944, Italy.**
[1] *Two partisans, Tenebra, the commander, and Echo, his subordinate and guide, are on a mission in the North of Italy.*
[1.1] The mission begins. [1.1.1] Echo says goodbye to his girlfriend, Agnese. [1.1.2] Days after, while they walk in the woods, Tenebra reveals that their have to meet an Allied officer in another county. [1.1.3] During the walk, they talk about their life as civilians. [1.1.4] They make a halt and decide to go back at Agnese's farm to get food and water. [1.1.5] As they resume the walk, Tenebra and Echo have a quarrel about Echo's reliability as a guide. [1.1.6] They talk about their previous life.
[1.2] They get to the farm without being noticed. [1.2.1] At the farm, they find that Agnese is being tortured by a brigade of nazifascists.

[2] *The fight with the nazifascists.*
[2.1] Echo and Tenebra split up. [2.1.1] While Tenebra decides to stick with the mission, Echo decides to rescue Agnese.
[2.2] Echo attacks. [2.2.1] With a stratagem, he kills most of the brigade, except the officer, who asks him to surrender in exchange for Agnese's life.
[2.3] The rescue. [2.3.1] Tenebra decides to go back. [2.3.2] Unnoticed, Tenebra reaches the officer from behind and shoots him.

[3] *Echo and Tenebra resume the mission.*
[3.1] Echo and Tenebra walk away from the farm. [3.1.1] Walking through a field of corn, Echo and Tenebra abandon the fight scene.

**Fig. 1.** The synopsis of the example story, the short film "1944", directed by A. Scippa, Italy, 2007. The numbers in square brackets mark the structure of the plot (see Fig. 2).

and the representation of characters' goals and actions within the template relies on ontologies. According to the BDI model, an agent consists of Beliefs about the world, Desires (or goals), and Intentions (i.e. commitment to action plans aimed at achieving goals). In computational storytelling, this model has proven effective both as an operational solution for creating believable characters [18,2] and as a theoretical framework for analyzing narratives from the aesthetic perspective [8]. In the annotation of a story, actions (and goals, as their originating, motivational source) have different levels of granularity across the plot tree. At the highest levels of the plot, characters' goals tend to persist, while low–level, immediate goals tend to be continuously modified in reaction to the plot incidents. Similarly, at the highest levels of the annotation, characters' actions can be described as complex actions, that incapsulate sequences of simpler actions at the lower levels – in the same way as the action "dating" includes "inviting somebody out", "reserving a table", etc.

As pointed out by [20,7] and [6], moral and emotional aspects must be accommodated into a rationally-inspired model, such as the BDI model, in order to account for actual characters. Taking screenwriting manuals as a reference, plots are organized so as to put at stake *values* of increasing importance, until a climax of characters' struggling, after which value–based conflicts tend towards a resolution. A value is an assignment of importance to some type of abstract or physical object [1]; recognizably subjective [9], values are ranked in a scale that may differ among characters. A model of how characters modify their goals (and plans) in response to values at stake is described in [6]: each value is associated with a specific condition; if that condition holds in a state of the world (as represented in the character's beliefs), the value is *at stake* and the character forms the goal to reestablish it.

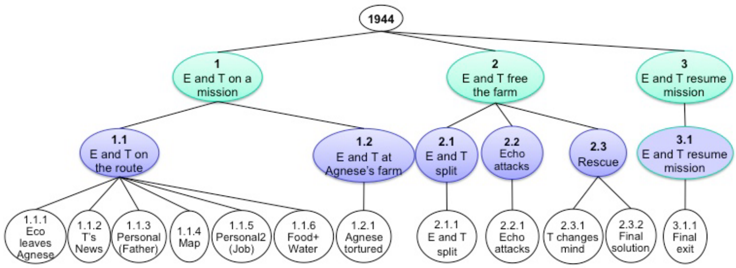


**Fig. 2.** The plot tree of the example story (see the synopsis in Figure 1)

Characters' actions can be successful or not in reaching goals; depending on their outcome, and on the outcome of the others' characters' actions, characters may feel *emotions* such as hope, fear, or shame. Cognitive studies have pointed out the relation between intentions, i.e., action plans, and emotions [10]: according to the cognitive framework proposed by Ortony, Clore and Collins [19], emotions stem from the appraisal of one's and others' actions based on a combination of self-interest and moral evaluation.

The third component of the annotation schema is given by the dynamics of the world state along the story. This component accounts for the narratologists' claim that plot incidents must be causally connected to each other as a very precondition for story construction [21]. In the annotation schema, this feature applies only to the elementary narrative units, i.e., where actual actions occur and actual preconditions and effects can be traced. Here, the annotator is required to detail out the actual changes brought by the characters' actions in each narrative unit, in order to track the causal connections among the individual story segments.

The annotation of the state of the world before and after a certain unit also accounts for the audience's point of view, mediating between the logical description of actions and their actual preconditions and effects as displayed in the narrative. This part of the annotation schema is particularly important because the automatic editing function uses it to combine the segments linearly.

## 2.2 Annotation Example

In order to illustrate how the model applies to actual media objects, we resort to an example story (Fig. 1). The structure of the plot of the example story is represented in Fig. 2 and the annotation of a sample unit is represented in Fig. 3. In the following, action types in characters' actions and goals refer to the IEEE Standard Upper Merged Ontology (http://suo.ieee.org/), for its paradigmatic value. However, while the annotation schema is intrinsically committed to formal models of story and character as described above, the same does not hold for the description of environment and the characters' actions: each story world is likely to require its own domain ontologies to describe how things and characters behave in it, and what type of values characters care for.

Unit Id: 1.1.1
Description: Echo says goodbye to his girlfriend, Agnese.

Story Structure

- **Unit Tree Position**: 1.1.1
- **Level**: 3.
- **Children Units**: none.

Characters

- **Character**: Echo.
  - **Character's belief**: occupied(Italy).
  - **Character's goal**: Leave.
  - **Goal achievement**: true.
  - **Character's action**: ExpressingFarewell.
  - **Values at stake**: freedom.
  - **Emotions**: sadness about departure; love for Agnese.

- **Character**: Agnese.
  - **Character's belief**: occupied(Italy).
  - **Character's goal**: ExpressFarewell.
  - **Goal achievement**: true.
  - **Character's action**: ExpressingFarewell.
  - **Values at stake**: freedom.
  - **Emotions**: fear for Echo; love for Echo.

World State

- **Preconditions**: $not(on\_mission(Echo))$; $together(Echo, Agnese)$.
- **Effects**: $on\_mission(Eco)$; $not(together(Eco, Agnese))$.
- **Link**: 1944_111.avi

**Fig. 3.** The annotation of the unit 1.1.1. (see the synopsis in Figure 1)

In the opening scene of "1944", Echo says goodbye to Agnese (unit 1.1.1), as annotated in the *Description* field of the schema. The *Unit Position* and *Level* fields of the Story Structure encode the position of the unit in the plot hierarchy. As for the annotation of the Characters, Agnese is sad (*Emotions*) for the imminent departure and worried that Echo's may be hurt or die. Echo is also sad (*Emotions*). Both of them are willing to sacrifice themselves in the name of the freedom of mankind (*freedom*). Echo's goal is to leave for the mission (*Character's goal*) and this goal is accomplished (*Goal achievement*) by saying goodbye to Agnese (*Character's action*). Agnese's goal is more limited in scope, as she simply wants to bid him farewell.

Finally, the annotation schema explicitly records the World State holding before and after each narrative unit. For example, in the annotation of the narrative unit 1.1.1, the preconditions and effects explicitly state the connection between the action of leaving (Echo's achieved goal in the unit) with the fact that, as a consequence of leaving, Echo begins his mission (*not*(*on_mission*(*Echo*)) and (*on_mission*(*Echo*)) before and after the unit).

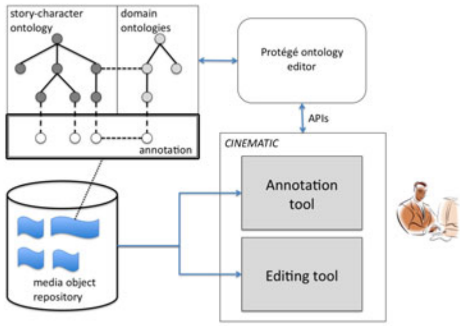


**Fig. 4.** The architecture of Cinematic. Ontologies (top left) are accessed by the annotation and editing modules (bottom right) trough Protégé APIs and constitute also the format in which objects (bottom left) are annotated.

Notice that the annotation above only describes the content of the narrative unit at the local level. The full intentional and actional account of Echo's behavior is provided by the annotation of the units that constitute the context of the individual unit in the plot tree, i.e. the parent unit, 1.1 ("The mission begins ..."), and the subsequent unit, 1.1.2 ("They walk in the woods...") in Fig. 1. In the parent unit, 1.1, Echo's goal is *to go to the meeting* with the Allied officer, a goal that is pursued by Echo (and Tenebra) by *walking* to the meeting point. The action of "leaving", displayed in unit 1.1.1, constitutes the initial subpart of the "going" action, as expressed by the axiomatization of the Leaving process in IEEE SUMO ontology ($(subProcess\ ?LEAVE\ ?GO)$).

## 3 The Cinematic System

Cinematic is a software tool for the annotation and automatic editing of audiovisual segments according to the schema described above. The design principle of Cinematic adopts the viewpoint of the script supervisor in a production team. The script supervisor is responsible for checking the continuity in a sequence of segments, during the film production, in order to prevent the introduction of inconsistencies or unmotivated meaning gaps.

### 3.1 System Architecture

The system consists of two main modules, the annotation tool and the editing engine (Fig. 4). The architecture builds on the top of Protégé ontology editor.[3] It takes as input a set of media objects, for example, video segments, and a set of ontologies that describe both the concepts of story and character and the domain knowledge, and generates a set of instances that constitute the annotation of

[3] (http://protege.stanford.edu)

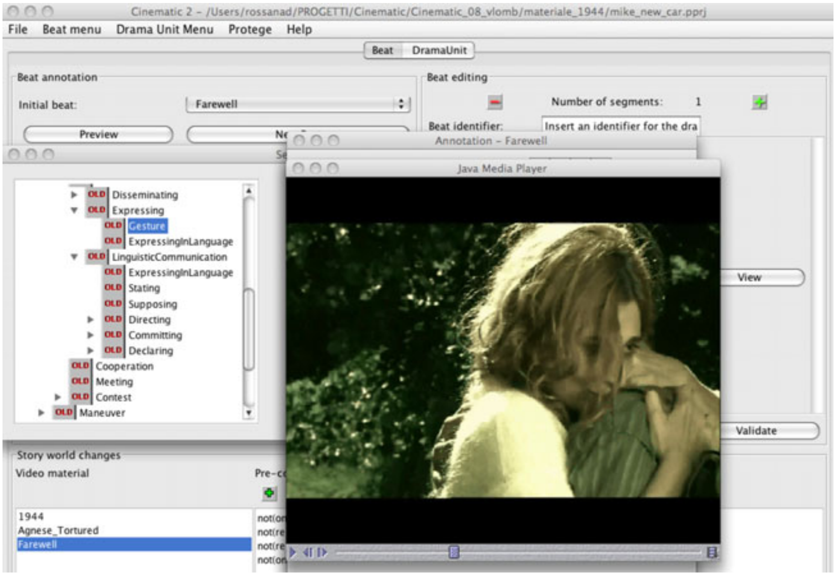


**Fig. 5.** A screenshot of Cinematic interface for annotating narrative units (here, the unit 1.1.1 is shown, described in Section 2.2). On the left, the pop-up window for navigating the ontology of processes in the annotation of characters' actions.

those objects. For example, each narrative unit is an instance of the "narrative unit" class in the story–character ontology, and the components of the annotation schema are represented as properties of this class. Narrative units are linked to the corresponding segments, stored in a repository.

Cinematic is developed in Java (SDK 1.4.2) and relies on Java Media Framework (JMF) for the display of videos. It embeds the Protégé ontology editor and is interfaced with Protégé through its APIs. In order to support interoperability, it adopts Protégé ontology language as its native format for encoding both the annotation schema and the annotation instances (e.g., units, characters, actions, ...). So, the annotation of a video is saved as a Protégé project and can be accessed standalone as such.


**Fig. 6.** The dialog box for annotating characters' emotions

### 3.2 Annotation and Editing

Since the complexity of the annotation schema and the formal language by which it is encoded may make the annotation hard for the human annotators, the user interface enforces the annotation schema through templates and allows the user to browse the ontologies during the annotation process[12].

The interface of Cinematic is divided into three parts. In the left pane, the structural aspects of the unit (characters, actions and goals, etc.) are annotated. The description template for the character is enforced by form filling; in the annotation of the action types, the user can rely on a decision procedure, opened in a pop–up window, that helps her/him to select the right type of action by answering questions. Action types can also be selected by the annotator by navigating the ontology, as shown in Figure 5. In order to keep the annotation open, new action types can be created by the user during the annotation process and become available for future annotations. A decision procedure is provided also for emotion types (Figure 6).

The lower pane of the interface for annotation deals with the annotation of the pre-conditions and effects of the unit. While the categorization of the actions is mainly oriented to the analysis and retrieval of segments (and, as such, it relies on ontologies), preconditions and effects are project-specific. So, they are encoded through ground formulae of predicate logic, but do not refer to a shared semantic layer. This pane contains two text areas for preconditions and effects, where the user inserts, removes or modifies the ground formulae one by one.

The right pane of the interface deals with the editing function (see Fig. 7). The editing tool allows the annotator to validate a given sequence of narrative units (manual mode), or to generate new sequences automatically by considering all the possible sequences of the available elementary units (automatic mode). Editing relies on the annotated preconditions and effects, considering a narrative unit as an action operator, in the perspective of situation calculus. So, while most approaches view segments as fillers of placeholders within templates of some type (see Section 1), Cinematic considers them as operators that transform a state of the world into another state of the world.

By clicking the 'validate' button, a search engine explores the space of the possible sequences (of length $n$) through an all–path exploration that retrieves one–by–one all the possible sequences. Or, in manual mode, it validates the sequence of units selected by hand by the user. Generated sequences are saved as annotation projects in Protégé format, but can also be saved as video files in .avi format.

With the automatic editing, the tool may output several sequences, due to underspecification in the annotation. For instance, in the example story (Fig. 1), the order is indifferent between the two units in which Echo and Tenebra talk about their families and jobs (1.1.3 and 1.1.5). In this sense, the editing tool lends itself to the exploitation in artistic productions, both to stimulate the author's creativity, and to test the re-uses of existing media objects. Being intrinsically non–linear, then, it is particularly suited for content editing in interactive storytelling.

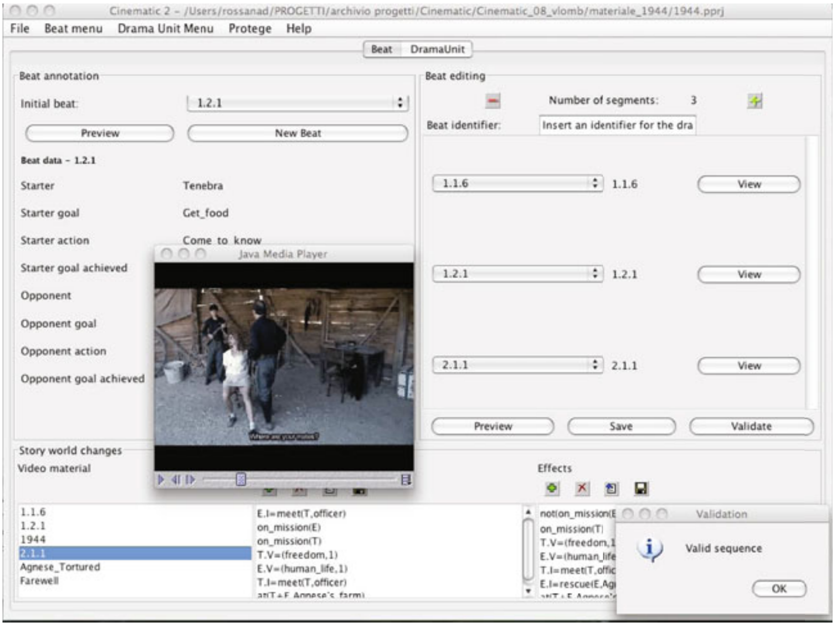


**Fig. 7.** The editing pane, on the left, with the manual editing mode (see Fig. 8)

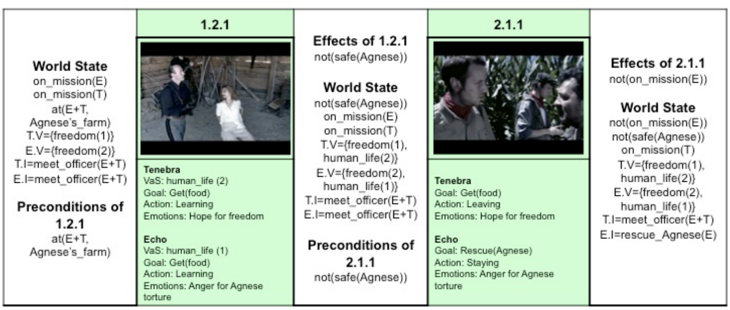


**Fig. 8.** A schema of the log of the editing of two "1944" units in Cinematic (Section 3.2). Grey boxes describe the characters' goals, intentions and values at stake in each unit. White boxes contain preconditions and effects of the units.

In order to describe how the editing works, we will resort again to the example story (Fig. 8). In the unit 1.2.1, Echo and Tenebra get to Agnese's farm and they come to know ("Learning" action type in SUMO) that she is being tortured by a brigade of nazifascists. As an effect, the value "human_life", acknowledged by the two characters, is put at stake. The annotation represents this state of affairs by inserting "human_life" as a new value at stake in the characters' description, and the formula $not(safe(Agnese))$ in the unit effects.

In the unit, 2.1.1, the preconditions include the fact that Agnese is not safe ($not(safe(Agnese))$). In this unit, the annotation of the characters accounts for their divergent moral judgements, due to subjective value scales. For Echo, "human_life" has a higher priority than "freedom", so he changes his goal from "Get(food)" to *Rescue(Agnese)* (an instance of the "UnilateralGetting" action type). On the contrary, Tenebra's commitment remains unaffected, since the value of freedom, for him, has a higher priority. In order to mark the fact that Echo in not on a mission anymore, the annotation explicitly states $not(on\_mission(Echo))$ within the effects of the unit 2.1.1. When the sequence of the two segments is validated through the automatic editing function, only the intended sequence is generated, since the effect $not(safe(Agnese))$ of the unit 1.2.1 matches the preconditions of 1.2.2., but the reverse does not hold.

## 4 Evaluation

In order to test the adequacy of the annotation schema and the usefulness of Cinematic, we carried out annotation experiments with short movies and selected scenes from feature films and other narrative media, such as theatrical performances. Users were students of film and media studies of the School of Media and Arts of the University of Torino. The testing lasted for a period of three years and involved about 30 students.

Students only received a basic training in the type of formal annotations required by the tool (ground formulae of predicate logic and computational ontologies), then students were required to segment and annotate narrative audiovisuals and to check the validity of the annotation by producing the original sequence through the editing tool. Also, we asked students to vary preconditions and effects so as to relax the constraints of the original work, in order to understand what aspects of the narrative were mostly responsible for the original sequence and to test the feasibility of alternative sequences.

Most students decided to apply Cinematic to short movies, especially animated cartoons, where gags were easier to annotate in terms of actions, and characters' features usually were extremized versions of human characters, so that they would easily fit into SUMO categories. However, we also received original projects, with students producing new videos according to an attitude that relied on the possibilities offered by Cinematic. For example, they carried out experiments in authoring by editing segments that only contained textual descriptions of the actions played by the characters, in order to find out what possible sequences would be generated before continuing the production process. In other cases, they took the logs of Cinematic executions to build interactive stories, by proposing the audience to choose among possible continuations.

The evaluation was conducted only in informal terms, with the intention to assess the satisfaction of users during the execution of their projects, which largely varied from one user to another concerning both aims and assumptions. Although a proper comparison was not possible, the general comments were that they found the tool interesting to use in both analysis and production. Those who started from existing videos complained about the length of the segmentation process (done outside the Cinematic tool, with standard slicers). On the contrary, the annotation of precondition and effects was considered challenging but easy to perform. One of the most difficult tasks in the annotation was to select the appropriate process type for describing actions and goals from the SUMO ontology. Users were often led to create completely new action classes, while a deeper exploration of the ontology would have been sufficient.

Cinematic has also been tested in experimental media production and cross–media analysis; the projects are described in [12]. These experiments also confirmed the suitability of Cinematic to stimulate the artists' creativity and to analyze different media by obtaining comparable results.

## 5 Conclusions

In this paper, we have proposed a narrative–based annotation schema for media objects and a tool for the annotation and automatic editing of video segments, called Cinematic. Cinematic relies on a widely accepted theoretical background, reflected in the tripartite schema of the annotation: the hierarchical organization of narrative units, the character–centred analysis of actions, and the story progress through the state changes in the story world. The feasibility of this approach has been tested by carrying out informal experiments with real users.

The long term goal underlying Cinematic is the production of a reference corpus for the annotation of narrative audiovisuals, useful in a number of tasks that include, but are not limited to: media analysis, production, media reuse, access to cultural heritage archives, interactive system design.

The current annotation schema does not address the visual properties of the media objects through which the story is delivered (mood, shot, sound, etc.). This aspect, pertaining to the language of filmic expression, should be incorporated in a more comprehensive schema, so as to account for the work in film language and its relations to cognition [22].

As future work, we also envisage the development of more sophisticated validation and editing functions, such as interactive editing, but also the evaluation of the tool through systematic experiments with professional users.

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# A Story to Go, Please

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**Abstract.** In this paper we present an approach for an association-based story environment, in which a priori unrelated experiences represented in images, are stitched together to guide users through interesting city spaces. We describe the associative stories generated by this system, and outline how the notion of 'hypespot' facilitates linking the real world with the structure of the story. We outline the overall architecture of the system and provide a generated story example.

**Keywords:** location-based storytelling, guided story space exploration.

## 1 Introduction

Visiting a place often means either exploring territory by comparing what we perceive with what we know, or listening to stories that tell us about people's experiences at this location some time in the past. The first option gives us the current now and here but we miss the rich hidden experience fabric of a place. The second option forces us to step back from the real and dive into representation forms that provide a specific view, such as travel guide books like Baedeker (art) or Lonely Planet (lifestyle). These media forms do not necessarily represent our current mood or conflict in a given context at a location. We could of course enforce face-to-face encounters with people who are able to knit us into the rich tapestry of a location, yet those are usually hard to encounter.

The integration of low-cost pervasive and personal technology such as mobile devices into our everyday life has changed the way we interact with a location [12]. We can now leave traces of our emotional and intellectual experience as digital audio-visual attachments to any location and make them available to others, for example through augmented reality browsers. Creating such traces is widespread, as people commonly upload text, images (drawn or captured), videos, or audio files to social web environments such as Flickr[1], Facebook[2], or Myspace[3]. Additionally, most mobile devices are now equipped with GPS, which means the generated content is geo-tagged with the location of creation.

However, this available material was likely not created with the intention of being presented in a context beyond its intended one. Thus, computationally

[1] http://www.flickr.com; last retrieved: 07-08-2010.
[2] http://www.facebook.com; last retrieved: 07-08-2010.
[3] http://www.myspace.com; last retrieved: 07-08-2010.

R. Aylett et al. (Eds.): ICIDS 2010, LNCS 6432, pp. 74–85, 2010.

creating a chronology of events, characters, and settings from user-generated content poses a real challenge. Specifically, the system would need to be able to organize arbitrary experience representations in terms of 'mimesis' or 'diegesis'[4] [2] and render them structurally meaningful, with the golden aim of automatically presenting a story not about a place, but a story about being at a place.

This paper presents a method that facilitates people, who wish to explore interesting and popular city spaces, to be guided by the experiences of others. The 'Story-To-Go' system leads users along known-to-be interesting locations, where interesting is defined as the amount of digital visual content recently left by others at a place. The system generates and presents a story in an associative, homeopathic manner, leaving the completion of the story to the visitor's own motivational and psychological attributes. As a use case, we will use the well-known classic Odyssey structure, which forms a poetic, non-linear plot of events as part of a journey [6]. The motivation behind choosing the Odyssey was largely driven by a pragmatic need, testing to what extent a well-defined story structure can be meaningfully perceived in a story engine that is essentially powered by people's associative capacities.

## 2 Mimesis Systems

Relevant work is performed by Fujita and Arikawa [4] and Landry [9], where they support users' experience of locations through story generation with location-based visual media. Fujita and Arikawa developed Spatial Slideshow, a system that maps personal photo collections and represents them as stories providing route guidance, sightseeing guidance, and so on. Each story is conveyed through a sequence of mapped photographs, presented as a synchronized 3D animation of photographs that induce a motion effect. Landry developed Storytellr, a system that utilizes the storage and tagging systems of Flickr to aid creation of retrospective stories based on a three-step process: annotation, search, construction. Both systems are interesting with respect to story generation, however they function as support systems rather than automatic story generation systems.

For generative story engines, Pérez et al. [15] describe 3 different models of story generation, where they distinguish between 'structure predictability' and 'content predictability'. The structure focuses on narrative transmission and content on events, people, and things. Their notion of 'structural predictability' inspired our approach. A different approach, but also focused on structure, is the work by Multisilta & Mäenpää [11]. The authors apply narrative structure, in their case jazz music, to generate video stories on mobile phones. The narrative is told using the structure of a jazz concert, which begins with the presentation of the theme, followed by solos of various musicians, variations, and finally the band plays the theme in a new, elaborated way. They concluded that instead of generating a coherent, intense and motivated storyline out of occasional video clips, the end result was more like a montage than a story.

[4] Whereas mimesis is about showing a story (comprised of actions), diegesis is about telling a story (which usually includes a narrator).

An analogous approach to the representation of narrative structure focuses on the applicability of story grammars (context-free and generative) to text understanding, where the main influences came from Propp's work on Russian folk-tales [16] and Chomsky's transformational grammar [8]. The foundations of using story grammars to generate narratives is problematic [1], mainly because the resulting systems were either too rigid or they produced very broad sets of story sentences. Nevertheless, we reuse the idea of a context-free story grammar to create an identifiable story structure where the narrative coherence is complemented by the user's own associative capabilities.

## 3 The 'Story-to-Go' System

The 'Story-To-Go' system is part of ongoing work within the MOCATOUR[5] project, which aims to establish computational methods to facilitate tourists with contextualized and media-based access to information while they freely explore a city. In 'Story-To-Go' we take the concept of location-awareness in our location-based multimedia messaging (LMM) prototype in order to create location-based stories. Below, we describe the LMM prototype briefly followed by the story engine.

### 3.1 LMM Prototype

The LMM prototype [3] allows augmenting locations using three different media types: text, drawing, and photos. A user can create a free drawing using touch-based input, type text, or snap photographs, where the media expression is fixed at the position and orientation of the user at the time of creation. These media-based expressions are assumed to create a digital memory of the user's experience. Anyone with the application installed on their multimedia-enabled mobile device and is at the same place where the media expression was created can view it. Here, a user is presented with a camera-view, where the anchored expression appears as an Augmented Reality (AR) overlay on top of the camera view. The user is guided towards an expression by means of an on-screen indicator arrow. The augmentations generated by this tool and related metadata form the conceptual building blocks of the material used by the 'Story-To-Go' engine.

### 3.2 Story Engine

The 'Story-To-Go' story engine is a client-server based system that covers three essential elements. First, it provides the syntactic structures to generate a story in the form of an Odyssey (structure predictability). This part establishes the structures that later allow the system to generate an associative story. Second, it supplies the metadata structures associated with the geo-tagged augmentation

[5] Mobile Cultural Access for Tourists - http://mocatour.wordpress.com; last retrieved: 07-08-2010.

data (content predictability), which facilitates the content selection and presentation mechanisms that provide the visual story stimuli. Third it contains the generation rules that facilitate the clustering of expressions into hypespots and the generation of stories. We look at each of these in detail below.

### 3.2.1 Story Syntax

A story in 'Story-To-Go' is presented by showing a sequence of expressions that follow the semantic coherence associated with the Odyssey. As stated earlier, the motivation behind choosing the Odyssey is due to it's well established structure, where our aim is to revive that structure (albeit associatively) in the user's mind as s/he moves from one location to another. Figure 1 depicts the graphical representation of the Odyssey structure.

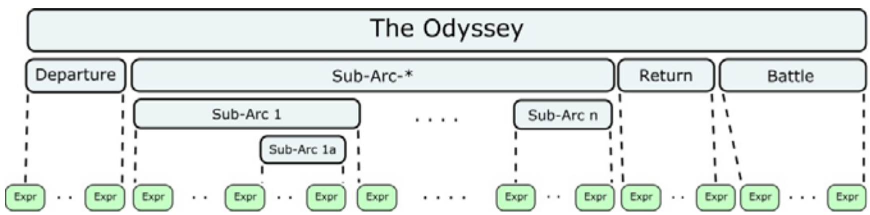


**Fig. 1.** Graphical representation of story structure of type 'Odyssey'

Syntactically, a complete Odyssey is an arc that consists of sub-arcs, where some arcs are mandatory, such as departure or battle, and others are placeholders for events that can happen in any order. Syntactically, a sub-arc consists of expressions and possibly other sub-arcs, which allows for nested structures. The elementary unit of a sub-arc is an expression. This is in line with our attempt to generate stories that are mimetic by nature.

The compositionality of the sub-arc is an important aspect of this representation. It has local meaning and provides a way for presenting the story in an episodic fashion. Its recursive character allows for stories of arbitrary length in terms of number of expressions and it facilitates branching between sub-arcs of different stories. A type of sub-arc is defined in a similar way as the story-type, except that it employs extra constraints on the meaning of the expressions that it consists of. Figure 2(a) shows the abstract definition of sub-arc, whereas Figure 2(b) presents an example of a particular type of sub-arc.

The definitions in Figure 2 represent the constraints on tags (see Section 3.2.2), which are denoted by the statements between square brackets. For example, [beginning] refers to the expression being tagged with 'beginning'. Preferred conditions are stated within parenthesis, necessary conditions without. A sub-arc definition describes its own size and complexity. The size is expressed in terms of a minimum and maximum amount of expressions that the arc can cover and the complexity refers to the maximum number of nested sub-arcs it can contain. The

```
a <X> ::= <opening>(<e>|<sub-arc-n>)*<closing>
  <sub-arc-n> ::= <sub-arc-(n-1)><sub-arc> | <sub-arc>
  <opening> ::= <e []>
  <closing> ::= <e []>

b <X> ::= <introduction><body><climax>
  <introduction> ::= <e [beginning]><e [beginning, (conflict)]>*
  <body> ::= <e []>*
  <climax> ::= <e [end]>
```

**Fig. 2.** (a) BNF of an abstract sub-arc. (b) BNF of a composite sub-arc.

abstract sub-arc definition in Figure 2(a) does not enforce any size or complexity limits, except that it should contain at least two expressions. The example composite sub-arc defined in Figure 2(b) only requires the opening and closing expressions to be tagged correctly. In Figure 3 we provide a basic example of sub-arc definitions for the Odyssey.

```
<departure> ::= <e [beginning, landscape, continuity]><e [disruption]>
<love> ::= <e [2 people, beginning]>
           <e [union, attraction, beginning]>
           <e [passion, (beginning, disruption, tension)]>*
           <e [passion, tension, 2 people]>*
           <e [separation, ending, (loose, sad)]>
<battle> ::= <e [beginning, antagonist, disruption, fear, evil]>
             <e [fear, conflict, 2 entities]>*
             <e [end, win|loose, (relief)]>
<illusion> ::= <e [illusion, vague]><e [illusion, clarity, (climax)]>
<return> ::= <e [ending, union, (relief)]>
```

**Fig. 3.** BNF of sub-arcs for type ‘Odyssey’

### 3.2.2 Story Semantics

Standard characteristics of a narrative in ‘Story-To-Go’, like identifiable characters or an explicit plot, are not used. Instead our presentation of expressions attempts to create a narrative by making use of the association created by the user. We thus use syntax and minimal semantic structures to create a coherent Odyssey narrative, but leave the more detailed semantics to be filled in by the user. In the end, the level of semantic detail that a story such as the Odyssey can contain is directly linked to the quality of the available metadata associated with the available media expressions, but our hypothesis is that this relation is logistic as opposed to linear.

The expressions used by ‘Story-To-Go’ are images, which requires the system to understand the visual semantics on three levels in order to support the story generation process: 1) What the image denotes 2) What connotations the image gives 3) How the image can be used in a story. These three levels are used in 'Story-To-Go' to provide the relevant metadata categories, namely: denotation, connotation and narranotation.

The annotations are supplied manually through tagging. This simple yet effortful mechanism was chosen because automatically acquired annotations such as name of creator, creation time and date, or location coordinates do not tell us much about the visual content. Additionally, extraction of low-level features, such as color, texture, or shapes, are insufficient for inferring the high-level intentions behind a created image expression.

Each metadata category has its own specific tags that can be added to an expression. Users can annotate expressions every time they encounter an expression, while observing an image in isolation or within a story context. Each of the metadata categories will be discussed below.

**Denotations**

For story generation, it is important to recognize what is in an image and especially relevant for detecting character agency within the image so that sub-arcs can be constructed. However, since logical continuity might cause problems, due to a lack of related material, denotative annotations in 'Story-To-Go' ask for high-level categories instead of detailed descriptions. In this way, expressions can be loosely matched. Users can add any number of these tags to an image. Over time the number of denotative annotations for an image will increase depending on the image's popularity as well as its reuse within different story settings. We used the following general categories: *people, animals, text, landscape, abstract image, entity count in image, gender count in image (male, female, neutral).*

**Connotations**

Connotations describe how a user feels about an image. In 'Story-To-Go', we use a semantic differential scale [14] to calculate the connotation value of an image. This scale is designed to measure people's attitudes toward objects, events, or concepts. People express their feeling by choosing a position on an interval scale between multiple pairs of bipolar adjectives or nouns. The configuration of positions on the scale forms the representation of a user's connotative interpretation of an image. We used the following connotation pairs, based on their usefulness to propagate a story forward [2,10]:

| | |
|---|---|
| Passion | Void |
| Continuity | Disruption |
| Attraction | Fear |
| Win | Lose |
| Clarity | Vagueness |
| Tension | Relief |
| Good | Evil |
| Happy | Sad |
| Union | Separation |

**Narranotations**
Narranotations provide information about how an expression can be used as an element within a story. They are needed to identify the type of sub-arc an expression can be used in, as well as the order expressions appear in within a sub-arc. In line with the Odyssey structure, we use the following fixed set of annotations: *beginning, ending, antagonist, conflict, illusion.*

While denotations and connotations can be thought of as generic metadata structures that can usefully enrich any expression, narranotations add more specifically to the development of a story. However, narranotations aim to capture the use of the isolated expression, so users do not require knowledge about the global structure of the story. We are aware that this type of tagging requests the use of a system like 'Story-To-Go' on a more frequent basis and hence see this as an attempt towards strongly contextualized tagging.

### 3.2.3 Story Generation

The 'Story-To-Go' story engine essentially performs two tasks: organizes the available images and related metadata according to hypespots, and then generates the story which is presented to the user in real time while exploring the city.

**Hypespots:** The aim of 'Story-To-Go' is to guide visitors through currently interesting places in a city. To achieve this, we cluster available material (images and metadata) by grouping expressions that are together at a location and that were created recently (a hypespot). A hypespot, covering 150 meter, forms a convenient real world unit to use in the creation of a story. This means that a hypespot represents a place that people frequently visit and create content there; furthermore, given the recency of expressions, it provides grounds to establish 'interesting' locations. The hypespot creation process is shown in Figure 4. This process happens in a dynamic environment, as every added image or a change in related metadata changes the expressiveness of a location, which is addressed by abstracting over all available metadata periodically every 12 hours (half a day), in order to provide the blocks of data the engine requires for generating a story.

The internal structure of a hypespot cluster makes use of the 3 metadata categories described earlier. Denotative and narranotative metadata for every image in a proximity range of 150m are handled similarly, as both provide tags that either inform about the availability of expressions or the applicability for structural placement. This allows for a simple selection process to be performed in which the relevance of a tag is determined by the frequency of its appearance. For connotative metadata, we filter for ratings that are not spread evenly [7] to ensure a bipolar representation that makes it easy to select dominant tags.

Based on the clustered material, the engine identifies and ranks the new set of hypespots in the data set by clustering the expressions according to spatial distance and activity recency. Here a variant of the QT clustering algorithm [5] was used with a temporal parameter integrated in the distance measure. This way only the maximum cluster diameter has to be defined. Once hypespots are identified, the engine searches in each hypespot for available story arcs, utilizing the sub-arc representation structures as defined in Section 3.2.1. When multiple


**Fig. 4.** Preprocessing scenario. Left: example data set. Middle: after clustering. Right: after sub-arc finding.

ways of constructing a sub-arc are possible, the system selects the best one based on the extent a given subarc complies to the preferred attributes. The found arcs are stored as frames. When a story gets generated these frames are used as the building blocks for the larger story structure.

**Story Generation Mechanism:** When a user starts a story, the system calculates basic context parameters, such as current position, end position of story and available time, to establish spatial bounds of the search space. An example heuristic looks like this: max number of hypespots = max distance / max number of hypespots per 300 m$^2$. Within this space the hypespots and their available sub-arcs are queried. The results are analyzed by making use of a partial-order planning algorithm [13], which is constrained by both story definitions described in Section 3.2.1 and the location of hypespots. The system then presents the material across different hypespot locations. The schemas shown in Figure 5 illustrate possible story paths across hypespots.


**Fig. 5.** Three possible stories

### 3.3 'Story-to-Go' Proof of Concept

We implemented a proof of concept of both the preprocessing and the story engine in SWI-Prolog and performed two evaluations. Given our limited set of material and participants, the evaluations were meant to be indications about the usefulness of the approach and not solid, empirical proof of its applicability.

In the first evaluation, we wanted to investigate the applicability of the preprocessing algorithm on a large data set. Due to the novelty of the environment we could not test our algorithm on a large enough set of real-world data. We decided to develop a simulation environment in which we applied both preprocessing as well as the story engine on a randomly generated set of 1000 expressions with variable locations spread over an area of 1 $km^2$ using a randomly chosen set of metadata for the 3 categories. We then processed the sets of hypothetical content, resulting in an average of 132 hotspot clusters, in which an average of 396 sub-arcs could be extracted.

In the second evaluation we wanted to gain two insights: first, could users identify the overall odyssey structure as well as the individual sub-stories if they are confronted only with the visual representation? Second, would our participants be able to tell a story using the material? 50 people, aged between 20 and 45, from different faculties of the University of Amsterdam participated in this experiment. Each participant was informed about the context of the research and the two tasks requested to be performed by them. Each participant was also provided with all metadata structures and associated keywords.

For the first task we asked the participants to generate multimedia messages (i.e., a digital graffiti). We wanted to make sure that the participants focused on the expressiveness of the multimedia message and not initially on the building of a story. Each participant was therefore provided with two locations, each represented as a camera snapshot taken with the mobile device's camera, and a set of related annotation keywords covering all 3 annotation classes. The provided locations all represented places well-known by the participants. This was to ensure that they could envision the complete environment even though they were only represented with a 2D fraction of it. The participants could use the LMM prototype or any other tool to generate the multimedia messages. They had a week to finalize this task. The outcome was 84 multimedia messages in the form of image overlays.

After the provision of all the multimedia messages, participants were presented with one of the odyssey stories generated by the system (see Figure 6). The participants received the Odyssey story (as a series of concatenated images) without the associated metadata. Each participant was asked to identify the story blocks and the related category of the block and state if the overall story structure passes as an odyssey. Afterwards they were asked to provide the story they made out of the images. Eleven participants provided the requested material, where the majority could identify the story segments (e.g., this segment is about love; here something violent is happening). However, none could get the section borders correct. All participants stated that the story structure could pass as an Odyssey but that it could also represent any type of drama structure.

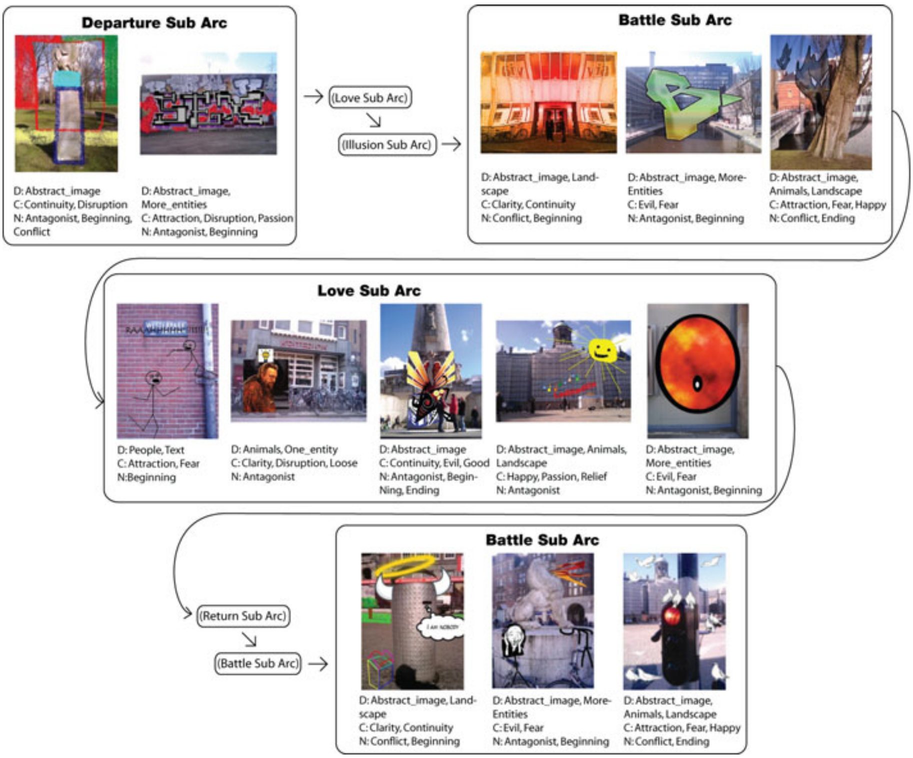


**Fig. 6.** Example story resulting from our second evaluation

The provided stories showed that all participants only at the beginning looked for indicators of the stories personage and then later connected the appearing material according to their mental representations. Thus, it was not relevant for the participants that the characters were actually present in each image, as long as they could relate some content to some character.

We are aware that presenting the story images together as a coherent whole is different than presenting a single image at a location, where the story is completed through the traversal of different locations in a city. However our evaluation supported our initial hypothesis: namely, that associative stories can be generated from user-generated content and understood by other consumers.

## 4 Conclusions and Future Work

Using the well-defined Odyssey structure, we have developed a method for generating and presenting an associative location-based story using user-generated media content, where the stories are based on the amount and recency of user activity. The proposed method uses a grammar-inspired compositional story representation based on sub-arcs. The semantics of stories are rooted in the content metadata. While we used the metadata to compose our Odyssey stories, mental associativity from the user is required for the Odyssey to be perceived as such.

The evaluations we carried out using the system-generated stories were not based on real-world user-generated content. This was because geo-tagged media messages required for the system to generate stories do not exist yet. Furthermore, motivating users to supply the necessary metadata poses an ongoing research challenge. It is important to further investigate how the established tagging categories of this work can be automatically populated with tags already available at sites such as Flickr. However, if incentive mechanisms that raise awareness in users about what stories the system can generate if they contribute their content are designed into the system, it might gradually motivate them to tag more often. Despite these limitations, our proposed method demonstrated a proof of concept system that can take arbitrary content and generate location-based stories on the fly.

To enhance the user experience of consuming location-based stories, future work should address the issue of making the user interaction with the story more interactive. One method of doing this is to allow the user to veto the system-provided routes about which location to go next and instead allow the user to pick her own route, where the generated storyline is constructed dynamically to accommodate the users decision. This kind of non-linearity would require the system to make quick, real-time updates as the user moves, which is currently not supported. However, the generic and compositional representation of stories used in our proposed method makes this possible.

Future work should also investigate using a stronger user evaluation the extent that users familiar and unfamiliar with the Odyssey structure can understand the narrative development in the Odyssey as they traverse hypespots within and across cities. This would provide powerful evidence to support the use of context-free grammar methods in generating generic story types (e.g., Shakespearean Tragedy) using locations as anchor points for the perceptual consumption and narrative development of story arcs.

Another issue important for enhancing the user experience is to set up user-driven tension bows in sub-arcs and stories. In other words, users should be empowered to give an immediate rating upon experiencing an expression (either in isolation or part of a story) that reflects their interest in what they are viewing. This kind of information acts not only as a quality-control incentive mechanism for users to exert effort in making high quality expressions with metadata, but also provides a story-quality ranking mechanism that permits the system to draw higher quality stories for presentation. To what extent system interactivity and user-driven tension bows can provide a better user experience remains an open question, one that depends on the rate at which tools that allow creating high-quality location-based media expressions are developed and deployed.

## Acknowledgments

This work is part of the Amsterdam Living Lab project (PID07071), and funded by the Dutch Ministry of Economic affairs and Amsterdam Topstad. The authors thank Amsterdam Innovation Motor (AIM) for their support.

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# Threading Facts into a Collective Narrative World*

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**Abstract.** The paper presents a framework that allows the collection of multiple story fragments from several sources and/or authors, in the context of social networks, where story fragments tell facts about items that are ontologically modeled in the system. The framework provides tools for threading facts together into stories; by doing so, it shapes a new narratological model, that mixes emergent narrative and authored approaches, and that can be defined as "collective".

## 1 Introduction

Recent years have witnessed the proliferation of Social Networking Services and more generally of the Social Web. People build, strengthen or nurture their relationships around *objects of interest*, by sharing multimedia content, tagging, rating, commenting. Due to the extensive usage of smartphones, this can happen virtually everywhere and at any time. While the first wave of Social Networks was generic, focusing on existing social relationships for the sake of themselves (e.g. FaceBook, Twitter), or revolved around digital or digitalized content (e.g. photographs in Flickr, web bookmarks in Delicious, music in Last.FM), a new generation of Social Services is emerging that focuses on real-life concrete objects, mainly as a result of geopositioning, item identification techniques (e.g. RFID) and again smartphone usage. Multimedia content, comments and tags can be attached to artwork in museums, monuments or street furniture in a city, products on a shop shelf. These physical objects then become hubs for sharing impressions, opinions, thoughts, and *stories*. Our work stems from a few observations on this phenomenon, some of which were excellently outlined in [13]:

- Story fragments are scattered around social networks. Are we able to recognize, aggregate and thread story fragments into *stories*?
- It is very difficult (even for a human) to tell apart story fragments from other content, as they are drowned in a huge amount of information.

* This work has been supported by PIEMONTE Project - People Interaction with Enhanced Multimodal Objects for a New Territory Experience.

R. Aylett et al. (Eds.): ICIDS 2010, LNCS 6432, pp. 86–97, 2010.

– It is also very difficult to give a semantic interpretation to story fragments. Mostly, they are in the form of free text, images or video. Tags can help in identifying some relevant concepts contained in a fragment, but *threading* requires finding meaningful relationships and connections, not only concepts.

It has been argued (see again [13]) that one possible way out is to provide users with tools that allow them to contribute *structured* story fragments, recognizable and suitable for interpretation.

In this paper we take a step in this direction, in the context of *semantically enhanced, thematic social networking services*. A *thematic social networking service* is a Web 2.0 application that allows users to get in touch and share diverse content regarding a specific *theme*, which is also referred to as the *domain* of the social network. A *semantic enhancement* consists of an ontological model that describes and relates the items in the domain, as well as other pertinent items.

In particular, we propose a language that allows users to (i) tell facts concerning his/her relationship and interactions with objects and/or people in the social network domain using a semi-structured approach, and (ii) provide links between facts. We discuss how a digital system can represent and interpret such facts by using *ontologies*. Finally, we describe a possible approach to help users find related facts, which they may want to connect into a story, by means of a *pertinence* measure. The result is an *interactive* and *collective* composition of stories, for which we propose a narratological model that expands the notion of interactive storytelling.

The work presented here is a part of the joint project PIEMONTE, which integrates a set of social networking and augmented reality tools, with the goal of developing a social application for iPhone™. The theme of the application is eno-gastronomy, with a focus on wine and food products as significant elements of the cultural heritage of a territory. Therefore the ontologies describe food and wine as well as restaurants, recipes, products, shops, fairs, and the actors of the domain such as cooks, producers, shopkeepers, etc. The semantic model includes also a geographic ontology for the physical locations. For this reason the examples throughout the paper will be taken from the eno-gastronomy domain.

## 2 Facts and Their Ontological Representation

In our framework users can either provide story fragments by telling simple *facts*, or provide *links* between them. An *ontology of facts* acts as a repository for such fragments. Each fact is characterised by a *predicate*, that defines the type of action represented by the fact, and a set $\mathcal{R}$ of *roles*: fillers of the roles are domain entities that play a role within the action. Examples of predicates are: `Drink`, `Walk`, `Listen`, whereas examples of domain entities are: `Yesterday`, `I`, `Wine`, `March 23rd`, `Beauty`. This structure is modeled after basic one-verb sentences in natural language.

Domain entities are elements of an ontology, with very general classes such as `Wine`, as well as very specific ones, e.g. `Bordeaux Grand Cru ACME 2001`. We do not describe in detail the domain ontology in this paper.

Domain entities can be role fillers for several roles; in particular, we consider the following roles:

– sbj (subject): who or what carries out the action (*John* drank wine.);
– obj (object): the thing(s) the action is carried out upon (John drank *wine*.);
– whr (where): any indication of the place where the action takes places (John drank wine *at home*.);
– whn (when): any indication of the time of the action (*Yesterday* John drank wine.);
– mdl (modality): any indication of the modality that further specifies how the action is performed (John drank wine *from a golden glass*.);
– why (cause or goal): the reason why the action took place (John drank wine *to forget his problems*)
– ctx (context): something related to the action that does not explicitly fit in any of the other roles.

The *predicate ontology* defines and organizes the predicates used to describe the actions performed in the facts. In the predicate ontology, predicate classes restrict the types of fillers for their roles. For example, the predicate `Drink` admits only `Liquids` as fillers for its obj role. For some predicates, or predicate classes, some roles may not be admissible, e.g. `Travel` has no object.

There are actually two sorts of predicate classes in the predicate ontology. **Abstract predicate classes** are non-lexicalized concepts, i.e. they are not associated with a specific verb (this is, actually, dependent on the specific natural language considered); they are used to define role constraints that are common to several predicates. However, there can hardly be any interest in providing (direct) instances of abstract classes, since they do not correspond to words in natural language. On the other hand, **concrete predicate classes** are lexicalized and can be instantiated. Concrete predicate classes can have subclasses as well, since there may be verbs that further specify certain actions. For example, the predicate `Devour` is a subclass of the predicate `Eat`.

The domain and predicate ontologies are represented in the Semantic Web recommendation OWL 2:

– There is a class of `Actions`, with properties corresponding to roles; i.e., properties `hasSubject`, `hasPlace`, etc.;
– Each subclass of actions has a name (e.g., `Ingest`, `Eat`, `Drink`, `Taste`) and imposes restrictions on the roles, e.g., `Ingest` must have as object some `Food` or `Drink` while `Eat` must have as object some `Food`. If a role is not admissible, we specify the empty range for the property. A role can have multiple fillers, and they can be fillers of subproperties, e.g. for an action `Move`, the property `hasPlace`, corresponding to the role whr, can have two subproperties `hasPlaceOfOrigin` and `hasPlaceOfDestination`; the origin and the destination are two fillers of the whr role.
– The class of `ConcreteClasses` has, for example, `Eat`, `Drink` and `Taste` as members, relying on the punning feature of OWL 2, i.e. the metamodelling feature where the same name can be used for a class (`Eat`, the class of eating events) and an instance (`Eat`, the member of the class `ConcreteClasses`).

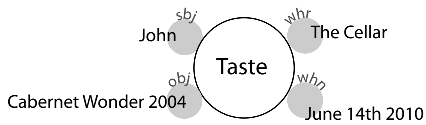


**Fig. 1.** A graphical representation of a fact

A **fact** is an individual in the OWL 2 ontology which is asserted to be an instance of some subclass of `Actions` (and inferred to be instance of other subclasses of `Actions`); the fact has role fillers in the domain ontology, respecting the type and number restrictions imposed in the action ontology.

As an example, consider the individual `f123`, represented graphically in figure 1, such that:

- `f123` is an instance of `Taste`;
- `f123` has `John` (an instance of `Men`) as subject;
- `f123` has `Cabernet Wonder 2004 - 14234` (a bottle of the `Cabernet Wonder 2004` class) as object;
- `f123` has `The Cellar` (an instance of `Wine Bars`) as place (role `whr`);
- `f123` has `June 14th 2010` as time (role `whn`);

and the other roles have no filler; `f123` would be expressed in natural language as "John tasted Cabernet Wonder 2004 (bottle no. 14234) at The Cellar on June 14th, 2010 ".

Notice that facts can also be seen as an advanced form of *tags*: tags are used to label an item, e.g., a blog post or a photo, with words the item is related to, but the relation type is generally unspecified, even though the tag is typically used to express what the photo or post is about. Facts, on the other hand, explicitly relate different elements of a social network - e.g. users, (food) items, places, etc. - and communicate the type of relation that holds between them.

## 3 Linking Facts Together

Facts express quite well simple meaning, generally conveyed in natural language with simple one-verb sentences, or paratactic sentences, containing verbs coordinated on the same hierarchical level. Notice however that the language we are introducing is less structured than natural language, leaving room for interpretation on the part of the reader. In a sense, our language can suggest what happened rather than describing it in detail. Think for example of a fact $f_1$ with predicate `Drink` having `sbj`=`Charles`, `obj`=`Cabernet Wonder 2004`, `whn`=`June 15th, 2010` and `ctx`=`Susan`. We know that Charles drank cabernet on June 15th, and that this has something to do with Susan, but nothing more is said.

In order for users to express narrative fragments, we need to provide them with means for linking facts together. In natural language this can be obtained by simple juxtaposition (when the connection between two sentences is obvious), or by subordination, or by using conjunctions. In our case, we provide three ways

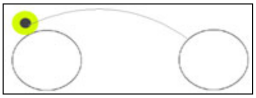

**Fig. 2.** Link 1

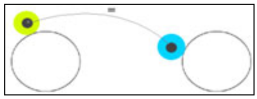

**Fig. 3.** Link 2

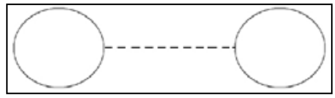

**Fig. 4.** Link 3

of linking facts that are inspired by natural language, but at the same time are less structured. Again, the idea is to suggest a connection between two things that happened, rather than precisely describing them. The user is not required to have grammatical knowledge to decide what type of link is suitable for his/her case; he/she is expected to choose what best conveys the meaning he/she intends without trying to translate a pre-formed sentence into a natural language.

1. **Fact/Role-filler Link.** The user selects a fact as a role-filler for another role. The concept expressed by the first fact acts as a role, for example the subject or the object, in the second one. In natural language this is obtained by subordination and in particular by relative sentences. For example, consider again the above example of Charles drinking Cabernet, and suppose that he wants to say that he did it for Susan's birthday. He may decide to write the second fact $f_2$ with predicate `Has`, `sbj`=`Susan`, `obj`=`birthday`, `whn`=June 15, 2010. Then he may use this second fact as a role filler for the `why` role in $f_1$.
2. **Role-filler/Role-filler Link.** The user links two role fillers in two different facts: the idea is that the two facts have a referent in common. What this link says is that the individual object referred to by the first filler is the same as the one referred to by the second filler. If the two fillers denote exactly the same entity within the system, this link exists implicitly. However, there are cases where it is necessary to make it explicit. For example, consider the fact $f_1$ above and the fact $f_3$ with the predicate `Buy`, `sbj`=`Charles`, `obj`=`Cabernet Wonder 2004`. If Charles wants to specify that the bottle he drank in the fact $f_1$ is the same he bought in the fact $f_3$, then he may link the two `obj` fillers.
3. **Fact/Fact Link.** This third type of link establishes a more generic relationship between two facts. In this sense it is similar to conjunction or juxtaposition of sentences in natural language - although a distinction between the two is not made here: in principle, a link between two facts may even represent a disjunction or an adversative. The link can be directed, thereby suggesting a sequence, or undirected, simply suggesting some kind of association. If we consider again the facts $f_1$ and $f_2$ above, a user may decide to suggest causality by simply adding a directed link from $f_2$ (Susan's birthday) to $f_1$ (Charles drinking Cabernet).

## 4 Reasoning on Facts

In our framework users can insert new facts into the system, as well as use already existing facts in conceiving their stories. Our aim is to design a system that is able to help the users by suggesting previously added facts that appear to be related to the facts they have inserted. For this reason we introduce a measure of *pertinence* between two facts: given a fact inserted by a user, it can be used to perform a query for pertinent facts already present in the system, which can be useful in threading a piece of a story. Before formally defining the pertinence measure, we will introduce *conceptual specificity* and *closeness*, two properties of facts which pertinence relies on.

### 4.1 Conceptual Specificity

An ontology is a rooted, directed acyclic graph of IS-A (subclass-of or instance-of) relations, and the distance between two nodes $n_1, n_2$ is defined as:

$$\textsc{dist}(n_1, n_2) = \min\{|p_1| + |p_2| \mid \exists g \text{ such that } g \xrightarrow{p_1} n_1,\ g \xrightarrow{p_2} n_2\},$$

where $g \xrightarrow{p} n$ means that $p$ is the path connecting the node $g$ to the node $n$ and $|p|$ is the length of the path $p$.

Conceptual specificity is monotonically dependent on the depth of the corresponding node in the ontology, where $\textsc{depth}(n) = \textsc{dist}(root, n)$. Although one may be tempted to use depth as a measure of conceptual specificity, this would not work in our case for the following reasons:

- Due to the lack of homogeneity among different parts of the domain ontology (which in fact is a grouping of several sub-ontologies), concepts with the same depth have different levels of specificity. Moreover, relative specificity may vary depending on the context in which the users are telling their stories. For example, if the context is a beer festival, then the generic entity `Beer` has a lower significance with respect to the case where the context is a Farmer's Market where beer is present among many other things.
- The highest part of the ontology is made of some fairly abstract concepts that have no practical significance with respect to the domain itself - the best example of this is the `Thing` node that is usually the ontology root. Any path crossing this node should have an *infinite* length, since if such an abstract concept needs to be considered to find something in common between the nodes $n_1$ and $n_2$, then it means that $n_1$ and $n_2$ are in different subdomains (for example, a `Bavarian Weissbier` and a `Countryside Village`).[1]

In order to address these two issues, we propose a tri-partition of the ontology, (if possible) provided by an expert. Initially, the expert should provide a boundary, given once and for all, between *abstract concepts* (denoted by $\mathcal{A}$) and *concrete concepts* (denoted by $\mathcal{C}$). For every $n \in \mathcal{A}$, we let $\textsc{spec}(n) = -\infty$.

Further, the expert should identify in $\mathcal{C}$ a subset of nodes $\mathcal{Z}$ that represent the 0 level regarding specificity. The point here is to locate the nodes in the different sub-ontologies that have similar relevance in a certain context. For example, in

[1] Notice that this does not mean that there is no connection between these two notions (maybe there is a Bavarian countryside village that hosts a wonderful brewery!) but that they are not *ontologically* connected.

a Farmer's Market scenario one may choose the ontology nodes that represent different food products, such as `Vegetables`, `Cheese`, `Fish`, etc. On the other hand, in a beer festival scenario one may choose the direct descendants of `Beer` together with the whole `Food` entity.

Starting from $\mathcal{Z}$, we compute a set $\mathcal{S}$ of *significant nodes* (nodes either in $\mathcal{Z}$ or descendants of nodes in $\mathcal{Z}$) and a set $\mathcal{I}$ of *insignificant nodes* (all other nodes in $\mathcal{C}$). $\mathcal{A}, \mathcal{I}, \mathcal{S}$ form a tri-partition of the ontology. Then[2]

$$\forall n \in \mathcal{S}, \textsc{spec}(n) = \textsc{dist}(\mathcal{Z}, n) \text{ and } \forall n \in \mathcal{I}, \textsc{spec}(n) = \textsc{dist}(n, \mathcal{Z}).$$

where $\textsc{dist}(\mathcal{Z}, n) = \min\{\textsc{dist}(n', n) \mid n' \in \mathcal{Z}\}$ and $\textsc{dist}(n, \mathcal{Z}) = \min\{\textsc{dist}(n, n') \mid n' \in \mathcal{Z}\}$.

In case there is no expert to provide the tri-partition, it is possible to set $\mathcal{A} = \emptyset$ and $\mathcal{Z} = \{root\}$. By doing so, we get $\textsc{spec}(n) = \textsc{depth}(n)$.

### 4.2 Conceptual Closeness

In the literature there are two main approaches to measure the closeness (similarity) of two concepts in an ontology. The first uses the definition of *entropy*, as in [15]. However, adopting this kind of approach requires a reasonably complete ontology, which is something we cannot assume. In fact, in the context we are dealing with (namely, the Social Web) the ontology of the domain is bound to grow depending on the social network usage, and it is fairly difficult to make any assumption about the completeness or even the homogeneity of the semantic information. Another approach is to use the ontology graph structure, as discusses in [14]; this method is also referred to as *edge counting*.

However, we need to account for the fact that, if an edge is a measure of conceptual distance, edges that are closer to the terminal nodes should be shorter than those closer to the initial (root) node. This corresponds to the intuitive perception of conceptual distance: two child nodes of the `Drinkable` entity (e.g., `Beer` and `Milk`) are conceptually more distant than two child nodes of the `Bavarian Weissbier` entity (e.g., `Hefeweizen` and `Kristallweizen`).

Therefore, we assign a non-constant length to the edges: the length of an edge is monotonically decreasing with the *conceptual specificity* of its source node. Then, for each edge $e = (n, n')$ from $n$ to $n'$ we define

$$\textsc{len}(e) = 2^{-\textsc{spec}(n)}.$$

This definition naturally extends to a path $p$ as the sum of the lengths of its constituent edges, and we can thereby give a modified definition of node distance:

$$\overline{\textsc{dist}}(n_1, n_2) = \min\{\textsc{len}(p_1) + \textsc{len}(p_2) \mid \exists g \text{ such that } g \xrightarrow{p_1} n_1,\ g \xrightarrow{p_2} n_2\}.$$

Using this modified notion of node distance we introduce a variation of the similarity measure defined in [10] given by:

[2] This definition has an undefined case if there is a leaf node that is not reachable from $\mathcal{Z}$. A solution is to include all such leaves in $\mathcal{Z}$ by default. We omitted it in the definition for the sake of simplicity.

$$\text{CLOS}(a,b) = -\log\left(\frac{\overline{\text{DIST}}(a,b)+1}{2\times\text{MAX}+1}\right) \quad (1)$$

where MAX is the maximum length of a path from a concrete concept node to a terminal node in the ontology.

### 4.3 Pertinence

In order to perform a query by pertinence we have to take into account that different facts can use different predicates to express their content and that for each predicate its set of roles has different weights associated with each role, i.e. each role filler contributes differently depending on the predicate used for the given fact. For example, `obj` has higher importance for the `Buy` predicate, whereas `whr` has higher importance for the `Travel` predicate. As mentioned in Section 2, the predicates are part of predicate ontology and each of these predicates has properties corresponding to the roles in $\mathcal{R}$. Without sacrificing generality we can assume that each fact has only one predicate, since every fact can be decomposed into more facts with only one predicate. Also, there might be more role fillers for each role. Then, given two facts $f$ and $g$, the *pertinence* of the fact $g$ for the fact $f$ takes into account how close the corresponding predicates and role fillers are in the ontology, by using the closeness measure introduced above and applying weights appropriately. Pertinence takes into account an additional factor, *co-location*, described below.

$$\text{PERT}(f,g) = \alpha_0\text{CP} + \Sigma_{i=1}^{m}\alpha_i\text{CRF}_i + \beta\text{COLOC} \quad (2)$$

where CP is *predicate closeness*, $\text{CRF}_i, i = 1,\ldots,m$ are *role filler closeness values* ($m$ is the number of role fillers for $f$), COLOC is the *colocation* and $\alpha_0,\ldots\alpha_m,\beta \in \mathbb{R}$ are weights. In the pertinence formula:

- Predicate closeness CP is calculated using domain entity closeness (given by equation 1), taking into account the weight $\pi_{f_0}$ of the predicate $f_0$ of the fact $f$ (given in predicate ontology for each predicate), i.e., $\text{CP} = \pi_{f_0}\text{CLOS}(f_0, g_0)$.
- When calculating role filler closeness, for each pair of role fillers from facts $f$ and $g$ we apply equation 1. The resulting value is then weighted. The weight takes into account several factors, such as the relevance of the considered roles for the given predicates, a multiplier for the case in which the two fillers are fillers of the same role, a normalizing factor depending on the number of fillers, and a threshold below which the value is set to 0. A detailed description is out of scope of this paper.
- In the special case where closeness is being calculated for two users, we use their social network relationship instead of conceptual closeness. In a social network, a given user may have a set of friends, a set of *trusted* users, and possibly other relationships. The type of relationship is defined in the user model, and it can be used to give a closeness factor between two people.
- The co-location of two facts estimates chances that their actors met while performing the described action[3]. We use Google Geocoding Web Service to

[3] Like in the *selva* of Ludovico Ariosto's romance "Orlando Furioso", or the international conferences in Davide Lodge's *academic* romance[11].

get the needed latitude and longitude position of a fact occurrence, as well as the information about the bounds of the specific area. We introduce a three-dimensional space where two dimensions are latitude and longitude and the third dimension is time. In this space, the spatial-temporal location of a fact is represented by a parallelepiped whose base is the region it is happening in and whose height is the corresponding temporal interval. Two facts are co-located if they happen in the parallelepiped obtained as the intersection of two parallelepipeds that correspond to the two facts.

## 5 Towards a Social/Collective Narratological Model

Considering the interactive, social and collective nature of our system, we propose a narratological model that describes both the interaction with the author and the generation of the narrative world contained in the system. Since the user has the possibility to insert into the system both narrations and single pieces of information, it is fundamental to define a way to combine these elements into a wider unity. As we will see in this section, the result is not exactly a narration, but a *narrative world* which has some characteristics in common with narrative forms such as interactive storytelling and emergent narrative.

The massive spread of digital media has brought in potential and peculiarities that can strongly influence narrative possibilities and make them substantially different from previous narrative forms [16]. In fact, they are not just authored by a single person, but derive from a potentially enormous number of authors, that can create, modify, assemble and link them, collaborating even without being in the same place or knowing each other. In digital media, text is not a sequential monolithic block anymore; it changes to hypertext through massive use of links that give the user the possibility to choose many routes to surf the content, thus becoming an author who establishes the order, the presence, the rhythm and consequently the meaning of the text. These innovative characteristics of digital narration permit an interbreeding among genres, producing new narrative forms, such as the branching narrative and the hyper-textual one, that can be classified as interactive storytelling [5]. There is another new narrative genre in digital media, called emergent narrative [12] which is a style of participated narration in which the structure of the narrative emerges from the interaction between the characters instead of being defined by a predefined plot.

Existing narratological models need to be revised because of the innovations introduced by digital media [9]. In fact, the traditional narratology model was thought to describe analogical narrative as a linear sequence of the author's work, the product and the reader (see figure 5). It is now obvious that this does not fit the narratives in digital media. A possible interactive storytelling model is sketched in figure 6. The author provides alternatives, that can be developed by the user interacting with the system. Hence, the product, being a composed story, is determined by the author's input to the system and by the users' interaction.

Referring to our project (see figure 7), there is no one controlling the evolution of the narration, but each user acts as an author writing his/her story fragments,


Fig. 5. Traditional narratology

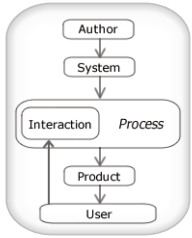


Fig. 6. Interactive digital storytelling narratology

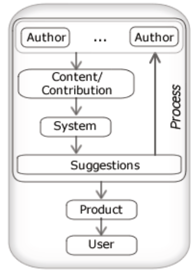


Fig. 7. Social/collective narratology

in the form of facts. The system collects and organizes them and can suggest authors connections between the facts they added and other pertinent ones. This allows authors to improve their narratives by relating them to experiences of other users, resulting in a collective emergent narrative world that always evolves in terms of contents, i.e. facts, and links among them. The system has the same characteristics of digital media and some features in common with the above mentioned forms of digital narrative. In fact, it is a mix of collective authored approaches, as several users of the community contribute with their facts, and an emergent narrative, as a story crops out connecting facts.

## 6 Related Work

For an overview of narrative theories, from Aristotle [1] through Propp, Greimas and Barthes, to Bremond, with the emphasis on their application in interactive storytelling, we point the reader to [4].

INSCAPE [6,17] is an authoring environment where even inexperienced users can conceive, create and experience interactive stories. It is possible to design interactive storyboards, edit and visualize the story structure, create 2D and 3D characters and scenes, include sounds, pictures and videos, and publish the story on the Internet. The stories are visually represented as topological graphs where nodes are objects of the story and edges are interactive transitions or conditional relationships. This is very similar to our approach of connecting facts into the story. Our aim is to provide a system where different kinds of digital content can be used in constructing facts.

In [3] an approach is described to evaluate narrative presentation for lifelog archives containing large amount of data in different formats: SenseCam diaries, photos, videos, text documents. The authors describe how the content is reduced and organized to produce a coherent narrative presentation. They conclude that visual content is the one used the most to communicate the experience; that the nature of the story and the author's personal view of the story have a considerable impact on the fragments used for representing the story and the final outcome. As in our framework, story fragments are collected from heterogeneous sources, letting the users freely chose and combine the available elements.

PoliCultura [2] is a project designed for Italian schools to enable children to participate in interactive construction of stories over a longer period of time. Using a web-based authoring-delivery environment, children are able to put together text, images and mp3 files and produce interactive stories. Although the work is presented as a platform encouraging *collective narratives*, it is more similar to a *collaborative narratives* system, where many authors participate in constructing a story in a collaborative effort. On the other hand, our approach is an effort towards constructing collective narrative where authors do not need to collaborate in order to produce a story.

## 7 Conclusions and Future Work

In this paper we introduced a framework for collective storytelling in social networking services. Our assumptions are *(i)* that the social network is *thematic*, with tales revolving around the chosen theme, and *(ii)* that there exists an ontological description of the domain we can rely on for the interpretation of users' contributions.

We focussed on devising a language that allows users to express simple facts in a semi-structured way: they can select an action and then associate elements of the ontology with it, specifying for each of them the role that it has in the fact. In principle, users can also fill roles with elements that are not in the ontology, but in that case the interpretation of the fact is going to be partial. Users can also link together facts, and we showed how the types of links they can use (namely, Fact/Role, Role/Role and Fact/Fact) can be related to connective elements in natural language. Our goal was to provide an expressive language, with a good trade-off between structure and simplicity. The result has in our opinion two interesting features:

- It is **non-linear**, since links organize facts in a graph and not in a sequence. In this sense, it integrates the experience of hyper-textual narration.
- It allows people to **suggest** connections between entities or between facts, without needing to be explicit or very precise about the nature of these connections.

We believe these features make our representation language suitable for automated link generation and emergent approaches. Indeed, we see automated link generation (or at least automated link proposal) as the next step in our work.

Our framework builds on top of the semantic social networking environment implemented in the PIEMONTE project. In the user interface, each concept (object, place, person) is surrounded by a wheel of related concepts and users navigate the social network by spinning the wheel and moving its central focus by dragging concepts inside it. The user interface for telling facts is designed in a similar way, putting a predicate in the center of the spinning wheel, allowing users to choose the related concepts around it.

An evaluation for the storytelling system is planned in two steps: an evaluation of the closeness measure on concepts in the ontology is currently being performed, where test users compare their own subjective measure of closeness with the one provided by the system. Then, facts will be collected from test users and the pertinence measure will be evaluated with the same method.

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# Learning Story Marketing through Practical Experience of Story Creation System

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**Abstract.** This paper introduces an application for learning story marketing using a story creation system, Anime de Blog. Anime de Blog is an animation-based consumer-generated media (CGM) application. Users can create animated stories of affiliate advertising by simply inputting basic words using Anime de Blog. Through practical work experience of affiliate advertising on the Web by undergraduate students using Anime de Blog, students learned about an internet application, story marketing, and the concepts of affiliates and affiliate advertisements; they could also critically evaluate the application.

**Keywords:** Story Marketing, Learning, Story Creation Practice.

## 1 Introduction

Storytelling is the conveying of stories from person to person. Recently, storytelling has drawn much attention in a variety of areas. In particular, applications for marketing and management using storytelling have attracted much attention. In the area of medical care, there is a method of *narrative therapy* [1] in which patients receive psychological treatment by telling their own life story. In the area of developmental psychology, there have been studies on child development by examining the process by which children generate stories[2]. In the area of social psychology, there have been studies of people's *life stories* [3], which are a way of understanding human identity, life, and society by recording and analyzing the stories.

Narratology, which is related to storytelling study, is an interdisciplinary field. It denotes both the theory and the study of narrative and narrative structure and the ways that these affect our perception. It is related to pedagogy, developmental psychology, cognitive psychology, clinical psychology, sociology, and linguistic philosophy[4]. Storytelling also covers a broad area because it is closely related to basic human activities, such as talking, understanding, and communicating with each other. Naturally, interactive digital storytelling is expected to apply to a broad area.

This paper introduces an application for learning story marketing using a story creation system, Anime de Blog. Anime de Blog [5] is an animation-based consumer-generated media (CGM) application in which blogs with animation content can be created. The system can collect 3D animation and image data corresponding to words. The animations or image data are searched for and selected from shared

R. Aylett et al. (Eds.): ICIDS 2010, LNCS 6432, pp. 98–110, 2010.

consumer-generated databases using simple words. If users cannot find appropriate data, they can easily create new data using the provided animation editor, and they can upload the new data by entering related words. The system works with an animation database called Animebase, which stores 3D animation and image data corresponding to words. When an animation is uploaded by a user, the system applies the motion data of this model to other models and generates new animations, which are then stored in Animebase. Users can create animated stories of affiliate advertising by simply inputting basic words using Anime de Blog. Users learn story marketing through practical work.

In this paper, we introduce an attempt to provide practical work experience of affiliate advertising on the Web for undergraduate students using Anime de Blog.

## 2 Storytelling Application and Interactive Digital Storytelling

Recently, the utility of stories in the area of marketing or management has drawn much attention. In the area of marketing, stories are often used to develop the concept of a product and its catchphrase, brand identity [6][7], product development, and communication with customers in events and shops. *Narrative planning* [8] is when marketers express a brand concept using stories. Stories are often used for marketing because they have an emotional appeal, generate a deep understanding, shape the subconscious mind, and motivate actions.

Similarly, stories have also drawn attention in the area of management. For example, storytelling is used as a management strategy [9] that enables the effective transfer of knowledge in organizations. This is called a *narrative approach* [10]. Originally, it was pointed out that the criterion of whether a management strategy is well made or not depends on whether the management strategy is a story or not [11]. That is, management strategy should be a whole story. Therefore, there should be connections throughout the whole story, the storyline, and associated causes and effects. The aim of the story approach is to depart from the existing planned strategy and then to use the story as the methodology to attain the set goal by making individuals and the organization engage in the strategy in an innovative manner.

The methods for business skill development using stories are more common in business books. For example, there are methods using stories for persuasion [12], sales, negotiation, planning, presentation, and communication in a business setting [13]. Specifically, in the business setting of sales, and because persuasion needs to present emotional appeal, stories can be utilized for persuasion.

Interactive digital storytelling, which involves the digital presentation of storytelling using tools such as computers, has possibilities in the above areas. Interactive digital storytelling often involves the visual expression of stories because of recent developments in computer technology. Similarly, there are the media of comics and animation for presenting stories in a way that is understandable for everybody.

Scott McCloud used the term *sequential visual art* to describe animation and comics [14]. He suggested that space does for comics what time does for film (and animation). He also said that, “Comics are a language with a vocabulary involving a full range of visual symbols" [15]. These visual media are easy to understand because of the expression of both visual symbols and languages. Animation is expressive and easy to understand intuitively because it involves direct movement. For easily understandable content creation, our system has been developed.

Illustration enhances incentives to learn [16] and promotes content understanding [17]. Screen images draw attention to content [18] [19] [20], facilitate learning [18], and enhance incentives to learn [21]. In interactive digital storytelling for learning, these effects are desirable. In addition, interactive digital storytelling for learning is desired to create stories easily without interrupting learning.

Drawing from scratch is the traditional way of generating animation. For example, animation can be created in this fashion using professional 3D computer graphics (3DCG) tools. Users require much effort, however, to master professional 3DCG tools, and because most of them are expensive, they are not suitable for novice users. This limits the users' creativity during trial-and-error learning for creating content.

In contrast, Anime de Blog enables novice users to create content using Animebase, in which 3D animation data, such as models and motions, are correlated with natural language data, such as subjects, predicates, and objects. Our system generates animation content by combining animation data and background graphics.

The related research area of text visualization includes many studies on visualizing certain objects from voice and text inputs [22][23][24]. Unlike these systems, our system focuses on story-like descriptions, such as who is doing what.

Some technologies combine content instead of creating it from scratch. Our previous work, Interactive e-Hon [25], is a media translation application that translates text into animation by linking animation data to words. Its main difficulty is that it requires the preparation of an enormous amount of animation data to match all the words that people are likely to use.

Scripting languages [26][27][28][29] are another technology for creating new content through content combination. However, the problem of how to prepare enough animation data remains.

Anime de Blog is a CGM application that aims to collect animation data matching all the words that people usually use. Our intention is that even first-time users can use the system without any difficulty. For this purpose, we enable users to add to the available data . The initial animation data are linked to high-frequency words from fairy tales and elementary school textbooks. There are not many systems that enable users to create stories showing animation content and have interfaces with simple selection operations and language that can be used to describe a fair amount of animation data.

A number of popular consumer-generated databases currently exist. For example, Wikipedia is an encyclopedia that enables users to edit Web pages. YouTube is a free video access site that lets users view and upload videos at will. Yakushite-net is a framework that generates and edits dictionaries for translation engines (Japanese and English) by letting users manage their own areas of expertise.

Similarly, Anime de Blog is the world's first animation CGM application based on natural language that enables novice users to easily generate content by combining natural language with animations.

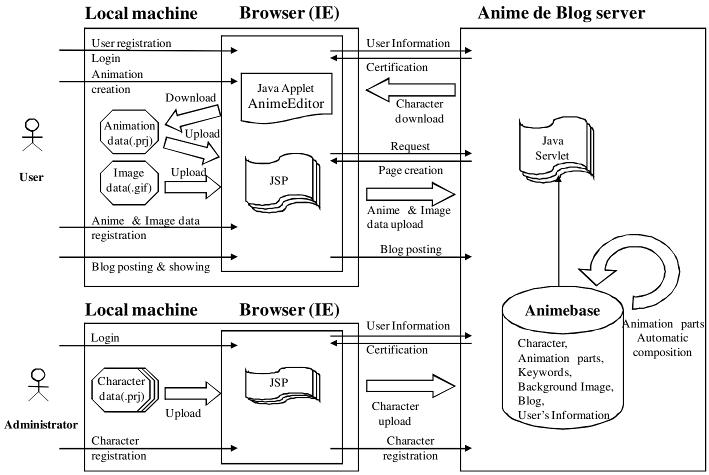


**Fig. 1.** Framework of Anime de Blog

## 3 Anime de Blog

Figure 1 shows the operation of Anime de Blog. The user creates a blog and registers animation and image data on the Anime de Blog server. The animation database Animebase includes character data, animation-part data for each character, keywords, background images, and user information.

The animation parts are composited at the user's request. The character data are managed by an administrator because the character output format should conform to a particular hierarchical structure, number of joint parts, and balance of part lengths for reusing animation data. This system was developed for the Japanese language.

When a user inputs a subject and predicate as a scenario and selects search, the system searches Animebase for animations matching the subject and predicate according to the frequency of use. Similarly, when the user inputs an object and selects search, the system searches Animebase for animations based on this object according to the frequency of use. When the user inputs a background and selects search, the system searches Animebase for images by referring to this background according to the frequency of use. The system then displays lists of animations or images as the search result. If users cannot find appropriate animations in Animebase, they can edit and register animation data in Animebase using an animation editing system called the AnimeEditor Java applet. They can also upload image data to create backgrounds. Regardless of their level of experience, users can easily use AnimeEditor on a Web page.

As they upload both new animation data created using this system and scenarios written in natural language, batch processing automatically occurs at predetermined times. The system creates more animations from the newly uploaded animation motion data and natural language expressions (subjects, predicates, or objects) by applying them to the motions of other characters, and it stores all of these new data in Animebase.

The initial test installation of Animebase has 31 simple cartoon characters: seven kinds of animals (bear, dog, cat, panda, pig, rabbit, and mouse), six different male adults, six female adults, three male children, three female children, three elderly males, and three elderly females. These characters have relatively few joints, but over the course of the test, we have uploaded more realistic characters with many more joints. Thus far, the system has bipedal human or animal characters. Each type has the same hierarchical structure, the same number of joint parts, and the same balance of body part lengths; therefore, the motion data can be shared among the same character types. Motion data can be shared even when new character types are added. Animebase has about 200 registered verbs for its cartoon-type characters. As mentioned before, these are high-frequency verbs extracted from fairy tales and elementary school textbooks. The initial animation data for Animebase were created by animators who visualized these verbs. The initial data yield a total of 9500 possibilities (31 cartoon-type characters × 200 predicates + other animations).

The following sections describe the processes of content generation from a scenario, animation generation using AnimeEditor, and animation data reuse in Animebase.

### 3.1 Blog Content Generation

Figure 2 shows a snapshot of creating a new blog entry in Anime de Blog. The user inputs a scenario in the form of a subject, a predicate, an object (item or other person), and/or a background and selects animations or images for them. The essential inputs are the subject and predicate. The Japanese case particles are selected using a toggle. In Animebase, a subject corresponds to a character, and a predicate corresponds to a motion. After a user inputs these words and selects search, the system searches Animebase for matching animations according to the frequency of use. The user can manually select the most appropriate animation from the returned list of animations. When the user inputs an object together with a subject and predicate and selects search, the system also searches Animebase for animations matching the object.

The case for a person object corresponds to a character who acts in the passive voice of the predicate. For example, when we write “father” as the subject, “boy” as the object, and “get angry” as the predicate and then select search, the system shows animations of a scolding father from Animebase according to the frequency of use. The user can then select an appropriate animation from the list. Next, the system shows Animebase animations of a boy being scolded, and the user can again select an appropriate animation.

To select a background, after the user inputs text, he or she can select a case particle and select search. The system then searches Animebase for images matching these entries according to the frequency of use, and the user can select an appropriate image from the images returned as the search results. Therefore, the user can create a scene by repeating the above operations.

An entire story in a blog contains one to ten scenes. The animations and images of each story are presented as transparent GIF files. A scene is created by overlapping animations and images. The duration of one scene can range from a few seconds to ten seconds. Presenting all the scenes enables the entire story to be reviewed. By ordering scenarios grammatically and using case particles, meaningful sentences can be formulated. In this case, the Japanese grammatical order is (1) the subject, (2) the


**Fig. 2.** Snapshot of "Create a new blog"

background, (3) an item object, (4) a person object, and (5) the predicate (each with a case particle).

A free text area, which is like a regular blog, can be copied from the scenario at the user's request. Furthermore, users can search Animebase by title, scenario, story, animation, background image, and author name.

## 3.2 Animation Generation Using AnimeEditor

When users are unable to find appropriate images or animations in Animebase, they can upload images or animations that they consider suitable. For this purpose, Anime de Blog has an animation editor system called AnimeEditor (a Java applet developed using Java3D).

Even novice users can intuitively create animations using the spatial keyframing method [30] in AnimeEditor. This method uses animation data to record the user's mouse operations in real time. The user sets the key poses for a character by placing yellow balls as a spatial keyframe. By changing the position of a pink ball in the special area, the user can easily create an animation.

The user can then save the animation as a local project file, which can be uploaded later to Anime de Blog. The project file includes settings (camera parameters and software version), background properties (background settings), base (initial pose of the model), cursor (cursor trajectory), key (poses of the model, corresponding to keyframes), model (virtual reality modeling language (VRML) data of the character model), properties (character model's information), texture (texture file), and ground properties (background settings).

(1) Character role configuration

AnimeEditor imports several characters and objects. These characters have to have specified roles so as to increase the variety of patterns of animations for reuse purposes. The roles include "main," "other," and "etc." "Main" means the central character of the predicate corresponding to the motion created by the user. "Other" means another character, corresponding to the character performing the passive motion of the predicate. "Etc." includes characters or items, and it indicates an accessory that is not changed for reuse in the animation register of Animebase. In other words, the role of "main" corresponds to the subject, "other" corresponds to the object (other person), and "etc." corresponds to the object (item).

For example, if the predicate is "play baseball" or "throw the ball", we set the throwing character as "main," the receiving character as "other," and the ball as "etc." The project is saved as "baseball.prj."

(2) Motion retargeting to other characters

The system can import a particular motion from the project file of an animation of a certain character, apply the motion to another character, and show the other character executing the same motion.

Copying from the basic model of the motion data (VRML) to another model can retarget its motion. Motion retargeting is achieved by setting the cursor value (cursor trajectory), key (poses of the model corresponding to keyframes), model (VRML data of the character model), and properties (the character model's information) to those of the other character.

### 3.3 Animation Data Reuse in Animebase

When the user clicks the "Upload the animation" button or "Upload the image" button, the animation project file made by AnimeEditor or a GIF image file, respectively, is uploaded to the Anime de Blog site. For example, the baseball project is uploaded for the predicate "play baseball," the main character "pig," the other character "rabbit," and "etc." for the "ball." Several keywords can be inputted to each input area by separating the keywords with a comma.

Once the animation is uploaded, motion retargeting is run as a background process. In this process, the system changes the "main" character to all the other characters of the same type in turn and does the same for the "other" character. Then, it generates combinations of these animation files.

First, the system creates each project file by setting the value of the cursor to that of the original project file, the key to the calculated rotation value using the value from the original project file, and the model and properties to those of the other character. Then, it creates a GIF animation for display on the blog page using Java3D rendering and the original VRML motion file.

Once this is done, if the user searches for "bear" as a subject, "dog" as an object (other person), and "play baseball" as a predicate, the system returns animations of a bear throwing a ball and a dog catching the ball, which are created by the background process.

### 3.4 Blog Content Representations

Figure 3 shows a sample from Anime de Blog. There are four scenes: the first scene represents "I," "Studied," with my "friend"; the second represents "I," "cried" in my "room"; the third represents my "friend" "introduced" the "home study tool" to me; and the fourth represents "I," "became happy" at "school." The written blog text is to the right: "I studied with my friend. But, my grades dropped. I cried in my room. Then, my friend introduced this home study tool to me. I got *A*. I became happy."

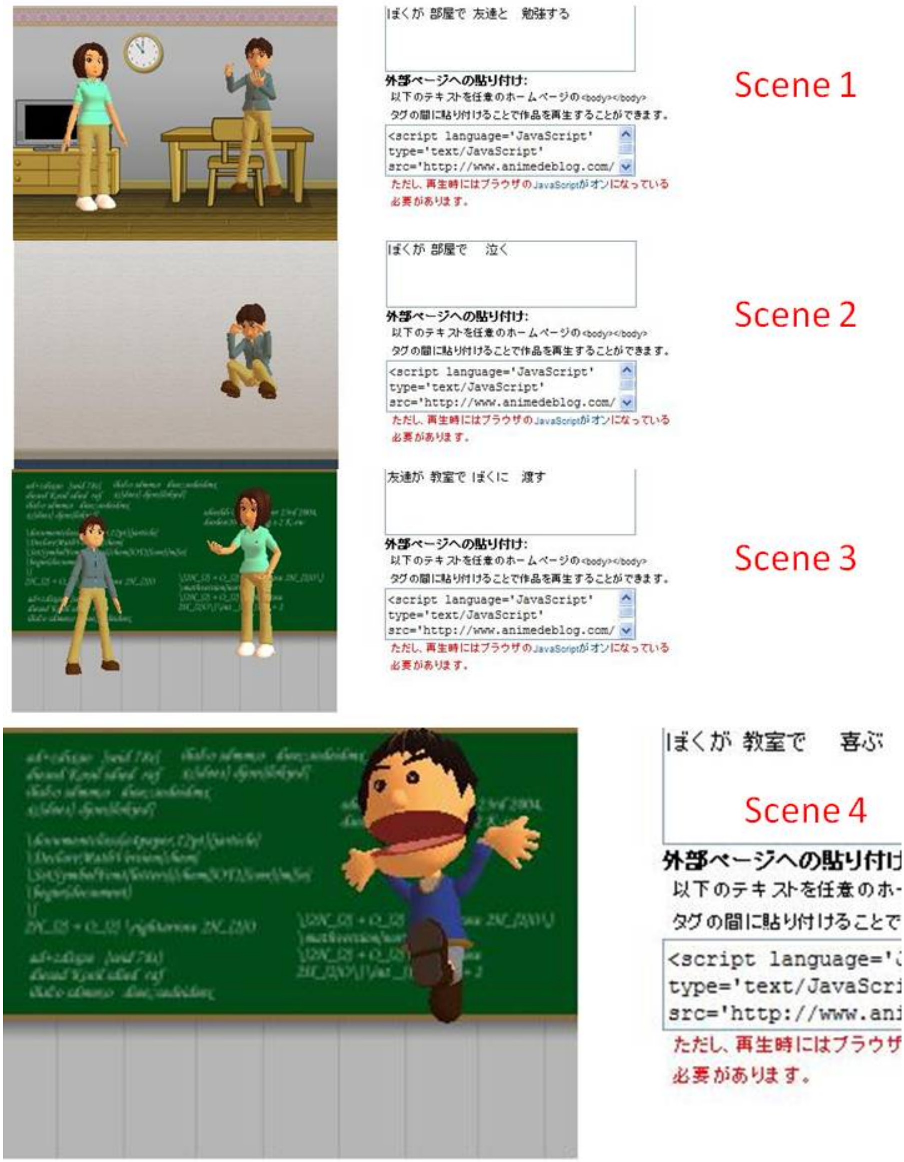


**Fig. 3.** Sample work from Anime de Blog

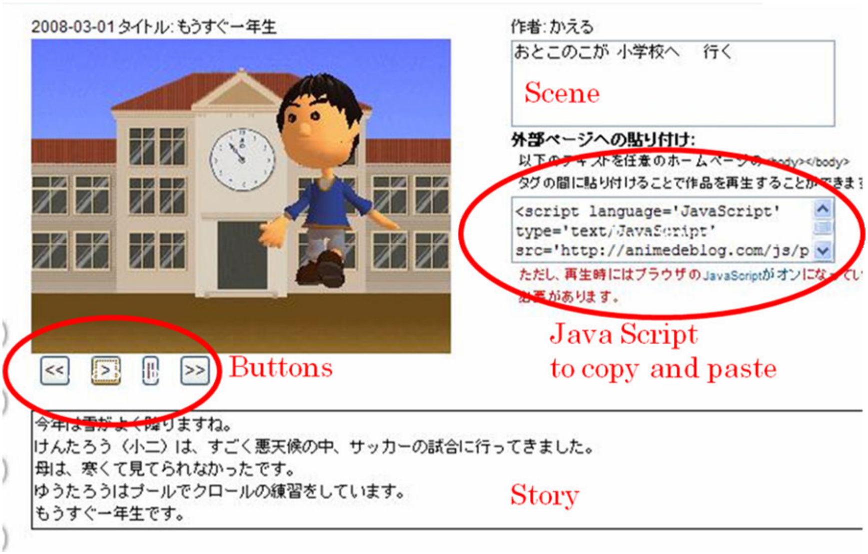


**Fig. 4.** Replaying a work

We can view the entire animation, as shown in Figure 4, using the buttons ">" (play), ">>" (skip forward), "||" (stop), and "<<" (skip backward). Web pages can show the original animation of Anime de Blog using embedded Java script on the page. This created animation can be used as affiliate advertising using the web pages.

## 4 Experiment

We had practical work experience of story marketing for undergraduate students using Anime de Blog. The examinees were 60 students who major in sociology or humanities and whose ages ranged from 18 to 26. They used one desktop personal computer each in a computer suite.

We gave students assignments to create stories for advertising and asked them to report the content of their output, its concept, and evaluate their output and the system. The respondents of the questionnaire numbered 36. The examinees gave scores in response to questions on a five-point scale. We regarded scores from one to three as a positive answer.

As a result, 61.6% felt that using this system was easy, and 58.3% felt that making animation stories using words was easy. However, they did not all feel that making animated stories using words was easy; 41.7% felt that it was difficult. The users pointed out that some animations corresponding to their words were not always provided by the system. It was considered that the users inputted words through a trial and error process because the operations are provided only by inputting or selecting words and they were not taught how to make animations using AnimeEditor.

63.9% felt that introducing continuity in the story was easy. Displaying synonyms was helpful for 56.4% of the users.

91.7% of the respondents answered that children can use this system without problems. 77.8% of the respondents also answered that elderly people can use this system without problems. 80.6% had a good impression of this system's use for affiliate advertising on the Web. However, only 22.2% would like to use this system for affiliate advertising of their own, because they don't create affiliate advertisement in their daily life.

We received comments such as, "It is a great idea," "I think it's interesting," "It is very good to create stories easily for everybody. I'd love to create more in the class," and "I had never imagined that creating animation by myself was so easy. I was surprised. I had fun."

In terms of comments for improvement, we received feedback such as, "The sense of character should be changed to one that is attractive for web users," "How about using characters popular with otaku (geek) and making otaku a target for this system?" and "If the system used facial expressions it would be better." Other comments included, "The amount of data used is small," "The system requires time for searching," "I think the system needs better quality of design," and "Smoother action and higher image quality are needed."

Through the experience and lessons, students learned about an internet application, story marketing, and the concepts of affiliates and affiliate advertisements.

## 5 Discussion

Trial operation of Anime de Blog, the world's first animation CGM application, has begun. It gathers animation and image data corresponding to natural language information and stores them in a shared database called Animebase. During our one-month trial operation of Anime de Blog, a total of 582 users registered with the system. There were an average of 963 accesses per day (maximum of 7424), and the number of stored animations increased from 9500 to 9647. On an average, there were 133 visits per day (maximum of 943). These figures show that the users were very interested in animation content creation.

We had practical work experience of affiliate advertising on the Web for undergraduate students using Anime de Blog. Through this practice students learned about an internet application, story marketing, and the concepts of affiliates and affiliate advertisements. They also critically evaluated the application. We have shown that users can create animation content by combining animation materials (animations and images), and that the content can be searched using keywords. We can display the original animation of Anime de Blog on our own web pages using embedded Java script. This created animation can be used as affiliate advertising using the user's own web pages. It would be the story marketing via animation content.

Most of subjects had a good impression of this system's use for affiliate advertising on the Web. A number of outputs are intended to be for affiliate use and the stories are for advertisements. Watching outputs of other students was also informative for them. According to their comments, the system has a real chance to be effective for affiliate advertising. We believe that the system has many possibilities for improvement. These include the amount of animation data and its quality, design, and the interface. In this practical experience, users were not told to make animations using AnimeEditor. However, we are planning to another practical session using AnimeEditor with the expectation of data enhancement.

The mental images that people have when they create something vary from person to person. In our system, users can select animation content and revise it through the reuse function. Although they cannot always create content that precisely matches their own imaginations, they can come close using our approach and large animation databases.

Users can create stories as if they are creating a four-panel comic using Anime de Blog. This kind of short story is influenced by personal sense or creativity. The system provides the opportunity of being a pseudo-content creator with little difficulty. According to the outputs of this practical experience, the ability to compose stories varies between individuals. The system enables an increase in the ability to compose stories. In a similar way, learning the meaning of a story or its effective interpretation may be possible.

As future work, we will study users' learning in many areas of story application using Anime de Blog. We think that Animebase will enable novices to create content by offering an environment in which information can be shared freely. It will be useful for the following situations: education; e-learning based on digital content; understanding and learning assistance for children or the elderly; business; transmission of information that appeals to individuals, with related services; advertising and marketing using digital content; communication support; visual communication support for people of different regions, cultures, or background knowledge; research; and free use of digital content. We believe that new research and business opportunities will be created and new areas of information science will be pioneered by allowing academic and business institutions to access this database.

## 6 Conclusion

In this paper, we have introduced Anime de Blog, an animation CGM application for the Web as a learning application for story marketing. Using the system, users can easily create animation content by simple familiar user interfaces involving the input of words.

Through practical work experience of affiliate advertising on the Web for undergraduate students using Anime de Blog, students learned about an internet application, story marketing, and the concepts of affiliates and affiliate advertisements. They also critically evaluated the application.

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# Enhancing Real-Time Sports Commentary Generation with Dramatic Narrative Devices

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**Abstract.** This paper looks at the current state of the art of academic sports commentary generation systems. It then summarises work on how drama is created in professional broadcast commentary using dramatic devices. A novel computational architecture for sports commentary generation based on analyses of professional broadcast commentary is then presented. This work presents a first step towards realising a computational model of real-time sports commentary which explicitly incorporates dramatic narrative devices in the form of dramatic structure, themes and texturing.

## 1 Introduction

Sports simulation video games are big business, with EA "FIFA 10" becoming the world's fastest selling title [1]. Sports commentary plays a substantial role in creating a sense of immersion, agency and excitement within these games, and presents an area where substantial improvements can be made. By analysing and explicitly modelling the dramatic aspects of broadcast sports commentary, we intend to enhance the emotive qualities of simulated sports commentary by exploiting its dramatic potential.

## 2 Classical Sports Commentary Generation Systems

Two events of particular relevance to academic sports commentary generation systems are the RoboCup Commentator Exhibition and the IVA GALA RaceReporter event. These events have been host to a number notable sports commentary generation systems, namely ERIC [2] and DEIRA [3] (GALA), and MIKE, Byrne and Rocco [4] (RoboCup). Topic control is central to the selection of commentary subject matter and represents an essential component of such systems. However, none of the systems outlined above incorporate an explicit model of the various dramatic elements inherent in broadcast commentary.

## 3 Drama in Sports Commentary

One of the main purposes of any dramatic narrative is that of creating emotional tension. Freytag [5] states that this is accomplished by cycling through the five

R. Aylett et al. (Eds.): ICIDS 2010, LNCS 6432, pp. 111–116, 2010.

stages of dramatic structure: exposition, rising action, climax, falling action and denouement. These are defined schematically by what is known as Freytag's pyramid.

Ryan [6] identifies a number of themes in the analysis of a sports broadcast, including: Last Chance, Fatal Error, Futility, Wasted Opportunities, Opportunism, Redemption, Downfall of the Hero, Triumph of the Hero, Confrontation Between Hero and Anti-Hero, Doomed, and It Ain't Over Until It's Over. In similar research, Bryant [7] observes 15 dramatic motifs: Spirit, Competition, Human Interest, Urgency, Pity, Miracle, Gamesmanship, Comparison, Performance Competence, Physical Competence, Old-College-Try, External Forces, History, Personnel, and Glory. Although Ryan and Bryant use different terms (theme vs. motif), they are essentially referring to the same thing, i.e. the core dramatic narrative concept being communicated by any given piece of dramatic commentary.

Morris and Nydahl's [8] analysis of commentary for a basketball game considers sports commentary as consisting of historical, objective and interpretive utterances that serve the purpose of captivating the audience by defining and punctuating the meaning of the unfolding drama. They note how sports commentary provides potential for texturing time rather than simply filling it, and define seven categories of texturing statement: Speculative, Foreshadowing, Empathic, Critical, Motivational, Metaphoric and Subjective.

## 4 Globality of Plot versus Locality of Action

Ryan [6] further analyses running sports commentary from a narratological point of view. Ryan attempts to reconcile the retrospective nature of narrative with the real-time nature of running commentary, stating: "narrative is essentially retrospective... knowledge of the outcome shapes the narrator's selection and evaluation of the preceding states and events; the crisis to be highlighted determines the exposition and the complication; the point to be made specifies the arguments to be used". However, the emergent nature of real-time sports commentary prevents a global view, and thus precludes any truly retrospective stance. Ryan explains how this limitation is mitigated through the parallel construction of multiple parallel storylines throughout the running event, using the real time broadcast as a source of narrative material. Ryan explains how the creation of true narrative can only be achieved in real time by widening the scope of the broadcast beyond the current action, and that this may only be achieved by leaving the present and introducing prospective and retrospective narrative to the live broadcast.

## 5 Integrating Dramatic Narrative Devices with Sports Commentary Generation

Explicitly defining dramatic themes and texturing devices in a computational model allows us to generate dramatic sports commentary based on a model of professional broadcast commentary. A database of subject matter that covers event-related dramatic aspects of professional sports commentary serves as the basis for a system capable of dramatic commentary generation. This paper presents a model of dramatic sports commentary generation whereby domain-specific knowledge is formalised to allow events in the game to affect the instantiation and control of specific themes, which subsequently serve as the basis for dramatic topic control and content selection. The instantiated themes (along with their level of activation) determine the nature of the dramatic commentary generated in response to the ongoing action events. Themes are affected in 4 ways by domain-specific events, namely:

– Activation (Freytag's exposition): When a theme that is not yet instantiated receives a reinforcement event, it will be instantiated into the theme pool
– Reinforcement (Freytag's rising tension): When an active theme receives a reinforcement event, its level of activation shall be escalated
– Degradation (Freytag's falling tension): When an active theme receives a degradation event, its level of activation shall be downgraded
– Deactivation (Freytag's denouement): When an active theme receives a degradation event that degrades it beyond the lowest possible level, the theme is deactivated and removed from the theme pool

This requires that each theme has a list of reinforcement and degradation events in order to control the active themes, their activation levels, and thus the dramatic flow of commentary. For example, the 'Teamwork' theme related to offensive play would be activated and reinforced by the events: One two, Assists and Passing; degraded by: Failed one two, Failed assists, Failed passes; and expressed by terms such as "Teaming up", "Rapport", "Gelling" and "Connection".

Active themes will affect which utterances are chosen for expression, with the level of activation of the theme defining from which list of utterance templates the commentary shall be generated. A number of themes running in parallel, each with its own activation level based on the state of the game, will therefore provide a number of relevant pools of pre-defined dramatic content on which to base the generation of dramatic utterances. The system is designed in such a way that as the activation level of each theme increases, so does the intensity of the concepts and related adjectives used to describe the dramatic state or event. This allows us to computationally model Freytag's pyramid by, over time, increasing the level of drama to a climax, and then gradually decreasing it (given that the evolution of events follows this pattern of behaviour). For example, level 1 of the 'Urgency' theme may invoke the phrases "looking shaky" and "fortune not on their side", level 2 "getting serious" and "a goal now is critical" and level 3 "doomed", "beyond salvation" and "in need of a miracle". A degradation of one theme will often be mirrored by a reinforcement of another (for example Urgency vs. Miracle). A theme will climax when it reaches its peak activation level.

Events and Themes map directly to a nucleus and related satellites describing informational and dramatic commentary content (similar to Chatman's [9] modelling of story and discourse elements in terms of nuclei and satellites). The nucleus and satellites then map to a number of varied text-based realisations of the content which is generated on the fly using a Lexicalised Tree-Adjoining Grammar (LTAG) [10]. The slots in the LTAG grammar for a chosen piece of commentary are filled with context-specific information contained within the world state ontology (a database of facts modelling the world state). This implementation allows for a varied ordering of content elements and substitution of synonyms, providing an infrastructure for encoding event-based, contextually aware and dramatically enhanced commentary that is capable of producing varied output for the same input. A simple example of a unit of commentary relating to the urgency of a team's defensive play might be: [ [Showing / singalling / displaying] a(n) [strong / urgent / desperate / all important] [need / desire] to [prevent / defend] (against) [(yet) another] goal.], with synonyms being either randomly selected if non-emotive, or selected based on the activation level of the relevant theme if otherwise. For example, the word 'bad' can be expressed with the following synonyms of increasing emotive intensity: level 1: bad, poor, shoddy; level 2: terrible, awful, dire; level 3: atrocious, horrendous, inexcusable. This is similar to the word group classes found in the BRUTUS storytelling system [11].

Each section of commentary relating to a specific event or theme (and therefore being related to a specific nucleus) may be composed of a number of satellite units, reflecting informational, dramatic or texturing content. Figure 1 shows an example of content units for the nucleus of the tackle event. The dramatic commentary generation algorithm works in a loop as follows, with Figure 2 showing this schematically:

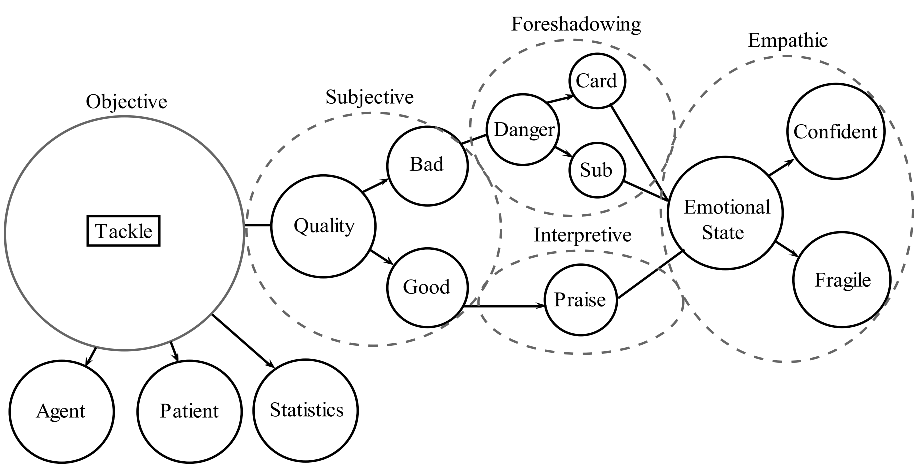


**Fig. 1.** Example of possible satellite content units for the nucleus of the tackle event

0. Initial Themes are activated based on the historical context of the game in question (last match of the season, derby match). This is done only once, at the start of the match. For example, the theme 'Rivalry' would be of particular relevance to a derby match.

1. Action Event Stream: Action Events are read in for the current time increment (defensiveTackle, midFieldTackle, attackingTackle, shotOnGoal, etc.).
2. Concept Event Stream: Time sequences of Action Events are mapped to more complex Concept Events (e.g. defensiveTackle(Penalty_Area) -> RedCard = Sending Off + PenaltyForOpponent).
3. Ontology Update: The ontology (a formalisation of all the entities, attributes and relationships in the modelled domain) is updated to reflect the current state of the world.
4. Theme Management: Action Events and Concept Events affect related Themes following a domain-specific rule-base for reinforcement and degradation (e.g. IF defensiveTackles(Penalty_Area) > 5 in a short time span THEN defensiveUrgency++).
5. Content Selection: Action Event, Concept Event and Theme-based commentary nuclei are selected for expression according to rules and active themes.
6. Utterance Generation: Commentary is generated from the selected commentary nuclei using a pseudo-random selection of satellite units, with selection of emotive words affected by theme activation level. Informational slots are filled in from the ontology. This is carried out using an LTAG grammar.

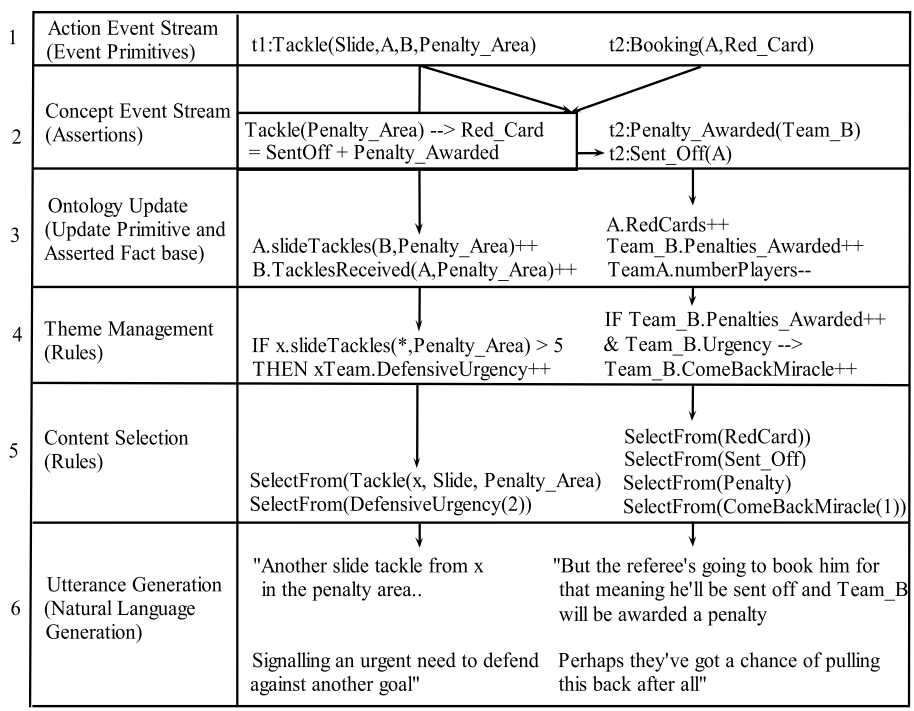


**Fig. 2.** Example flow diagram of the architecture

## 6 Conclusion

Integrating real-time commentary systems with dramatic devices presents an important step in adding dramatic commentary abilities to real-time commentary generation systems; helping bring such systems closer in terms of knowledge and skill to a professional commentator. Explicitly formalising the knowledge required for the modelling of dramatic themes/motifs and texturing devices enables us to implement these in a computational model of dramatic sports commentary, increasing excitement and immersion for the end-user. The event-driven progression of dramatic themes is based on Freytag's pyramid of rising and falling tension and provides us with a model for selecting dramatically loaded commentary fragments. Parallelising a number of running themes allows us to construct some form of coherent domain-specific plot-based dramatic narrative even when we lack a global view of the outcome. Basic play-by-play-, concept event-, and dramatic theme-based commentary nuclei map to a data structure that formalises both informational and dramatic narrative content in a way that dynamically maps to varied expressions of the content.

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# Zuzie: Collaborative Storytelling Based on Multiple Compositions

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**Abstract.** This paper presents an expressive activity program and a support system for collaborative storytelling based on multiple compositions: Zuzie. Zuzie's storytelling is designed so that people can experience rich expressions and extend their interpretation of them through creation of compositions. Each composition is a deliberate arrangement of a single set of figures on a background plane. Coupled with the expressive activity program, this research is intended to design and implement a system that supports multiple compositions. This report describes our Zuzie expressive activity and presents discussion of the expressions through the study and artworks.

**Keywords:** Collaborative storytelling, Storytelling workshop, Information design, Expression support system, Entertainment computing.

## 1 Introduction

Recent development of information and communication technology has enabled non-professional users to create stories that include rich media. We can appreciate and reuse others' stories that have been created with text, music, videos, and other media. Furthermore, we can create new stories easily. Even 3D animation has been used to create stories for non-professional users, with assistance by shared technology of specific scenes and creation techniques [7]. This is epoch-making because we can create our own stories and appreciate neighbors' stories using 3D animation in everyday life.

Storytelling is a robust method for circulation of "emotion-embedded information" using processes of composing a "story" and its "telling", which are sufficiently powerful to change each person's subjective world and even the physical world. The "story" comprises multiple elements such as the subject, the predicate, and the object. To deepen the story, it is effective to understand each element deeply and their mutual relations from various points of view in a collaborative manner. Furthermore, the "telling" entails both expression and appreciation of a story. Those actions and their associated feedback from audiences help users to understand elements more deeply and to find new relations among them.

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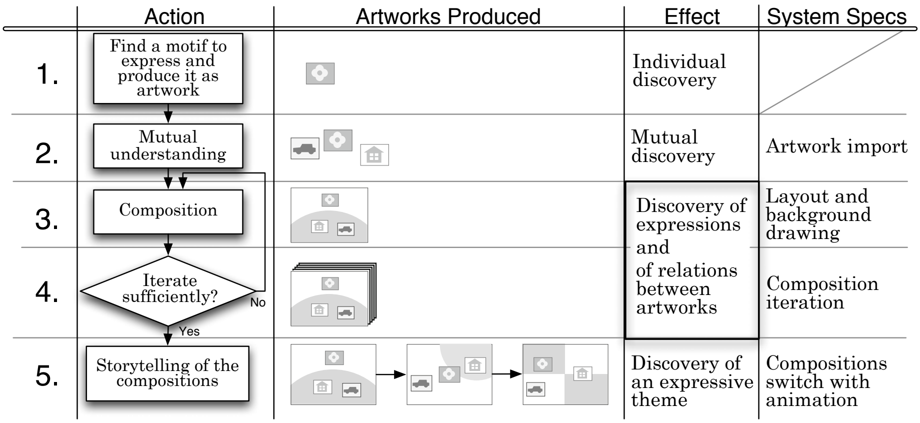



**Fig. 1.** Concept of Zuzie Method

Two main conventional studies are related to collaborative storytelling: diagramming methods and workshops. Regarding the diagramming method, affinity diagrams such as those of the KJ method [6] are known as an effective method for brainstorming and idea-processing. This method is used for collaborative discovery to elucidate a theme. Mind map [1] is another powerful diagramming tool that uses not only language that is logical but also drawings, which are illogical and impressionistic. A workshop is a real-world activity that provides a set of methods and technical know-how for creating a story. Those workshops are led actively by organizations of various kinds [4,3,2]. At those workshops, people happily express their own opinions and note different aspects of the theme. They do not, however, aim to achieve collaborative storytelling based on multiple perspectives.

Therefore we believe that repetition of story creation and story telling will help users to discover new viewpoints, notice new opinions, and experience impressive discoveries. Thereby stories will be created with empathy. As described in this paper, we propose a new activity and an application system to facilitate collaborative storytelling for non-professional users by inducing users to compose elements from multiple perspectives. This composition will lead us to "imagine each element and try to understand and visualize relations among them" from various perspectives. The composition used herein is an expressive method that arranges several figures on a background plane.

In Section 2, this paper explains our Zuzie method for storytelling in detail. The following Section 3 discusses the method and the system using a collaborative storytelling workshop practice. Finally, this paper concludes with Section 4.

## 2 Zuzie Collaborative Storytelling

The Zuzie method is a storytelling process that prescribes what and/or how people express their thoughts about a given theme on a workshop in a collaborative manner. Figure 1 shows that our Zuzie method consists of five procedures overall. Here the name

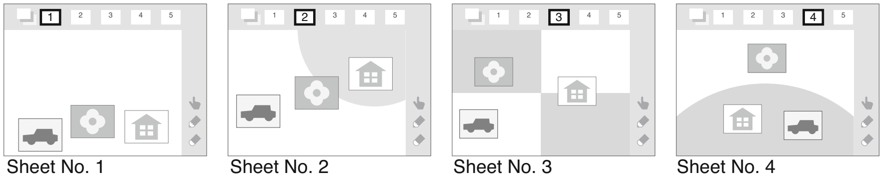



**Fig. 2.** Differences of Selected Composition-ed Screen

"Zuzie" is associated with *figure* (Japanese Zu) and *background* (Japanese Zi), which are used in the composition. The following gives details about the procedures.

Procedure 1 of expressive action compels the participants to express a motif of the workshop theme in their own way in the form of sketching out pictures, writing poems, or taking photos. The externalized motifs are designated as *figures*.

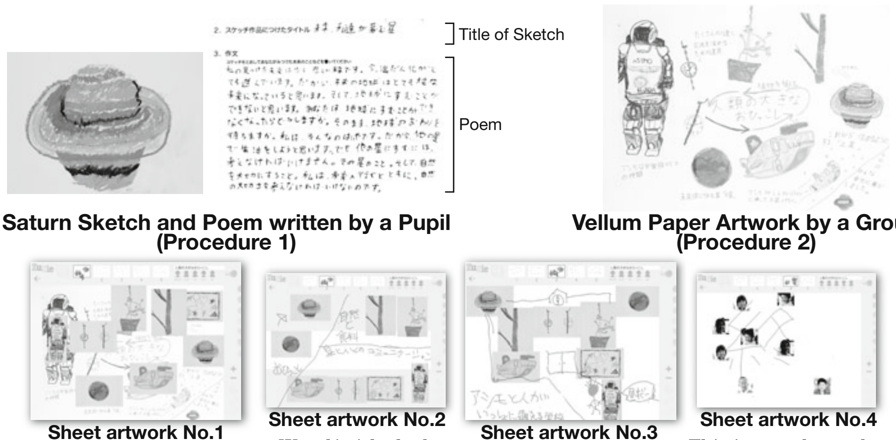
Procedure 2 of mutual understanding improves the participants' understanding of motifs through mutual observation of and storytelling about the figures of motifs. This procedure functions as a bridge from individual expression to the group's expression.

Procedure 3 of composition then dictates that the participants lay out the figures on a background plane. It stimulates the participants to reflect upon their composition work because it includes an explicit comparison process like "graphics" and a subjective expression like "paintings". Therefore, a certain context for the motif is clarified on the background plane because the composition has a property both as a graphic and as a painting simultaneously. The Zuzie method designates the found context as a *background*.

Procedure 4 of iteration for composition repeats procedure 3, although this is one important feature of the Zuzie method. An important feature for the Zuzie method is that a single set of figures is used throughout the multiple compositions. This constraint stimulates participants to view the figures panoramically, and to determine which are the motifs. A theme of the multiple compositions arises during iteration of the compositions.

Procedure 5 of storytelling is that of finally telling a story to the audience that is relevant to a series of compositions. Some reflections are anticipated through the storytelling in the form of creating a story in this procedure. At the same time, it is expected that experts and staff offer some feedback about the theme to the participants. That feedback stimulates rediscovery of their motifs.

Composition affords the participants a chance to compare and to appreciate artworks through laying out of the figures and changing backgrounds (sheets). By incorporating comparison processes like "graphic" into subjective expressions like "picture", Zuzie's composition prompts the participants to engage in reflection and appreciation of their artworks. Figure 2 presents the relation of the figure and background plane in the composition. The sheets shown in the figure are the results of each composition. The layouts of the single set of figures are expressed by each background plane in this manner. Differences among compositions are presented by animation at the time of comparison. Although the changing position of the object quickly complicates the viewers' recognition of the relations between previous and current, continuous animation aids that recognition [5] and simplifies the comparison.




Human beings became unable to live on the earth. (snip) ASIMO (a robot name) and astronauts got into Shinkai-6500 (a deep-sea research vehicle name) and went to Saturn for a geological survey. They planted a plant that is able to live there. (snip) But then new problems arose. Their languages differed. Therefore, they used a head-mounted saccade (words from a saccade-based display). Using it, they became able to communicate with each other. They lived in happiness.

We divided the sheet into three areas. We arranged Mars and Saturn on the immigration area, plants on the nature and food area, and machines on the communication area.

Here is a school that ASIMO and humans can attend together. A morning glory flower was used for mind-reading classes. Sugar cones were excellent and regal; it was placed where it was hoped it could live. Shinkai-6500 goes to the other planet to study science. The picture mind is used for friendship between ASIMO and humans.

This image shows the relationship of the purple group members. This relationship indicates their order of presentation. The order is given along with the strokes used to write the Japanese kanji character: 終.

**Series of Composition Artwork and Story by a Group (Procedures 3-4)**

**Fig. 3.** Artwork by the Purple Group: “Mass immigration of human beings”

The Zuzie support system is implemented as a web-based client-server system. The user interface is implemented using Flash (Adobe Systems Inc.). Therefore, the system can be run on web browsers of various kinds. In the server side, a database that preserves the composition data is implemented using MySQL. When the user starts the Zuzie support system on a Web browser, card picture data and coordinates are downloaded from the database on the server through the internet. The coordinates are updated when the user drags and drops the card. They are then uploaded to the server. Images drawn by the users are uploaded when the user changes the sheets from the current one to another.

## 3 Practice and Discussion

To date, since 2008, we have conducted 15 Zuzie collaborative storytelling workshops with 352 participants. As a representative example, this section presents a description of the museum practice session and examines five Zuzie procedures as a practical matter.

We held a Zuzie collaborative storytelling workshop (WS) called “Finding the Future” during July 26–27, 2008 at the National Museum of Emerging Science and Innovation (Koto-ku, Tokyo). As collaborative storytellers, 30 pupils of Baba Elementary

School (Yokohama, Kanagawa) participated. They were divided into six groups, each of 5–6 pupils. Other participants such as the WS facilitator and teacher of the school attended as supporters.

### 3.1 Artwork Results and Zuzie Method Discussion

Figure 3 shows the result of Zuzie method procedures 1–4, through which the expressive artwork is created by one of the five groups. The bottom half of Fig. 3 presents an example of a series of four compositions that was created on a computer screen using the Zuzie support system. The first sheet is a composition that is a reconstruction of procedure 2's construction paper product as a digital rendition. The group members chose the theme of the construction paper artwork, categorized their expressions in terms of school subjects, composition-ed a future school, and then finally produced an end credit that expresses how stories were written and by whom. All other groups produced similar artworks shown in the figure and collaboratively wrote their stories in terms of collaborative compositions.

The goal of procedure 3 of composition was especially that a new and different viewpoint and/or expression were acquired through the collaborative activities. A new expression using authors' portraits was discovered by the group members during a discussion about a new composition policy with changing of the card view to an authors' portrait. They also discovered a new expressive viewpoint for ideas for ordered proposals through the expression using authors' portraits.

The goal of procedure 4 was iteration and comparison support of the compositions for procedure 3. The new expression and viewpoint described above were acquired during the creation of sheet No. 4, which is the last sheet. Therefore, multiple compositions stimulated the participants to produce multilateral expressions.

Finally, in procedure 5 of storytelling, museum staff members who attended this session gave feedback to the storytellers. They evaluated the collaboratively produced artworks and stories. The feedback from audiences stimulated the storytellers to reflect and to appreciate their activities.

### 3.2 Zuzie Support System Discussion

The Zuzie support system is intended to support participants' expressive artwork iteratively. It uses some digital features that facilitate copying and arrangement of objects in a 2D fashion. The bottom half of Fig. 3 shows that four different sheet artworks were expressed. Furthermore, the users frequently switched sheets and card views from a sketch to a portrait during creation of sheet No. 4. Consequently, the system supported multiple compositions.

All information is known to be categorizable into five groups of LATCH [8]: initial word combinations of location, alphabet, time, category, and hierarchy. Sheet Nos. 1–3 in the bottom half of Fig. 3 are respectively categorized into time, category, and location. The title of sheet No. 1 is "Mass immigration of human beings". Therefore, a stream of time is expressed. In sheet No. 2, the cards are categorized and arranged according to the motifs of the sketch. Sheet No. 3 produces a geographical expression. Furthermore, it is interesting that, although the card arrangement creates the structure of sheets in sheet Nos. 1–3, a sheet inversely creates a card arrangement in sheet No. 4. In sheet


**Fig. 4.** Smiles

No. 4, strokes of a Japanese kanji character 終, which means "Finish" are written on the sheet as a background, and the authors' portraits are composed on the top of the strokes that express an order of proposing ideas. Results indicate that the Zuzie support system aided the viewing of motifs from multiple perspectives.

## 4 Summary

As described in this paper, we proposed a collaborative storytelling method, Zuzie, which uses multiple compositions. We also implemented a Zuzie support system that is designed to be coupled with the Zuzie method. We practiced storytelling in the setting of a workshop in a museum. This paper described details of the practice and explained our storytelling and the system with the collaborative composition artworks. Results show that our Zuzie method has stimulated participants' multiple perspective of the theme. It has encouraged them to create expressive artwork collaboratively. Finally, we report that we were fortunate to receive many smiles in the workshop presented in Fig. 4.

## Acknowledgments

We would like to thank the workshop participants –pupils and teachers of Baba Elementary School– and the staff of the National Museum of Emerging Science and Innovation, who kindly helped us.

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# An Interactive Documentary Manifesto

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**Abstract.** In the last few years the word "documentary" has been loosely used to describe multimedia pieces that incorporate video no matter its nature, technique, language or scope, taking advantage of the fuzzy and fragile boundaries of the documentary definition. The present manifesto aims to give a brief insight on the interactive documentary arena and also to sketch some production remarks for future interactive documentary productions.

## 1 Introduction

As a rule, all film literature starts with a reference to the Lumière brothers and their 1895 cinématographe, but when it comes to interactive documentary, should it begin with Lumière's invention or Babbage's Analytical Engine in 1830, the starting point of the modern computer? Probably both, and we might use this question as a pretext for a discussion on the current state of the art of a new "type" of documentary that lays between film and interaction: the interactive documentary. As for its definition we will cite Galloway's et al. [1] straightforward but nonetheless accurate: "any documentary that uses interactivity as a core part of its delivery mechanism". On a first glance this joint venture appears not only to be a simple task given the current state of evolution of both documentary and interaction but also creates high expectations on interactors since both concepts are two appealing buzzwords. However, the sad truth is that so far the current production of interactive documentaries has failed to meet the built expectations and is often no more than a series of multimedia pieces closer to PowerPoint than cinema. Regarding this matter, Whitelaw [2] wrote that interactive documentary "is little more than a catchy tag and an open question" and we couldn't agree more. How should an interactive documentary be? How does an interactor relates to the work? These questions and many others are not totally new as we can track its roots at the Word Expo 67 in Montreal in the sixties [3] and Gene Youngblood's seminal book "Expanded Cinema" [4] that followed, or the Aspen Moviemap Virtual Tour in the seventies, or Moss Landing in the eighties (probably the first piece of digital production to be officially called "interactive documentary" [5]), so why this manifesto today? Three main reasons ahead. First and foremost, because the time of interactive documentary has come: online video distribution has proven its feasibility on a high bandwidth world and its proximity to interactive environments is pushing it towards interaction. Second, the massive convergence process in course on a battle for "the screen" between TV broadcasters, online newspapers, and media distribution companies that desperately need innovative quality products to

R. Aylett et al. (Eds.): ICIDS 2010, LNCS 6432, pp. 123–128, 2010.

survive. Third, it appears that nowadays everyone is using the word "documentary" to describe every single multimedia piece that incorporates video no matter its nature, technique, language or scope, taking advantage of the fuzzy and fragile boundaries of the documentary definition. Regarding this semantic abuse, the term "documentary" has been used with all sorts of prefixes, namely "interactive", "expanded", "database", "locative", "evolving", "cross-platform", "transmedia", "enactive", "docugame", among many others. We believe this matter can't be seen as a minor question of semantics since there's a secular cinema tradition inherited whenever the word "documentary" is evoked. Not wanting to enter the realm of documentary theory, many of these "prefixed" documentaries don't "feel like" documentary at all, when "feeling like" is a crucial assessment to validate the belonging to the documentary family. These pieces recurrently end up poorly made with a serious deficit of engagement when compared to traditional linear ones [6], failing to embrace the best features of both worlds with an inclination towards interaction. Just because the Web is successfully incorporating some types of linear video -usually the short and the user generated kind- that doesn't mean that video is adjusting itself to the interactive format. In the words of Whitelaw [2], "many make only a very modest engagement with the potentials of interactive media. Very often they follow the path of remediation, reproducing the language of documentary film: cue music, fade in titles, cue voice of god narrator-all in 16:9 widescreen". So, thinking in practical terms, to what extent can we import the guiding principles from both documentary and interaction into the interactive documentary field? To what extent these rules can be combined and which new hybrid creatures might emerge from this process? One of interactive documentary's problems is being in No Man's Land, a place in-between different knowledge areas, such as cinema, interaction, videogames, video art to name a few, and it is not likely that any of them will find the answer alone. No one knows exactly what skills are needed for an interactive documentary or how to build up a team; even more challenging, no one knows for sure if some of the skills exist yet. "Who are the interactive documentary makers? Are they filmmakers who experiment with a new media or are they coming from different fields of expertise?" [5]. Under these uncertainties and dilemmas the only way interactive documentary has to find its identity is through a heuristic push based on a new orientation, so we noted down a few production remarks for interactive documentary makers to consider.

### 1.1 On Prima Materia

The Prima Materia of linear documentary is moving images and so it should be on interactive documentary, from content to interface. Gaudenzi [5] raises one legitimate point for further investigation: "why should interactive documentaries still mainly based on the moving image?" But, for the sake of the manifesto, we have to promptly say "yes" because that's what documentaries are made of. By saying this we're not rejecting the incorporation of other media as documentary always did, but only in those cases where conceptually the subject demands it and not for any other reason. Interactive documentary makers have been overusing pictures and it's time to go back to moving images. And, regardless the screen, interactive documentary should always pursuit a full screen approach for the sake of immersion and engagement.

As far as audio is concerned, it's a key element of interactive documentary due to its versatility and engaging properties (it can even make a picture be perceived as a moving image). Bunt [7] wrote down "I'd originally regarded sound as secondary. It was only very late in the production phase that I realized it's importance, both in terms of lending coherence to the spatial experience and of enabling a musical play of interactive sound/image juxtaposition".

### 1.2 On Subject and Framework

Not every subject is suitable for an interactive documentary, on the contrary: we can guess that very few are so every piece needs to start with a firm belief of the subject's suitability to the format. Interactivity is not a universal formula. As stated by Manovich [8], it's easy to go for the "temptation to immediately create an "interactive CD-ROM", or to make a feature length "digital film", instead of focus on determining the new media equivalent of a shot, a sentence, a word, or even a letter". Linear documentary is a successful centennial formula so the question "why not linear" should always come first, any attempt to force a subject into an interactivity is a recipe for failure. Regarding this topic, the approach to the subject must be willing to change as interactivity demands, the relation between format and subject needs to be resilient (as it should happen on every documentary, actually). The framework of the interactive documentary should look for formal arrangements within the subject -like geography, chronology, or preferably more sophisticated ones- and, more important, should run away from the traditional approaches we can find on traditional multimedia products (like geography="a map"; chronology="a timeline") that usually moves the production away from cinema. Formal arrangements shouldn't compel interactive documentary into structural rigidity, it's important to find a solid but flexible structure that allows some degree of freedom. There's also no need to make it too clickable, too interactive: if linear documentary has zero interaction points and is a successful model, why would we make an interactive one a "clickable extravaganza"? Seek for continuity first, interaction last. And, of course, its always better a good idea made simple.

### 1.3 On Input Devices

As far as input devices are concerned, two ideas stand: simplicity and universality. Input devices should be those people know how to operate and they should never surpass the consumer market. The mouse is central to the operation; tactile technology is becoming a standard, too. The microphone is also a good tool to trigger events. Wii controllers might bring something interesting to the arena in the future (and these days Wii is planning on launching a pulse detector so interactive documentaries might incorporate basic biometric data into their input feed, good news for the enactive documentary model [9]). If the work has a locative component, then GPS. The input can also come from multiple data sources over the Internet, like weather or news reports just to name a few. But, again, we emphasize the orientation towards simplicity: every single input should have a grounded purpose and shouldn't be used just because it's fun for the maker. The outcome of the input should be clear to the interactor and significant to the experience, otherwise it should be avoided.

## 1.4 On Interface

The interface should be moving images based (any other approach will easily lead to a traditional multimedia piece) and has to merge with content to the point where one cannot be dissociated from the other. Interface is content, content is interface. Manovich [8] wrote, "contrary to traditional media, in hypermedia the elements and the structure are separate from each other. The structure of hyperlinks -typically a branching tree- can be specified independently from the contents of a document". And that's precisely what we should avoid. Smooth continuity between both is compulsory, engagement is a shared responsibility; interactors should "watch" the interface too. Shaul [6] identified incoherent transitions within and between different narrative threads as one of split-attention stumbling blocks of interactive cinema. So, every click (cut) should match the previous one. The Tate Street Art website (www.tatestreetart.com) is a great example on how moving images can have engaging properties even when there's no particular action. Interface should keep away from text and buttons as much as possible (audio cues is a good alternative).

## 1.5 On Navigation Structure

When considering the navigation structure of an interactive documentary it's essential to move away from a linear mindset, any attempt to emulate a linear structure will most certainly fail. An interactive structure has no ability to compete with a rigorous and linear edit made with story arch and closure in mind. Moreover, why giving someone the option to choose if, in a way, it's a blind choice? Can't linear documentary be regarded as a navigation curatorship? And if the goal of some documentaries is to challenge the interactor and its beliefs, should he be able to choose? Some of these issues could be overcome with input data that wouldn't depend on an explicit choice of the interactor, like biometric data, but it's too early for that.

Consequently, interactive documentary should always explore unique approaches to the subject that cinema can't achieve -the so-called "being there" feeling comes to mind. In that sense, the interactive documentary "Only Fish Shall Visit" is a good model: before the flood of Halfeti due to the construction of a dam, Bunt [7] has decided to document the place under an interactive " flâneur" approach, whereby the interactor wanders through the soon to be underwater town. This technique allows a particular relation with the subject as it comes close to the actual experience of exploring a place, the decisions the interactor make are more or less similar to those he would do if visiting the real town perpetrating a sense of freedom, like choosing the left trail on a junction. This real life emulation generates a strong relation with geography; the choice given to the interactor endures an engaging and memory friendly experience, very useful for pedagogic content. So, the plastic nature of this approach allows exploring some aspects that cinematic montage has been traditionally ignoring for a long time. In a way this approach reminds us a game structure, so it's crucial for interactive documentary to assess what can be merged with other areas and how to perform the operation.

Another successful approach can be seen on the documentaries "The Big Issue: Obesity" and "Prisonvalley", where a "Choose Your Own Adventure" type of strategy is used to engage the audience.

### 1.6 On Time

How long should the experience take? Duration is a tricky issue and the answer depends entirely on goal of the work, on how it is supposed to be experienced by the interactor. Some topics should be stressed out, though. First, the replication of the golden rule for video on the Web "keep it short" might not be valid to interactive documentary: if, as we predict, interactive documentary might be consumed on the biggest screen on the living room (note: during leisure time), why can't it be experienced for at least the duration of a linear one? But maybe our mind is too deeply connected with linear when it comes to duration, maybe it's an experience that can last for several days if we consider, for instance, that people play video games sometimes for months or even years. Are interactive documentaries supposed to be consumed one time straight or throughout several days? Is the interactor expecting the Aristotelian drama path as usual? Is the closure within the piece or does the interactor needs to find its own closure? Does interactive documentary requires full attention throughout the whole piece? Too many questions to be answered.

### 1.7 On Tools

Since interactive documentary is such a new production area and since every single documentary has it's own approach then it's normal that the market has no ready-made authoring tools, and we wonder if it will ever have. As a result, interactive documentary has to be built either using general-purpose programming languages, that offer basic or no support for moving image narrativity [10]. Concerning the use of Macromedia Director in 1997 (but still up to date), Weinbren [11] stated, "these products bring a conception of interactivity (centered around "buttons" and a notion of "choice"" that he finds deeply problematic. "Advanced users of the software, of course, trick it, or bend it at least, into doing what they want it to do: but novice users repeat the same structure again and again" [11]. If we look closer into the market, probably the best software to author interactive documentaries comes from the video art arena, but these tools are impractical for wide distribution since they don't work as a stand-alone. Max, for instance, starts with a blank page to which we add modules, and "everything can be connected to everything, because everything speaks numbers" [12]. Hence, makers aren't conceptually propelled to follow a specific paradigm allowing a welcoming intellectual freedom. It's important to think ahead, to explore concept before choosing the tool or it will conform thought.

### 1.8 On Attitude

On documentary we replace the script for a notebook [13]. This statement is representative of a mind-set towards documentary filmmaking, but can we expect this same attitude on the making of an interactive one? Is it possible to perpetuate a certain degree of freedom under a structural formalism demanded by interactive documentary? We would guess that in most cases interactive documentary isn't (unfortunately) as open so we wonder if this transformation won't harm the documentary's essence. And, speaking about the essence, "making a choice involves a moral responsibility. By passing on these choices to the user, the author also passes the responsibility to represent the world and the human condition in it" [8]. If montage is at the center of cinematic meaning, and if choice is given to the interactor, then the interactive filmmaker's task becomes that of producing a set of film materials and plotting some pathways through it. The filmmaker becomes more the designer of a pattern of trails through a landscape of images, less the tour bus driver [11], which inevitably forces us to think if the filmmaker is set aside from one of its crucial purposes on the production: point of view. Only the future will tell, but it's definitely worth trying.

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# Rhetorics of the Interactive 3D Installation "Virtuelle Mauer/ReConstructing the Wall"

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**Abstract.** This case study of "Virtuelle Mauer/ReConstructing the Wall," a prize-winning interactive 3D installation on the Berlin Wall, describes an approach using artistic concepts of abstraction and interactive narratology to simplify production and focus on subtle but powerful user interactions with the virtual world. Interactivity is predetermined and invariable, but after two years of exhibitions in Europe, the USA and South Asia, the authors are confident that it provides an engrossing, affective experience for a general public across cultures and including schoolchildren and their teachers, contemporary witnesses and their families, historians and historic preservationists.

**Keywords:** interactive narrative, virtual worlds, cultural heritage.

## 1 Introduction

This paper describes rhetorical devices used in the prize-winning interactive 3D installation "Virtuelle Mauer/ReConstructing the Wall" to create an affective encounter with the long-vanished Berlin Wall. [1] Users, moving through the virtual world in a first-person viewpoint, experience the freedoms and constraints on movement that residents had in their respective neighborhoods in East or West Berlin. The interactivity, encounters with virtual characters and dramatic structure are predetermined and invariable, but we believe this paper can provide insights both for content creators wanting to design effective interactive narratives with current technology, and for researchers developing technology for computer-driven interactive drama systems.

"Virtuelle Mauer/ReConstructing the Wall" was developed by the artist team T+T, of which Tamiko Thiel and Teresa Reuter are the principals. It was created in close cooperation and with the support of the Berlin Senate Chancellery for Cultural Affairs as an integral part of its Memorial Concept for the Berlin Wall. Partial funding was provided by the Berlin Capital City Cultural Fund (Hauptstadtkulturfonds).[1]

The Berlin Wall was the best-known symbol of the Cold War and still arouses curiosity even in people with little other interest in European history. "Virtuelle

[1] Other sponsors included: Berlin Wall Documentation Center/Berlin, Federal Republic of Germany State Department, Goethe-Institut Boston, Dr. John Czaplicka/Harvard University Center for European Studies, Massachusetts Institute of Technology/Center for Advanced Visual Studies, metroGap e.V. – Association for Urban Theory and Practice, Bitmanagement Software, JSC Softline, Lunatic Interactive GmbH.

R. Aylett et al. (Eds.): ICIDS 2010, LNCS 6432, pp. 129–140, 2010.

Mauer/ReConstructing the Wall" draws on this interest to engage a general, worldwide public, including schoolchildren and their teachers, historic preservationists and historians, older people who perhaps encountered the Wall themselves in East or West Berlin and young adults born after the Fall of the Wall, for whom the Cold War seems like "ancient history." A very special public is families, with children keen to navigate the virtual world as the "computer game experts" but in the process unconsciously opening up to stories from their grandparents and parents about this important period.

With substantial support from the German government cultural institution Goethe-Institut we showed the installation extensively from 2008-2010 in Europe, the USA and South Asia in events leading up to and memorializing the 20th anniversary of the Fall of the Berlin Wall in 1989.[2] "Virtuelle Mauer" has been praised by historic preservationists and historians for providing an engrossing, affective encounter with the now vanished Berlin Wall,[3] reviewers from Boston, USA to Bangalore, India hailed it as their "Critic's Choice" and in 2009 it won the Grand Prize of the IBM Innovation Awards for Art and Technology at the Boston Cyberarts Festival. [2]

Although the contextual background and knowledge of Cold War German history of each audience was very diverse, we observed similar emotional responses to the dramatic devices described in this paper with all audiences. This paper is based on anecdotal evidence rather than rigorous scientific studies of audience reactions, but it was very important to us to understand and improve the dramatic impact of our work so we spent many hours at each exhibition observing users at the joystick to see how they navigated the virtual space, and talking with them about their reactions to the content to see if it came across in the ways we had intended.

The mechanisms described here evolved partly due to constraints on finances and resources familiar to all content creators. The production grant from the Berlin Capital City Cultural Fund covered less than half of the real costs of production; nevertheless the expectation was that our piece would accurately reflect the built environment of Cold War Berlin. We needed to use creative insights into interactive narratology to minimize the technical complexity of the system and the amount of content that we had to produce. We initially planned to involve the user in historical escape attempts, using a dramatic structure closer to a classic game design, but were advised by the Berlin Wall Documentation Center, the official Berlin memorial center for the Berlin Wall, that the families of those who died in escape attempts at the Wall react very negatively to any works that bring the tragic destinies of their relatives into a "game-like" context.

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[2] Selected exhibitions in Germany: Museum for Communication Berlin (Aug.-Sept. 2009), City Museum of Berlin (Nov.2009-Feb.2010), Willy-Brandt-Haus Lubeck (June-July 2009), Kunstverein Wolfsburg (Sept.-Nov.2009). In Spain: LABoral Centro de Arte Gijon (Oct.2009-Apr.2010). In the USA: 911 Media Arts Center Seattle (Nov.2008-Jan.2009), Goethe-Institut / Cyberarts Festival Boston (Apr.-May 2009), Harvard University Kennedy School of Government Cambridge (Nov.2009), American University Museum Washington D.C. (Nov.-Dec.2009), Goethe-Institut Los Angeles (Nov.-Dec.2009). In India: Goethe-Institut in New Delhi (Dec.2009) and in Bangalore (Jan.2010), India Institute of Technology Mumbai (e.g. Bombay, Jan.-Feb.2010). In Sri Lanka: Goethe-Institut Colombo (Jan.2010).

[3] Dr. Axel Klausmeier/ Director, Berlin Wall Documentation Center, Prof. Dr. Gabi Dolff-Bonekämper/Technical University Berlin, Prof. Dr. Leo Schmidt/Technical University Cottbuss, Dr. Klaus Schariot/historian and German Ambassador to the USA (personal communications with the authors).

As T+T artist Tamiko Thiel has argued elsewhere, depending on the content to be conveyed it may be efficacious for designers to shift focus from "interpersonal" interactions between the user and characters to interactions between the user and the virtual world itself, with characters considered simply as special elements of the virtual environment. [3] This can be true even if user interactions with characters are an important part of the drama, as is the case in "Virtuelle Mauer/ReConstructing the Wall," where interactions with officials play a vital affective role in the piece. Characters are used to illustrate and reinforce aspects of the virtual world, especially restrictions on free movement, rather than being the primary focus in a character-centered narrative.

## 2 Description of Project Content and Goals

For decades the Berlin Wall was a symbol of repression and of the division of Germany, Europe and a large portion of the world into two politically opposed systems: Communism and Capitalism. The Berlin Wall was "built"[4] practically overnight on August 13, 1961 by the East German government to prevent its own citizens from fleeing from Soviet occupied East Berlin to Allied occupied West Berlin. [4] On November 9, 1989, to the complete surprise of everyone in both East and West it was suddenly and irreversibly opened. The Wall had fallen. [5]

As the premiere symbol of the divisions of the Cold War, people in both East and West Berlin wanted to eliminate the Wall as quickly as possible. Only a year later, almost all significant portions of the Wall had disappeared. For those who never experienced this military fortification cutting through quiet residential neighborhoods in the middle of a modern metropolis, for those who never experienced the steely-eyed glare of a hostile border guard barring the way from one side of the street to the other, the effects of this structure on life "in the shadow of the Wall" are not comprehensible today, nor are the political and sociological divisions that live on in Germany as a "wall in people's heads."

The purpose of the interactive 3D installation "Virtuelle Mauer/ReConstructing the Wall" is to give those who have never encountered the Wall, especially young people born after its fall, an affective, kinesthetic encounter with the Wall. Our project area is a one kilometer (0.56 mile) stretch of the Berlin Wall between the West Berlin district Kreuzberg and the East Berlin district Mitte. We chose this particular area because it featured many of the surreal situations engendered by the Wall: a densely built inner city residential area split in two by the Wall, the "inner German" border crossing Checkpoint Heinrich-Heine-Strasse, where no local residents were allowed to cross (only West Germans resident outside of Berlin were allowed to transit here); destructive changes in the cityscape as a result of wartime bombing and the erection of the Death Strip; urban renewal in post-war East Germany; daily life in the shadow of military fortifications – under constant surveillance and with the possibility of lethal crossfire in the case of an escape attempt; and finally, urban changes in reunified Berlin after the Fall of the Wall.

[4] In the early hours of August 13, 1961 the entire border surrounding West Berlin was blocked off with barbed wire and armed East German soldiers.

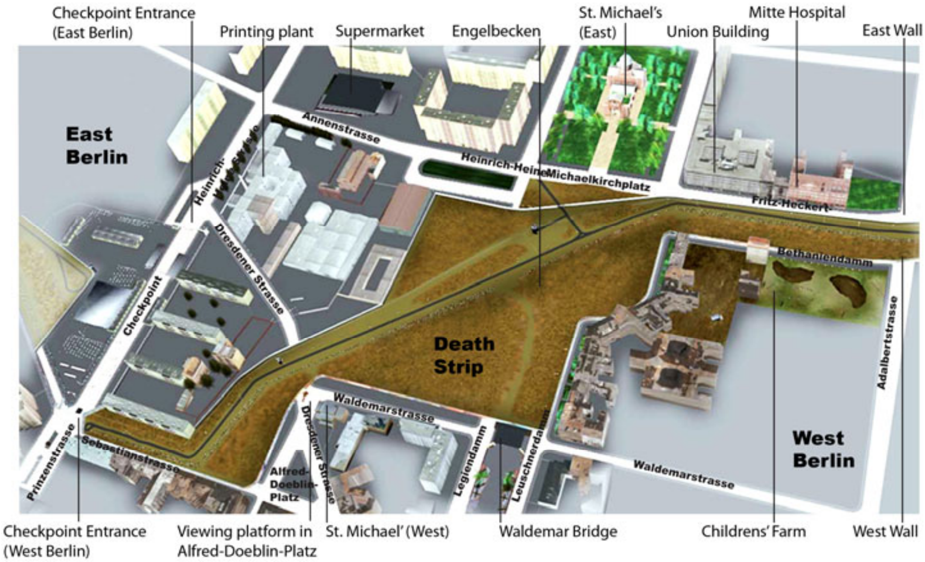


**Fig. 1.** "Virtuelle Mauer/ReConstructing the Wall," project area map

On the basis of extensive research in city and state archives, including those of the former East German Secret Police (Stasi), we wove historical events, sounds and images into the 3D virtual world. Users' actions trigger time travel, animations & simulations that depict events spanning the 1960s to the present time, conveying a sense of what it was like to live "in the shadow of the Wall." An important aspect that is expressed through the interaction rhetoric was how a normal person would be treated differently near the Wall in East Berlin versus in West Berlin.

## 3 Discussion of Related Works

The unique aspect of "Virtuelle Mauer/ReConstructing the Wall" is that it provides an interactive narrative encounter with the Berlin Wall in which users are not tourists, immune to conditions of life at the Wall, but rather experience the same freedoms and constraints in their explorations and their movements that a resident would encounter.

The official 3D virtual city model published by the City/State of Berlin shows the entire course of the Berlin Wall using Google Earth technology, but is essentially a 3D map and layers the Wall over 21st century Berlin, which has substantially changed since the time of the Wall. [6] Twinity has a navigable 3D reconstruction which however presents a tour rather than involving the user in an interactive narrative. [7]

An artwork which does confront users with a coercive environment is "Gone Gitmo" (2007) by Nonny de la Peña and Peggy Weil, a Second Life world dealing with the Guantánamo Bay prison camp [8]. After a first-person "introductory experience" of being a hooded prisoner in a transport aircraft users find themselves in a prison cage at Guantánamo. They are however not constrained to the role of a prisoner and can walk out of the cell at any time. [9] Walking around the camp users encounter additional narrative material such as for instance a video of a father relating the conditions under which his son is being held. Additionally, the artists are using materials from the world to present fascinating, highly structured interactive narrative experiences with head-mounted displays, such as the “immersive journalism” IPSRESS Experience in which users see their avatars – and by transference feel themselves – as prisoners being held in stress positions. [10]

Beyond Manzanar (2000), an earlier 3D installation by Thiel in collaboration with Zara Houshmand, constrains users to the role of a prisoner in the former Manzanar Internment camp in California. [3] It layers the internment of Japanese-American families by the US government during the Second World War with similar threats to intern Iranian-Americans during the Iranian Hostage Crisis in 1979-80. Beyond Manzanar deals however not with historic incidents so much as it contrasts the American Dream with the demonization of entire groups in times of crisis.

In a different narrative twist, Maurice Benayoun’s virtual reality installation “World Skin” (1997) puts users in the role of photographers in a war zone. As they take “pictures” of the scene with cameras, each portion of the world they “shoot” loses its texture and becomes white. The focus of the narrative is on the short but powerfully destructive interaction between users and the virtual world via the “weapon” of the camera.

## 4 Description of the Exhibition Design

The physical and technical set-up of “Virtuelle Mauer/ReConstructing the Wall” follows a system that Thiel has tested in venues in many countries over the last decade. It uses a single large projection (3m x 5m or 9’x15’) to achieve a roughly life-sized image that is large enough to fill the user’s peripheral vision and produce a feeling of immersion without expensive helmet or CAVE equipment. The screen is close to the floor so users feel they can walk “through the fourth wall” into the virtual space. Three-dimensional sound from the virtual world, important to enhance the sense of space, is heard via two active stereo PC speakers. The code for the virtual world runs in the Bitmanagement Software BS Contact VRML/X3D browser on a business grade Windows PC with midrange graphic card (Nvidia GTS 250). The equipment is economical and common enough to be purchased even by low tech venues, thereby reach a broad range of audiences.

The navigational input device is a Logitech Extreme 3D Pro joystick modified to have only forward/back/left/right movement. With artworks that often address historical, wartime incidents, Thiel has aimed over the last fifteen years to reach a broad general audience including the elderly and the computer-phobic, and also disabled veterans in wheelchairs. For these audiences the physical interface must require no previous familiarity with computers, be easy to learn and physically easy to use, so that users can focus on the content instead of the interaction. Even disabled in wheelchairs can steer themselves through real space with simple joysticks, and it is heartwarming to see everyone from small children to the elderly and disabled jump at the chance to grab the joystick and sail off through the virtual world.

The joystick speed is purposely restricted to a leisurely walking pace to encourage users to look around while they walk. Besides the active user at the joystick any number of other visitors can watch as well, and users will often stay to see what things the next users discover. We have tried to include enough material so that users can discover new details each time an episode is repeated.

As users can enter and leave the installation space at any time, the narrative structure of "Virtuelle Mauer/ReConstructing the Wall" has no beginning and no end. There is no break in the narrative when one user gives up the joystick to the next one, so passive watchers have continuity from user to user as well.

**Fig. 2.** "Virtuelle Mauer/ReConstructing the Wall," installation photograph

A separate informational exhibit consisting of 8 poster-sized panels is displayed in a well-lit space directly before the entrance into the darkened installation. (A more detailed version is available for sale as a project book in an English or German version.) Maps show the division lines between East and West Germany and Berlin during the Cold War and a chronology gives an overview of the relevant historic and political events of that time. Images depict the construction and fortification of the border structures over the decades. Archival aerial photos and images from different decades show how the urban landscape in this part of Berlin changed as a result of the building and the demolition of the Berlin Wall. We separate the affective and the pedagogical experiences so that users of the installation focus on the sensory and kinesthetic encounter with the virtual world of the Wall.

This focus on the affective experience is particularly effective at getting children to develop an emotional relationship to otherwise difficult historical material. For the academic year 2010/2011 T+T artists Teresa Reuter and Sabe Wunsch have received a grant from the Berlin Project Fund for Cultural Education to use the "Virtuelle Mauer" installation and its accompanying informational materials as the basis for workshops with Berlin high school students to create projects and exhibitions about the Berlin Wall and Cold War Berlin. [12]

## 5 Rhetorical Devices in the Media Design of the Virtual World

The visual aesthetic is used to set user expectations and give rhetorical clues as to the nature of the experience. We reconstructed the built environment of our segment of the Berlin Wall and its surrounding neighborhoods as accurately as possible in order to satisfy historic preservationists with a measure of “authenticity.” In order to control expectations as to “realism” however, we used a visual style similar to a graphic novel. When the virtual world fades from the “standard time” of the mid-1980s back to the early days of the Wall in the 1960s, buildings fade to black and white to indicate a flashback. When the world fades forward into the “future” (i.e. 2007), the buildings become more photo-realistic, taking on the clean, restored look of post-Wall Berlin. We indicated the accessible part of the project area by texturing the facades of the buildings; where the buildings are untextured grey blocks, the virtual world has “come to an end” and semi-transparent walls prevent users from going further.

The “graphic novel” visual style gave us more artistic freedom with characters as well. As the purpose of uniforms is to obscure the individual, turning him or her into a symbol of state power, we used the same character for all officials of the same type, e.g. one character for all border guards. The mouths of the character do not move when they speak, but their voices are localized in 3D stereo space onto their figures, shifting to remain centered at the character when the user moves. We found we could even repeat more distinctive, unique characters such as the “Wall tourist couple” shown in Figure 3. As in medieval narrative paintings, they are perceived as being the same couple in different places at different times. [13]

## 6 Rhetorical Devices in the Navigation and Interaction Design

“Virtuelle Mauer/ReConstructing the Wall” is a spatial, first-person viewpoint narrative in which users’ movements through the virtual space carry them through the narrative structure of the piece. The dramatic structure is episodic, with each episode having a its own small dramatic buildup and release. Users are self-directed and can decide to simply explore the space, or to trigger depictions of historic events. To keep the user mentally situated “in the world” we wanted appurtenances for these triggers to be naturalistic parts of the virtual world, rather than signs or buttons. In past works Thiel has guided users through spatial narratives with open doors and pathways, but in the wealth of detail in “Virtuelle Mauer” naïve users rarely noticed these clues. We found that walking up to characters to “hear their stories” was a compelling mnemonic even for older, inexperienced users, and so use them now to mark most hot spots, where proximity sensors then trigger the events of the episodes. Each episode is predetermined and invariable, being the same whether users trigger them for the first time or multiple times in succession. How then could we create dramatic tension and user involvement?

Thiel has argued elsewhere that in interactive works the true character development happens in the users themselves. [3] As users go through the piece, the episodes accumulate and color their reactions to new experiences with memories of the past and premonitions of what could happen in the future. Although going through an episode does not affect the future, it does change how the user will perceive subsequent events. This is in fact the primary affective mechanism of the piece, as it arouses emotions in users by playing with their expectations. [14]

For instance in the episode in Figure 3, when the user approaches the characters the seemingly solid, realistic world suddenly changes dramatically, as houses torn down to enlarge the Death Strip reappear in a flashback to the 1960s. A rope hanging out an open window depicts an historic escape attempt, about which the "Wall tourists" then comment in German and English. From interviews with local residents we found this is how they actually experienced escape attempts, not like a TV crime show depiction but only seeing mysterious traces and hearing after-the-fact rumors of what had happened or might have happened. Given the sensibilities of the Berlin Wall victims groups, and wanting to reach a world-wide audience, we depict escape attempts primarily through abstracted visual enactments, with spoken stories providing additional information but not necessary to grasp the basic story.

**Fig. 3.** "Virtuelle Mauer/ReConstructing the Wall," escape seen from West Berlin

In fact the ways in which these stories are related carry additional clues about how residents were treated differently in East Berlin and West Berlin. In West Berlin the "Wall tourists" talk about an escape attempt openly. In East Berlin one would not speak about such things in public. We therefore use silent children as the "trigger," such as in the escape attempt depicted in Figure 4, as East Berliners told us children had more leeway to approach restricted areas near the checkpoint and the Wall.

Freedom of movement is another radical difference in the experience of a normal resident of East Berlin in comparison to West Berlin – and users are always treated as residents of that part of Berlin in which they currently find themselves. Users are apparently free to explore the project area at will. If their own choices suddenly bring them into danger, however, and in that moment we take away their ability to move, the emotional shock of loss of control is very strong.

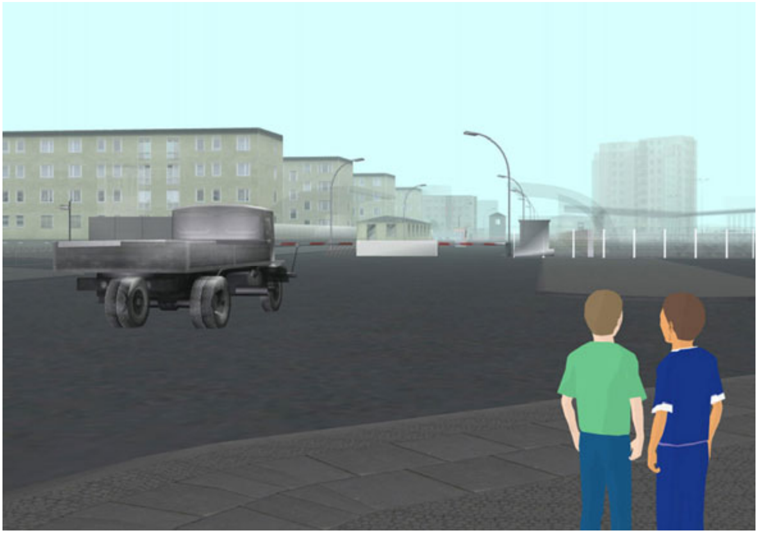

**Fig. 4.** "Virtuelle Mauer/ReConstructing the Wall," escape seen from East Berlin

In West Berlin the Wall was a site of anarchic freedom, covered with colorful graffiti, and the neighborhood of Kreuzberg was populated by immigrants and alternative sub-cultures. In West Berlin, users' interactions with the virtual world are free of consequences. Although users, being treated as local residents, are not allowed to cross at the checkpoint, they can come and go as they please even while the guard is talking, can go everywhere along the Wall and climb viewing platforms to peer into the Death Strip watchtowers and across to East Berlin.

**Fig. 5.** "Virtuelle Mauer/ReConstructing the Wall," East German police in front of East Wall

The East Berlin district of Mitte, on the other hand, was a neat and clean residential idyll, but under stern and continuous state control. Older people who lived in East Berlin at the time of the Wall told us that they immediately recognized certain areas near the Wall as restricted zones and that it would not even occur to them to approach these areas. How could we communicate this "inner wall" to our carefree users who has never lived with the fear of attracting unwanted attention from the secret police?

When users overlook the subtle signs marking a restricted area and walk blithely into the zone they are immediately confronted by East Berlin police. As soon as the police appear, we take away users' control of the joystick. They are trapped.

The police take the users in for interrogation – an abstracted experience, with dim figures silhouetted against the glare of lights and loud, distorted voices. Compared to a real interrogation it is brief indeed, but East Berliners who have been interrogated by the secret police have told us we have managed to convey the feeling of threat and disorientation that they felt themselves.



**Fig. 6.** "Virtuelle Mauer/ReConstructing the Wall," screenshot: interrogation scene

When the interrogation is over, the interrogator disappears, a door slams, and users find themselves in a vague, grey world that symbolizes their removal from normal society. We give them back control of the joystick, and they must find their own way back into the "normal" world.

Similar experiences await users at the East Berlin entrance to the checkpoint. The first time users approach a border guard we take away control of the joystick and hold them until the guard sends them away. If users obediently leave, nothing happens. If they however come back a second time (within 5 minutes) or approach a different border guard, they are taken in for interrogation. We have tried to reflect the constraints and compulsions of the real world, no more but no less.

## 7 Conclusions

"Virtuelle Mauer/ReConstructing the Wall" aims to provide an affective encounter with the Berlin Wall in an interactive 3D narrative installation. It uses relatively generic commercial hardware and software in order to provide an economical and robust system that can be shown in practically any venue where there is electricity.

In "Virtuelle Mauer" the user is not a tourist on a guided tour, removed from the day to day constraints of life in Cold War Berlin, but a resident subject to the contraints of life "in the shadow of the Wall."

The user is the protagonist, but we considered the entire virtual world itself to be the antagonist. Characters are used to justify and reinforce aspects of the virtual world rather than being the primary focus of a character-centered narrative. The interaction rhetorics are enhanced by abstractions in the visual and acoustic design of the virtual world that communicate subtle differences in the situation of the user, as an East Berliner versus a West Berliner, or during and after an interrogation. The interactive rhetorics used to create dramatic tension are technically very simple but emotionally very powerful, playing off the user's perceived freedom of movement with the reality of constraints and compulsions within the virtual world, in a situation not unlike real life itself.

The interaction rhetoric was refined by intensive observation of and discussion with users. The initial release of "Virtuelle Mauer/ReConstructing the Wall" did not include the interrogation sequences mentioned above. At the first showing of the installation (at the Museum of Communication in Berlin) East Berliners told us time and again how they knew instinctively not to even look at or approach the checkpoint or certain areas near the Wall – without ever having been directly told as children that it was "dangerous." We realized that more than the tangible, physical manifestations of state power visible at the Berlin Wall, with its watchtowers and guards, the formation and existence of this unconscious, intangible mental barrier was the most important experience to be communicated about the Berlin Wall. Interactive narrative is a unique – and perhaps the only – medium to teach people the reality of an internal, intangible constraint. After being stopped and interrogated several times for their "reckless" behavior, users will look more closely and think more carefully about what they should or should not do near the Berlin Wall in East Berlin. They will learn that their choices and their actions can have unpleasant, personal consequences.

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# From Physical to Non-material Art – Design Choices of the Digital Artist

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**Abstract.** This paper is a study of the different characteristics of the presentation media of artwork that can exist in physical and non-material form. The paper explores how these characteristics affect the design of an artwork. Physical in this context refers to physical installations, and non-material is used to define artworks where the designer has little or no control over the presentation media, such as artwork that exists online.

**Keywords:** Media art, non-material, online, remediation, installation, design.

## 1 Introduction

Most contemporary digital art installations not only exist in physical form. Artworks are remediated into other presentation forms such as online art. Remediation in this context is considered as Jay David Bolter and Richard Grusin [1] describe it, as mediation of mediation, where every act of mediation is dependent on another. This article takes a look at the different characteristics of physical and non-material artwork, studying their similarities and distinguishing traits. The questions presented here, are not only limited to projects dealing with remediation, where physical and non-material versions have been created around the same theme, they are just as relevant to artwork which only exist in either physical or non-material form.

## 2 Motivation of Remediation

The approach to creating an online or other non-material version of an installation is usually dependent on the motivation of the remediation. Remediation is carried out for a reason and it is important to recognize and understand this reasoning when studying the relationship of the different presentation forms.

When a documentation of a physical installation is provided in a new non-material format or a non-material version is created by straightforwardly transferring the content of an installation, to a non-material form, the aim is to give an understanding of what the physical installation is like or how it can be exhibited in a gallery space.

When a unique non-material artwork is constructed around the same theme as the physical installation, the aim of the remediation is to provide some new aspect to the theme or provide an alternative interface to the interaction with the content.

R. Aylett et al. (Eds.): ICIDS 2010, LNCS 6432, pp. 141–146, 2010.

In The Salt Satyagraha Online Joseph DeLappe [2] reenacted Mahatma Gandhi's 1930 Salt March. The reenactment took place physically in Eyebeam in New York City, where DeLappe walked the entire 240 miles on a converted treadmill. At the same time, the treadmill controlled DeLappe's avatar that walked the same journey inside Second Life. This is a fascinating example of a co-existence of physical and non-material artwork. Both counterparts form the whole, and their relationship is an important part of the concept. In addition the physical activity performed by the artist becomes the story of the artwork, thereby introducing a new layer that connects the two worlds together.

# 3 Characteristics of Physical and Non-material Artwork

## 3.1 Technical Aspects of the Presentation Media

The technical configuration of an installation is a controlled environment. The output and input devices are defined by the designer and chosen by their ability to accommodate the content of the piece. Experimental devices can be used, and even specifically manufactured for the artwork.

Even though in the case of non-material media art the devices don't have as wide a range, they can still differ greatly from case to case. What is significant for the designer is, that these variations can't be controlled. The common home devices – monitor, speakers, mouse and keyboard – have a wide enough variety as it is, additionally the use of other devices like web cameras and microphones is an option that expands the possibilities of interaction further. The primary design decision in this context is that of first selecting what devices can or need to be used with the piece. The next step to take is defining how these devices are used on the level of the software.

## 3.2 Space and Spatial Narrative

A constructed space is not limited to the buildings designed by an architect. It can comprise the people presently within the space and their interaction with each other, as well as the history of the location and many other aesthetic dimensions. A physical space is a subjective experience that is individually defined by the observer. Kirsi Saarikangas [3] defines that a constructed space is at the same time an architectonic, material and social space, a collection of heterogeneous cultural practices, images and ideas.

What then is the space of a software application. Typically we experience this space through a square computer display. The world inside the screen is often built with real-world metaphors to make it more easily approachable. However the primary goal of this space is not only to mimic the real world. Lev Manovich [4] states that "Synthetic computer-generated imagery is not an inferior representation of our reality, but a realistic representation of a different reality".

For the designer, an installation space has a dualistic nature. On one hand she has to consider the spatial qualities of the installation itself, and on the other she has to take into account the space wherein the installation is to be placed. Johanne Lamoureaux [5] states that a shift can be seen in the artist's relationship to the exhibition space. When the focus of the artwork's design previously used to stress site-specificity, nowadays installations are more often designed to be movable pieces that are transported from one exhibition space to another.

A designer of a non-material artwork does not have similar control over the exterior space as an installation artist. If we consider an online artwork or a CD-ROM, the surrounding environment of the user can be virtually anything. This doesn't mean that the designer shouldn't consider them. To achieve some level of control the designer must think about the target audience. What are the typical users of the piece and what is the most common environment where the user would use such a piece?

**Fig. 1.** A Burial at Ornans, painting by Gustave Courbet (1849-50), musée d'Orsay, Paris. (http://upload.wikimedia.org/wikipedia/commons/5/57/Burial_at_Ornans.jpg).

In his book ON THE "TOTAL" INSTALLATION Ilya Kabakov writes about the specific case of a "Total" installation that is an installation concept, the construction of which, he defines with very specific rules. In doing so he also analyzes installations in general. Kabakov [6] defines that installations are similar not only to visual arts like painting, sculpture and architecture, but also to temporal arts like theater and cinema. By Kabakov's definition the temporal aspect can be seen in the viewer's movement through the installation space. According to Kabakov, this temporal movement can serve to create the drama of the installation.

A two dimensional computer screen doesn't seem to support spatial narrative inherently. In the case of traditional cinema, storytelling started out as sequential and to this day that tradition affects contemporary movies strongly. But in fact spatial narrative has a long tradition as a tool in storytelling on two dimensional surfaces. Manovich [4] recognizes historical examples like Gustave Courbet's A Burial at Ornans (See Figure 1), where artists presented several different events in a single space. In Courbet's painting a line of mourners cue to the grave in a great S-curve. The members of the crowd form many small groups, each of which are frozen in their own narrative sphere. Finally Manovich [4] describes how traditional cinema's sequential narrative is contrasted by spatial narrative, where all the "shots" are accessible to a viewer at once, and points out how this form of narration is also continued in the form of contemporary comics.

### 3.3 Human Computer Interaction and the Interface

Throughout the history of computers, interaction with machines has fascinated researchers and users, and by this day it is a big part of our everyday lives. In her book Computers as Theatre Brenda Laurel [7] compares human computer interaction and interface design to theatre and drama, and suggests that by studying interaction with its theatrical aspects in mind, many of its characteristics are easier to understand.

Laurel [7] makes a reference to the work of Donald A. Norman, founder of the institute for Cognitive Psychology at the University of California, and agrees with Norman's idea that effective interfaces should begin with an analysis of what the user is attempting to do, rather than with an interface metaphor or concept of what the screen should display. The desired action of the user is key in interaction design and interface is the mediator of interaction.

Installations have a tendency to challenge users on the level of the interface. More usability is expected from computer screen interfaces. The functionality of the non-material artwork is compared to the software applications we use in our everyday life. The shift from using the interface of a web browser, to immersing oneself to the artwork inside a software window is quite unclear. In the physical world, when a visitor enters a gallery space, the context prepares her for the experience she is about to have. In the case of the software application, there is no similar transition space between the two realities. Christoph Blase [8] suggests that the user of a computer screen based medium is more able to access structured data than a person that is accessing similar content in an exhibition situation. In many cases this is true, but it can be argued, that the reason for this isn't the characteristic nature of either form, but rather the fact that art installations have assumed a role as a platform for experimental interaction technologies.

There are many non-material artworks that try to stretch the boundaries of usability with interfaces that are a riddle to the user. Ken Feingold's works, that range from physical installations such as "Where I can see my house from here so we are" to non-material pieces like the "JCJ-Junkman", challenge the users and their pre-set ideas about interactivity. Erkki Huhtamo [9] compares Feingold's artwork to labyrinths, which give little advice for the user who is struggling to find her way through the maze. Some users that are faced with these seemingly impenetrable obstructions, must be frustrated while they try to figure out the logic of the system and they are likely to attribute the illogical response of the interface to bad programming or a technical failure.

Interface design should also be content and context specific. The interface needs to serve the story that the artwork is mediating and support the world in which the story is told. The technologies used and the design of the interface should be an integral part of the experience so that they don't brake the user's immersion to the artwork.

### 3.4 Collaborative Experience

In a public installation a viewer is seldom alone in the space. She shares the space with other people and on some level shares the experience of the artwork. While comparing art installations to artwork distributed on CD-ROM's Christoph Blase [8] makes an interesting comparison, pointing out how a physical installation is to the CD-ROM what a cinema screening is to the video cassette. The CD-ROM has more potential for a private, individual experience, where as an installation is by it's nature more collaborative. Manovich describes a shared experience, in the case of viewers' interactions with computer installations, as a situation where one user's interaction with an installation becomes a new text for other people who are within the "arena" of the work. The actions of the primary user are altered by her awareness of the other people monitoring her. The user becomes a representative for the other people. Her attention is shared between the artwork and the observants [4].

When discussing the concept of collaborative experience in the context of non-material applications, the most natural case that comes to mind are online pieces that exploit some kind of multiplayer features. An interesting example of such a collaborative experiences are the art galleries in Second Life. There the experience is straightforward mimicking a traditional art gallery visit. Only the visitors of the gallery are represented by 3D avatars.

Yet any conceivable experience shared with other users' avatars in a virtual environment, is never quite the same as sharing the real physical presence of other people in a space. Human beings communicate with a wide variety of signals: speech, gaze, movements and gestures. While the non-material environments are limited by the lack of multi-sensory output, at the same time they can liberate the users to take on different roles from what they are used to.

## 4 Conclusions

Both physical and non-material artwork have aspects in their design process that can be specific and exclusive to the presentation format. The act of remediation should aim to take advantage of the strengths of each medium, while keeping in mind its weaknesses. One prevailing feature of non-material artwork seems to be the reduced level of control the designer has on such aspects as technical equipment and the exterior space of the artwork.

Many basic principals of design are still the same for both presentation formats. Such aspects as usability and interface design are very similar in both, even though the actual interfaces can vary greatly. Content and context specificity in all parts of the design process also contributes to a uniform and immersive user experience in both physical and non-material formats.

In productions where physical and non-material versions are created around the same theme, defining the motivation of the remediation is a priority. It is not advisable to attempt to create two identical experiences in both formats. The goal of remediation should be to take advantage of the medium, while keeping in mind the purpose of each of the artwork's versions.

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# The iLand of Madeira Location Aware Multimedia Stories

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**Abstract.** This paper describes the initial stages for the iLand project, a Location Aware Multimedia Story project that captures and exposes the rich oral culture and traditions at the Island of Madeira, using the Madeira main city, Funchal, as a setting to bring a new level of engagement of the audience with the city and its traditional stories. We developed high quality content to be used in an already existing platform to deliver location aware stories. With the story experience carefully designed, an evaluation was carried out in order to expose the opportunities where such systems can be improved. Finally we discuss the results from the evaluation and explain how we will address them in the design of our new system.

**Keywords:** Interactive narrative, Locative media, Mobile Devices, Experience Design.

## 1 Introduction

Madeira is a small island in the Atlantic Ocean with a very rich oral culture and traditions. In order to take advantage of this special context we conceived, designed and produced a digital mobile story experience to capture and share the intangible heritage of this island. In this paper we describe the first prototype and user study of the iLand Location Aware Multimedia Story project.

### 1.1 Mobile Devices

Mobile devices have become indispensable artifacts embedded in our lives: tools for supporting people's activities in their work as well as leisure time. In the last few years mobile devices have rapidly evolved in size, screen and general performance and now often include of a number of sensor technologies like GPS, compass, and accelerometer.

The new generation devices are equipped with bigger and better screens and a general increase in performance, which has led to a trend in developing multimedia applications for Smartphone platforms like Android, iPhone, Symbian, etc [6].

R. Aylett et al. (Eds.): ICIDS 2010, LNCS 6432, pp. 147–152, 2010.

### 1.2 City as the Place for Play/Interaction

Each city has its particularities, different purposes and meanings, because of the different kinds of people and actions that take place in it. These differences represent an opportunity for sharing and discovering different cultures and meanings through the design and development of mobile location aware experiences.

As human beings, we need to see, hear, touch, smell and taste in order to understand, make sense of and fully enjoy reality. The city itself offers a rich sensorial experience to us: *"The city assaults all senses continuously awakening a wide range of meanings and desires"[1]*. By coupling stories with the exploration of real city locations we are designing an experience where all senses are stimulated. By using the city as a set, people are able to see, hear, touch and smell the environment where the story happened. This way we enable our audience to act in public spaces while offering a rich and all senses encompassing experience. Moreover the experience of visiting a new place can be transformed, by knowing the stories of that place and culture and understand why the city, its inhabitants and social environment are the way they are.

### 1.3 Location Aware Multimedia Stories: LAMS

After considering the city as the context for our experience, we focused on defining what kind of experience we are building, expanding on the concept of Location Aware Multimedia Stories (LAMS), which is defined by Nisi et al. [2] as:

"Cinematically rendered narratives, which content is related to specific locations and embedded in those real spaces through the use of location aware mobile technologies."

## 2 Related Work

In the following section we give a brief overview of the main projects that served as inspiration for the iLand project. Our work builds directly on the Media Portrait of the Liberties (MPL) project [2], which makes use of location aware and mobile technology to deliver a collection of video stories adapted from written accounts of life in an inner city area of Dublin. We decided to extend and redesign the experience for a site-specific installation in Funchal. Further inspiration for our work comes from the M-Views [3], a system for creating and participating in context-sensitive, mobile cinematic narratives. There are no conclusions regarding the user experience with the M-Views system and what people actually felt when using the system. By studying the audience reaction to the experience of LAMS as a whole, we envisage progressing LAMS research. The project StoryTime [7] is a location-based system for presenting stories in a networked mobile computing device. It offers the users a sense of connection to a location's past through stories that are told by the people who experienced them. Stories told in first hand can make the audience feel more engaged with the character and with the story. In our project, we also acknowledged the importance of searching for stories that are meaningful and filled with personal connotations.

# 3 The iLand Project

Stories are all around us but sometimes it is hard to access to them. Often the people who have them do not find the right opportunity or setting to share. Through the iLand project we designed an opportunity to uncover and share these stories.

We started by connecting with local people who are part of our social network, like friends and relatives, asking them for stories. The stories collected in this way were colored by personal shades of drama, personal details and warmth that could not be found in formally written accounts. We selected eight stories for production, based on the potential drama and the thematic connection to religious and spiritual matters. We wanted our audience to learn about the folklore of the island and to remain open regarding the truth and the value of these folkloristic tales.

While developing the stories' plot and characters we designed the iLand LAMS experience as a whole. We targeted foreigners as well as Madeiran users who are not familiar with Funchal's old part of town. The location chosen was Rua Santa Maria in Funchal, since it is has a mysterious as well as traditional atmosphere that fits the type of experience that we want our audience to have.

## 3.1 Location Aware Story Delivery Platform

As our story delivery platform we used Placeware [4], the second iteration of the system used for the MPL experience. Placeware runs on a Windows Mobile, GPS enabled smart phone. It uses a wide touch screen that allows an easy use of a map based interface and the presentation of multimedia videos. As the application starts, a map of the place is displayed and the system obtains the GPS coordinates for the user's position, represented as a circle on the map. The circle moves as the user walks. Small dots represent the stories on the map. When the user position overlaps with the dots the phone vibrates and the dot enlarges. The user has then the option of clicking on the dot to watch the story's video fragment. After watching the story the application returns to the map and the user continues the tour.

**Fig. 1.** Video Frames from the iLand stories

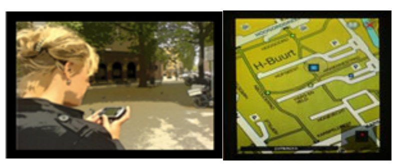


**Fig. 2.** Placeware interface

# 4 Evaluation

After the story production, we designed a pilot study to uncover the main issues encountered by our target users. We focused our pilot on a sample of five young adults (aged between 24 and 34) with different backgrounds and experiences with the city: a foreigner recently moved to Madeira and four residents in Madeira, two of which live in the city but are not familiar with the Rua Santa Maria, while the other two live in others cities of Madeira. The users were asked to try the iLand story experience singularly. They were taken to the location, explained how to use the system and after establishing basic demographics, such as age, nationality, and profession etc. they were left exploring the stories on their own. We observed them by shadowing without intervening if not on request. At the end of the experience we conducted a semi-structured interview to better understand how users generally felt about the experience as a whole.

## 5 Discussion/Future Work

In this section we present the main issues uncovered through the study, starting with the strengths and weaknesses of the system, and ending on how we intend to address these problems in our future work.

### 5.1 Strengths of the System

Beside the strengths and weaknesses of LAMS systems discussed in [3], we want to highlight the features that users enjoyed the most during the iLand experience:

***GPS and Vibration notifications*:** People enjoyed the device highlighting their location and vibrating when in range with a story. Having a system performing the location detection surprised them as well as empowered them.

***Audience connection with the surrounding location:*** People liked the stories, in particular the ones where they could connect with the surrounding. When this happened the experience was more immersive.

***Clean and simple Interface*:** All the users enjoyed the simple and clean interface.

### 5.2 Story Related Problems

***Lack of context of the stories presented:*** As some users did not understand the relation between the stories and the location in which the stories were made available, we decided to create a narrator to introduce each story and explain why the user is seeing that specific story in that context.

***Overwhelming experience:*** Some users found it hard to stay focused on the stories with all the activity and the richness of the urban surroundings. As a solution the narrator will point out specific places in the surrounding and let the users take some time to observe and only after this time of observation the multimedia story will begin.

***Hard to pinpoint exact location details*:** People reported that they couldn't relate the story to the specificity of the place. We plan to integrate the D-Touch markers (see figure 3) developed by Costanza [5] to pinpoint specific points in the locations. Using this technology, we can design markers that are related to each story and that will be placed on the exact spot that has a reference to the story itself.


**Fig. 3.** D-Touch marker

### 5.3 Technical Problems

***GPS accuracy is sometimes poor:*** This problem is going to be alleviated by the use of the D-Touch markers. After the phone vibrates near the story, even if it is not on the exact place, the users will need to look for the marker: upon finding it they are sure to be in the right place for the story.

***Visibility of the screen was poor in broad sunlight:*** The use of a different device (Nokia 5800) with a brighter screen and a larger resolution will tackle this issue. Also, we recommend users to experience iLand at the end of the day, when sunlight is weaker.

#### 5.3.1 Experience Design

***Traffic disturbing and endangering users:*** This is an issue that will be addressed by the use of the D-Touch markers. The markers are going to be put in places where people can watch the stories safely without being disturbed.

### 5.4 Reflection on the Study

In LAMS, content has proven to be essential to provide a meaningful experience. Sometimes stories developed for such systems can be superficial and users cannot deeply connect to them. The link between the story and the place may not always be obvious to the user. Furthermore combining real space with rich media content can overwhelm the user. In order to deliver a pleasurable experience, a balance between looking at the mobile device screen and the surrounding context needs to be found. Therefore, to build a system that provides not only a service but also a meaningful experience, we need to pay attention to the overall experience and design the system together with the stories' narrative structure and visual production.

## 6 Conclusion

The increasing development of mobile platforms, such as the Android, iPhone, and Symbian, led to a demand for new and meaningful mobile experiences.

In order to fulfill this need we have highlighted a number of key issues regarding the design of the interactive location aware story experience. Our current effort to design and implement a new system for delivering location aware stories involves a specifically designed narration style and the use of marker technology to address the main issues uncovered by the study presented in this paper. Through the redesign of the iLand system we are progressing the state of the LAMS and repositioning our work for further user study.

## Acknowledgements

This project is part of the Madeira Life project, a collaboration of M-ITI with ZON Madeira, financed through the +Conhecimento fund. The authors would like to acknowledge Enrico Costanza for all the support shown in using the D-touch markers technology. The second and third authors are members of the CCM research center at the University of Madeira, Portugal.

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# Modeling of Interactive Storytelling and Validation of Scenario by Means of Linear Logic

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**Abstract.** Research on Interactive Storytelling has mainly focused on the opposition between a discourse point of view and a character point of view for a story. In this paper, we propose an approach to model Interactive Storytelling using Linear Logic, which is a support for reasoning on both points of view. Then we give an example on an educational game that shows the possibility of validating a scenario of a story, by applying the proof graph of a Linear Logic sequent. Finally we discuss about issues which should be settled and future works to be done on the Linear Logic approach for the IS modeling.

**Keywords:** Linear Logic, Interactive Storytelling, formal model, validation of scenario, Interactive Storytelling controller.

## 1 Introduction

Everybody loves a great story, and everybody loves a great game [1]. It seems natural to bring these two very human activities together, to create a new entertainment one that is different from either, but artistically engaging and gives a lot of fun. The quest in finding a way to combine storytelling and gaming took on new life in the last years of the 20th century, when video games started to incorporate realistic environments, and then well-written stories and characters. As computers and consoles improved technically, video games became more visually interesting, their sound and music improved dramatically, and new interaction techniques appeared. As designers sought to make their games deeper and more engaging, they naturally started to incorporate stories and characters into their work, with the wish of creating really great games that are blended with really great stories.

However, storytelling unfolding and player's interaction are commonly said as opposite [2]. The first relates to designer's control on the game he has created as the second relates to player's control on the game he has bought. Research on **I**nteractive **S**torytelling (IS) has mainly focused on this opposition, and now is divided into two major families: scenario driven approach and emergent narrative theory [3].

In the first set of families, in order to control development of a story according to player's interaction, automated directorial control (drama management) is often applied. It aims to guarantee that player's action will keep the story in the field of the pre-defined scenario, so that the story development is both coherent and leads to author's desired effects. Various approaches for directorial control have been proposed.

R. Aylett et al. (Eds.): ICIDS 2010, LNCS 6432, pp. 153–164, 2010.

For example, [4, 5, 6] aim at comparing player's behavior with a plan, using advanced techniques for anticipating risks of disruption. And hence when a player's action deviates from the pre-computed story plan, the system either replans (gets the story back on track), or makes the player's action have no effect on the story development. [7] extends Thespian (a multi-agent framework for authoring and simulating interactive narratives) with the ability to provide proactive directorial control, using explicit user models for predicting player's behavior and estimating his experience. A director agent is designed to monitor the progress of the story, predict its future development and adjust virtual characters' behaviors and beliefs if necessary, in order to prevent violations to directorial goals. As a consequence, the scenario driven approach only gives a few sets of possibilities to the player, or only proposes alternative paths, and finally the player cannot influence narrative structure. In other words, this control is somehow presented as in contradiction with player's ability to influence the game unfolding in a persistent way.

On the opposite, the emergent narrative theory gives a complete freedom to the player, who can direct the game unfolding through his actions. This means that the story will emerge from characters' actions and its unfolding is not based on a specific narrative structure. For instance, [8] aims at breaking story bounds by proposing models in which the story is not directly written, but emerges from player's interaction with a set of autonomous virtual agents. [9] uses a set of agents designed with complex behaviors which is able to design plans and adapt them with game events. [10] explores "co-creation" role that story generation feedback may play within the creative process of interactive story authoring, in which the outcome of the story generator influences authorial intent. And hence it reduces tensions between authorial intent and the partially uncontrollable outcome of story generation. Emohawk [11] is an educational toolkit which features a narrative scenario with three characters controlled by an appraisal-driven architecture. The narrative is to some degree emergent due to this architecture, as well as due to natural non-determinism and user's interaction. At the same time, it is also partly scripted, which means that it evolves around several pre-determined plot points. Thus we can find that the emergent narrative theory offers a great space of freedom to the player, who may deeply influence the evolution of the virtual world in which he has been immersed. In other words, the player can evolve freely and autonomously. However, its foremost limit is the deriving quality, in term of consistency and pertinence, which highly depends on the player and therefore cannot be guaranteed.

We do not intend to choose between these two approaches, but would prefer to propose an IS modeling strategy that allows combining their strong points (by balancing between the discourse point of view (scenario driven) and the character point of view (emergent narrative)). As one of actual major issues is the development of formalisms supporting the IS modeling, in which these formalisms, ideally, should be computational or support a translation to traditional computational ones. So we focus on Linear Logic because it is the logic of control of events/actions and resources that is well suited to reasoning (in particular when it embeds concepts of high relevance to storytelling, such as causality), it fits narrative formalism approaches and is also close to computational aspects.

This paper begins with a presentation of how Linear Logic is applied to model IS with the discourse point of view as well as with the character one. Then we give the example on the educational game that shows the possibility of validating a scenario of a story, by using the proof graph of a Linear Logic sequent. Lastly, we discuss about the issues which should be settled and the future plans to be done on the Linear Logic approach for the IS modeling. The works mentioned in the paper are an inheritance of the ones realized in [12], in which we have improved the following essential points:

- To enhance the modeling capacity, we have ameliorated the approach by starting from the Greimas' semiotics, which has made the IS modeling more reinforced and correct. Therefore, we may take into account vaster discourse types (scenario driven and emergent) as well as increase the number of considered concepts, and so analyze much more aspects of more complex stories. This has arisen the requirement of using more connectors in comparison to the previous research (that only used $\otimes$, $\multimap$ and $\vdash$), hence we now include the !, & and $\oplus$ ones in the modeling process. As a consequence, we have to improve the translation from a Linear Logic sequent into a Petri net in order to deal with the addition of the ! connector.
- Besides, we have also expressed players' action decisions as inputs, thanks to which we can realize their role easily in the modeling.
- Finally, the contribution of the paper focuses on, first, the definition of a new proof algorithm of Linear Logic sequents and a new execution algorithm of IS models in real time that matches the above extensions; second, detailing the complete example on the validation of a scenario of a story by means of Linear Logic, which at the same time illustrates these ameliorations.

Before beginning the principal contents of the paper, we define some important notions that will be used in the next sections:

- A *story* is a set of entities, events/actions and constraints that solves a set of problems, describes an evolution concerning a set of characters and/or objects. It consists in starting from an initial state, solving the given set of problems in order to reach a final state that is an acceptable conclusion.
- A *discourse* is an ordered sequence of events/actions that is a possible unfolding of a story. Therefore a same story can generate various discourses. This consists in scheduling the events/actions corresponding to the story.
- A *scenario* is a set of all the possible discourses for a specific story. A same story may have many different scenarios, which depends on the validation phase during the game analyze/design process.

## 2 Linear Logic: A Formalism for the Interactive Storytelling Modeling

### 2.1 Overview of Linear Logic

Linear Logic has been introduced by Girard [13] as a restriction of Classical Logic (a non-standard logic) that allows taking into account the notion of events/actions and representing control of resources. For instance, the "A $\multimap$ B" formula can be interpreted as: "The consumption of A produces B, and so we only have either A or B", whereas in Classical Logic, the “A $\rightarrow$ B” formula can be interpreted as: “If A is true then B also, and so the both is true”. Classical Logic is actually designed to model a static world, where formulas are interpreted as eternal truth that, once established, last forever and can be used again and again in derivation of other formulas.

Unlike Classical Logic, Linear Logic is not employed to determine whether an assertion is true or not, but rather the validity of how formulas are used (and then consumed) when proving an assertion. It has also been introduced as the logic of resources [14]. In fact, Linear Logic is well suited to derive a formal model to partially ordered problems with resource sharing. In Linear Logic, formulas are treated as resources that are produced and consumed. The consequence is that every formula should be used exactly once in a derivation. Thus contrary to Classical Logic, where sequents are composed of automatically expandable sets of formulas, in Linear Logic, sequents are composed of automatically non-expandable sets of formulas.

[14] gives a complete presentation of the connectors of Linear Logic and their introduction rules. In this paper, we only mention the ones which will be used in the next sections:

- $\multimap$: linear implication (imply), expresses the possibility of deduction. Example: “1€ $\multimap$ 1kg strawberries” means that we can give 1€ to buy 1kg strawberries.
- !: of course, expresses the infinite available number of a resource or the infinite occurring number of an event/action. Example: “1€ $\multimap$ !(strawberries)” means that we can give 1€ to buy as much strawberries as we want.
- $\otimes$: multiplicative conjunction (times), expresses a set of resources (not ordered). Example: “1€ $\multimap$ 1kg strawberries $\otimes$ 1kg tomatoes” means that we can give 1€ to buy 1kg strawberries and 1kg tomatoes.
- &: additive conjunction (with), expresses an external choice to the system (for instance coming from the player). Example: “1€ $\multimap$ tea & coffee” means that we can choose tea or coffee when we give 1€ to an automatic machine.
- $\oplus$: additive disjunction (plus), expresses an internal choice to the system (for instance coming from an IS controller). Example: “1€ $\multimap$ tea $\oplus$ coffee” means that it is the automatic machine which will decide if we receive tea or coffee when we give it 1€.
- $\vdash$: turnstile, separates the left part (antecedent) and the right part (consequent) of a sequent. Example: “D $\otimes$ (D $\multimap$ E) $\vdash$ E” (or “D, (D $\multimap$ E) $\vdash$ E”) means the possibility to produce a copy of “E” by consuming “D” and “D $\multimap$ E” (we can substitute the $\otimes$ connector by the comma (,) in the left part of a sequent to be easily readable).

### 2.2 Proving a Linear Logic Sequent

Gentzen introduced the sequent calculus as a tool for studying natural deduction [15]. It aims at proving the consistency of formula. A sequent is a $\Gamma \vdash \Lambda$ expression, where $\Gamma$ and $\Lambda$ are sequences of formulas; the initial sequent is A $\vdash$ A, where A is any atom.

Proving a sequent consists in rewriting the sequent, by making a substitution of its formulas in order to obtain initial sequents. In our approach, we base the proof strategy on using a Petri net (which is described in [16]). It has been shown [17, 18] that there is an equivalence between a Linear Logic sequent and a Petri net (with some restrictions). We perform the translation (inspired from [17]) of a Linear Logic sequent into a Petri net and supplement several ameliorations as follow:

- An atom is modeled by a place. The availability with any number of the atom in the left part of the sequent is expressed by the presence of the corresponding token number in the place. We add a parameter to the place to show its token number. If the token number is infinite (which means that the availability of the atom is infinite (for instance, !A)), the value of the parameter is “i”.
- A linear implication formula in the left part is modeled by a transition. We add a parameter to the transition to show the occurring number of the formula. If it is infinite (for instance, $!(A \multimap B)$), the value of the parameter is “i”.
- The left part of the sequent involves a set of available atoms and a set of linear implication formulas. It corresponds to the initial marking and a set of transitions, respectively.
- The right part of the sequent is equivalent to the expected marking.

Thus the demonstration of a Linear Logic sequent corresponds to the firing of a sequence of transitions, starting from the initial marking and going to the expected marking. This process will be executed by the token player algorithm [19]. For example, we consider the following sequent: $!A, C, D, A \otimes C \multimap B \otimes C, !(D \multimap E), E \otimes C \multimap F \otimes C \vdash B \otimes C \otimes F$, the equivalent Petri net is given in Fig. 1 where: A, B, C, D, E, F are the atoms; A is available and infinite; C, D are available and their available number is 1; B, E, F are not available; $A \otimes C \multimap B \otimes C$, $D \multimap E$, $E \otimes C \multimap F \otimes C$ are the transitions; the occurring number of the $A \otimes C \multimap B \otimes C$ and $E \otimes C \multimap F \otimes C$ formulas is 1; the occurring number of the $D \multimap E$ formula is infinite. If after firing of a sequence of transitions starting from the initial marking (!A, C, D), and going to the marking corresponding to the right part of the sequent ($B \otimes C \otimes F$ means that there are one token in place B, one token in place C and one token in place F), then this sequent is demonstrated.

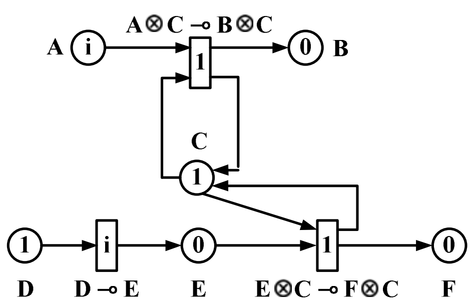


**Fig. 1.** Equivalent Petri net of a sequent

### 2.3 Interactive Storytelling Modeling by Means of Linear Logic

According to Hebert [20], Greimas developed the concept of narrative program which is an abstract formula used to represent an action. More concretely, doing (action) is defined as a temporal succession from one state to the opposite state, effected by any agent (the subject of doing) and affecting any patient (the subject of state). A state may be broken down into a subject of state and an object of state and the junction between them, which is either a conjunction (the subject is with the object) or a disjunction (the subject is without the object). The subject of doing may or may not correspond to the subject of state; in other words, what accomplishes the action may or may not be what is affected by it. A narrative program array is composed of at least two narrative programs, between which at least one temporal relation (succession, simultaneity) or one logical relation (simple or reciprocal presupposition, mutual exclusion, comparing/compared, etc.) is identified. Hence we find that a discourse (an ordered sequence of events/actions) may be described by a narrative program array.

Greimas also developed the concept of actantial model, which can be used to break an action down into six facets, or actants: (1) The subject (for example, the Prince) is what wants or does not want to be conjoined with (2) an object (the rescued Princess, for example). (3) The sender (for example, the King) is what instigates the action, while (4) the receiver (for example, the King, the Princess, the Prince) is what benefits from it. Lastly, (5) a helper (for example, the magic sword, the horse, the Prince's courage) helps to accomplish the action, while (6) an opponent (the witch, the dragon, the Prince's fatigue, a hint of terror) hinders it. Therefore this model is a tool that can theoretically be used to analyze any real or thematized action, in which we assign each element of the action being described to one of the actantial classes. An action may be analyzed by one (or a number of) actantial model(s) and so, a same action can often be seen from several different perspectives (for example, from the subject's point of view, or his rival, the anti-subject's).

Originated from those ideas, the L3i laboratory has proposed the approach to model IS by means of Linear Logic, in which we balance between the discourse point of view and the character one (by taking into account the influence of the both in the modeling process), as follow:

- Characters are modeled by atoms in the left part of the sequent. An atom corresponds to a state of a character considering a certain point of view. So a character can be modeled by various atoms giving different points of view of the character (one for each layer). The size of the state vector of the character may vary during the unfolding of the story.
- States of the story are modeled as atoms in the left part of the sequent.
- Resources are modeled as atoms in the left part of the sequent. If the available number of a resource is infinite, it is modeled by the ! connector (for example, !A).
- The availability of the characters' states, the states of the story and resources are considered as the availability of the corresponding atoms in the left part of the sequent.
- Players' action decisions are expressed by inputs. This means that the players decide their occurrence in the unfolding of the story by entering the inputs. These inputs are modeled as atoms in the left part of the sequent and will become available after being entered into the program by the players.
- An additive conjunction formula in the left part of the sequent represents players' choices in the progress of the story. We will split this sequent into

subsequents corresponding to each element of that additive conjunction formula. For instance, the $A, C, ((A \multimap B) \& (D \multimap E)), C \multimap F \vdash F$ sequent is split into two $A, C, A \multimap B, C \multimap F \vdash F$ and $A, C, D \multimap E, C \multimap F \vdash F$ subsequents. Then we only consider the created subsequents and the received result of the original sequent will be the union of the results of all the subsequents.

- A linear implication formula in the left part of the sequent models an event/action of the story (that makes some partial states/resources evolve). If the occurring number of an event/action is infinite, it is modeled by the ! connector (for example, $!(A \otimes C \multimap B \otimes D)$).
- An outcome (goal) of the story corresponds to an atom, or a set of atoms (connected between them by the $\otimes$ connector) in the right part of the sequent. Outcomes of the story are connected between them by the $\oplus$ connector.
- A proof models a discourse of the story. As the proof is not unique, we may deduce various ones.
- The sequent gives all the possible discourses (scenario) for its corresponding story.

For instance, the $A, C, D, G, A \otimes C \multimap B \otimes F, D \multimap E, G \multimap H \vdash H \oplus (B \otimes F \otimes E)$ sequent has the proof graph given in Fig. 2 (simplified to the substitution of the linear implication formulas) where $L_1$: $A \otimes C \multimap B \otimes F$; $L_2$: $D \multimap E$; $L_3$: $G \multimap H$. It expresses all the possible discourses (scenario) for the story corresponding to this sequent, in which: $L_1, L_2, L_3$ are the events/actions; H and $B \otimes F \otimes E$ are the outcomes; an example of two of the discourses (two proofs) are the $(A, C, D, G, L_1, L_2, L_3)$, $(B, F, D, G, L_2, L_3)$, $(B, F, E, G, L_3)$ and $(A, C, D, G, L_1, L_2, L_3)$, $(A, C, D, H, L_1, L_2)$ paths.

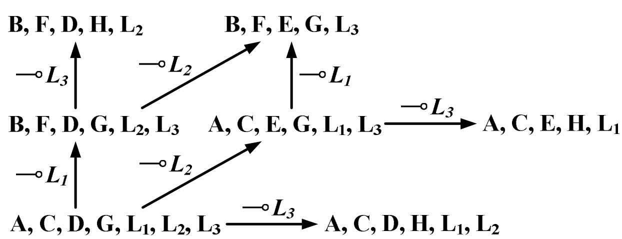


**Fig. 2.** Proof graph of a sequent

To apply this approach on creating interactive games, our purpose is the development of a system assuring a set of objectives: The players do not feel constrained by the game but they can determine its evolution; the virtual world must provide a coherent environment that is appropriate for players' actions; the progress of the game has to respect a structure of discourse (introduction $\rightarrow$ giving problems $\rightarrow$ solving them step by step $\rightarrow$ conclusion). To do this, we have proposed in [3] a system architecture being composed of two components: an IS controller and an IS rendering (Fig. 3). The IS controller aims to manage the unfolding of the story (discourse) by taking into account players' actions, states of the game, and game designer's goals. The execution of this process is based on reasoning of a Linear Logic sequent that models the game. Its influence is on two levels: non real-time and real-time. Firstly, for the non real-time one (the game analyze/design phase), the Linear Logic model allows validating a scenario of the game according to the discourse point of view, which will be clearly described in the next section. Secondly, for the real-time one (during the game execution), an automatic translator transforms the received Linear Logic sequent into a Petri net. Then the Petri net performs the computation of the model in real time (thanks to the token player algorithm), and gives one (or some) decision(s) by which the IS controller (with the help of an expert system), can ask the IS rendering to build suitable interfaces for the game. Thus the IS controller is able to follow the execution track and the structure of the discourse, so may detect unsatisfactory events. And hence it will operate correctly (be never in an incoherent situation), as well as assure players' freedom and their determinant role on the game, together with the reasonableness of the generated discourses.

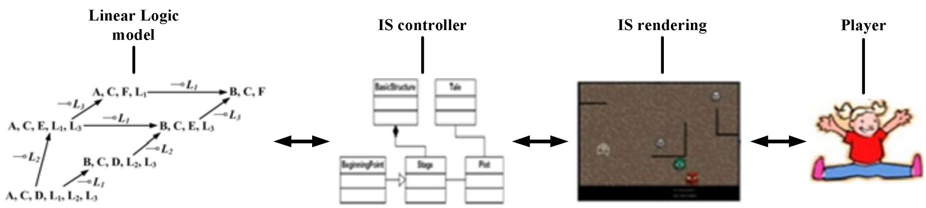


**Fig. 3.** Architecture of the system

## 3 Validation of Scenario: An Example Based on Linear Logic

In addition to the possibility of IS modeling as has been presented above, we can use the Linear Logic model in order to validate a scenario of a story. In fact, the following example will illustrate how to apply the proof graph of a sequent to this goal.

Let us consider the educational game which warns of domestic electrical accidents, whose objective consists in causing an electric shock for the player. At first, the game designer anticipates that the player, from his initial position, will go in the kitchen, where the IS controller will start the strategy of causing the electric shock for him, by tools in there such as fridge, microwave oven, electric cooker,… However, what will happen if the player does not go in the kitchen, but has other choice, for instance, staying at the initial position to work or going in the bathroom? We model this game by means of Linear Logic as follow:

- *States of the story:* Si - Being at the initial state; Sk - Starting the strategy of causing the electric shock for the player in the kitchen; Sr - Reaching the goal (the player got the electric shock).
- *States of the player:* Pi - Being at the initial state; Pw - Working at the initial position; Pk - Being in the kitchen; Pb - Being in the bathroom; Pe - Getting the electric shock.
- *Inputs of the player (his action decisions):* Iw - Deciding to work at the initial position; Ik - Deciding to go in the kitchen; Ib - Deciding to go in the bathroom.

- *Events/actions of the story:* The player decides to work at the initial position (E1: Pi ⊗ Iw ⊸ Pw); the player decides to go from the initial position in the kitchen (E2: Pi ⊗ Ik ⊸ Pk); the player decides to go from the initial position in the bathroom (E3: Pi ⊗ Ib ⊸ Pb); the IS controller starts the strategy of causing the electric shock for the player in the kitchen (E4: Pk ⊗ Si ⊸ Pk ⊗ Sk); the player gets the electric shock in the kitchen (E5: Pk ⊗ Sk ⊸ Pe ⊗ Sr).
- Finally, we have the following sequent in which the formulas are replaced by their label: Pi, Si, (E1 & (E2, E4, E5) & E3) ⊢ Pe ⊗ Sr. It gives all the possible discourses (scenario) of the story. Because the sequent has three choices concerning the & connector, we split it into three subsequents: Pi, Si, E1 ⊢ Pe ⊗ Sr (the player decides to work at the initial position by entering Iw); Pi, Si, E2, E4, E5 ⊢ Pe ⊗ Sr (the player decides to go from the initial position in the kitchen by entering Ik); and Pi, Si, E3 ⊢ Pe ⊗ Sr (the player decides to go from the initial position in the bathroom by entering Ib). Their proof graph is represented in Fig. 4.

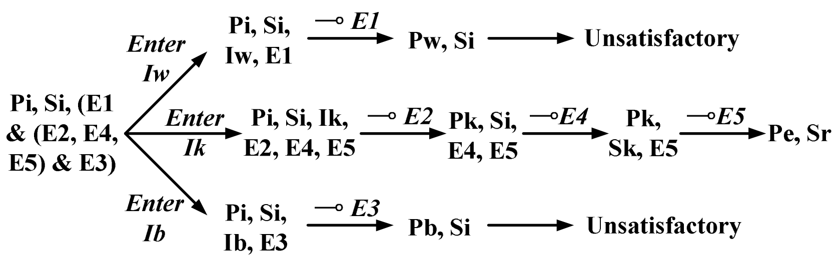


**Fig. 4.** Proof graph of the sequent before the validation phase

We can see that there are two paths which lead to the unsatisfactory endings of the goal of the game (if the player decides to work at the initial position or go from the initial position in the bathroom). Therefore we have two possibilities:

- either remove the actions of the player causing the unsatisfactory endings (E1 - Working at the initial position and E3 - Going in the bathroom), but that may restrict the player's freedom, so we do not choose this possibility;
- or add two new plots to the story: If the player decides to work at the initial position, the IS controller will ask him to go in the kitchen (for example, a non-player character asks him to take an apple in the fridge); if the player decides to go in the bathroom, the IS controller will start the strategy of causing the electric shock for him in there (by tools such as hair-dryer, light bulb,…).

Thus we remodel the game as follow:

- *States of the story:* Si - Being at the initial state; Sa - Asking the player (who is working at the initial position) to go in the kitchen; Sk - Starting the strategy of causing the electric shock for the player in the kitchen; Sb - Starting the strategy of causing the electric shock for the player in the bathroom; Sr - Reaching the goal (the player got the electric shock).

- *States of the player:* Pi - Being at the initial state; Pw - Working at the initial position; Pk - Being in the kitchen; Pb - Being in the bathroom; Pe - Getting the electric shock.
- *Inputs of the player (his action decisions):* Iw - Deciding to work at the initial position; Ik - Deciding to go in the kitchen; Ib - Deciding to go in the bathroom.
- *Events/actions of the story:* The player decides to work at the initial position (E1: Pi ⊗ Iw ⊸ Pw); the player decides to go from the initial position in the kitchen (E2: Pi ⊗ Ik ⊸ Pk); the player decides to go from the initial position in the bathroom (E3: Pi ⊗ Ib ⊸ Pb); the IS controller asks the player (who is working at the initial position) to go in the kitchen (E4: Pw ⊗ Si ⊸ Pw ⊗ Sa); the player (who is working at the initial position) goes in the kitchen according to the asking of the IS controller (E5: Pw ⊗ Sa ⊸ Pk ⊗ Sa); the IS controller starts the strategy of causing the electric shock for the player in the kitchen (E61: Pk ⊗ Si ⊸ Pk ⊗ Sk; E62: Pk ⊗ Sa ⊸ Pk ⊗ Sk); the IS controller starts the strategy of causing the electric shock for the player in the bathroom (E7: Pb ⊗ Si ⊸ Pb ⊗ Sb); the player gets the electric shock in the kitchen (E8: Pk ⊗ Sk ⊸ Pe ⊗ Sr); the player gets the electric shock in the bathroom (E9: Pb ⊗ Sb ⊸ Pe ⊗ Sr).
- Finally, we have the following sequent in which the formulas are replaced by their label: Pi, Si, ((((E1, E4, E5, E62) & (E2, E61)), E8) & (E3, E7, E9)) ⊢ Pe ⊗ Sr. It gives all the possible discourses (scenario) of the story. Because the sequent has three choices concerning the & connector, we split it into three subsequents: Pi, Si, E1, E4, E5, E62, E8 ⊢ Pe ⊗ Sr (the player decides to work at the initial position by entering Iw); Pi, Si, E2, E61, E8 ⊢ Pe ⊗ Sr (the player decides to go from the initial position in the kitchen by entering Ik); and Pi, Si, E3, E7, E9 ⊢ Pe ⊗ Sr (the player decides to go from the initial position in the bathroom by entering Ib). Their proof graph is represented in Fig. 5.

We can find that all the paths lead to the satisfactory endings of the goal of the game (the player got the electric shock). Thus this example demonstrates the Linear Logic model is effective in determining whether the proof graph, on where we execute the planning algorithm, contains error paths. It also shows that to increase the players'

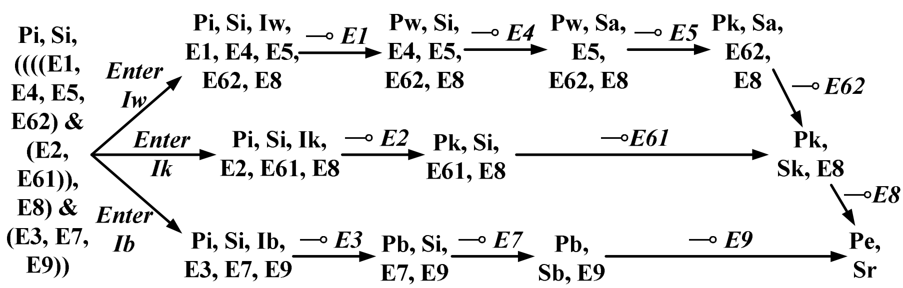


**Fig. 5.** Proof graph of the sequent after the validation phase

freedom, we have to augment the number of their choice possibilities (by adding new plots). Besides, thanks to the use of Linear Logic model for reasoning, we are able to know the form of a scenario of a story as well as improve it easily.

## 4 Conclusion

In this paper, we have presented the approach for the IS modeling by means of Linear Logic, that combines the discourse point of view and the character one, in which we have supplemented several important ameliorations in comparison to the works before, therefore extended the capacity of Linear Logic in modeling IS. Then we have given the example on the educational game in order to show the possibility of validating a scenario of a story (by applying the proof graph of a Linear Logic sequent), as well as illustrate the mentioned ameliorations in the approach. We also realize that, although Linear Logic offers promising perspectives for the development of formalisms supporting the IS modeling, a number of issues should be settled.

As stated before, we base the sequent proof strategy and the execution of the model on using a Petri net, which has some restrictions (it is only possible for several connectors and so cannot model really complex systems). To overcome this inconvenience, we are implementing a proof algorithm that may apply to every case of the Linear Logic sequents. In parallel, we must also propose other method to execute the computation of the model in real time.

Concerning the scenario validation, more difficulties arose. The first, we have to build all proof graph of a sequent to validate its scenario, this meets the combinatorial explosion problem. We have implemented (and will supplement) some heuristics together with solutions based on analyzing the form of the scenario and the structure of the discourse, in order to reduce the search space. The second, we actually can validate the soundness of a scenario but do not yet validate its quality. In other words, how to show an "interesting scenario" for a game?

Another particular problem is that the geographical aspects (for example, location of characters and resources) are not yet modeled by Linear Logic. Lastly, concerning the future works to be done on the Linear Logic approach, we will incorporate the received results into the IS Engine design of the IRIS Network of Excellence [21].

**Acknowledgments.** This work has been funded (in part) by the European Commission under grant agreement IRIS (FP7-ICT-231824).

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# An Analysis of Narrative Moves in Improvisational Theatre

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**Abstract.** Our continued investigation into the experience of improvisers as they construct narrative in improvisational theatre provides a meaningful decomposition of its atomic unit, the offer. Our study was conducted with improvisers performing improv "games" in their theatre with each performance video recorded. Individual participants were selectively shown individual performances before being interviewed. This process is meant to elicit deeper information into how the performer chooses specific narrative interactions to develop in an improvisation performance. This paper presents our ongoing findings related to narrative development in improvisational theatre and how they were used to create an improvisational micro-agent. These findings have demonstrated that the use of offers to construct a scene involves the offers' acceptance and augmentation in a scene more than just the strength of an offer.

**Keywords:** Improvisation, Narrative, Offers, Performance, Micro-agents.

## 1 Introduction

Synthetic characters in interactive narrative have been described as existing along a spectrum of autonomy [13]. *Strongly autonomous* agents [e.g. 2] rely solely on their own knowledge, goals, and actions to emergently create a narrative based on the user's interactions with the environment and the behaviors of other agents. *Weakly autonomous* agents, on the other hand, are given direction from a drama manger agent to coordinate their actions based on story-level goals instead of individual characters goals (e.g. [13]). A mixture of these two approaches leads to *semi-autonomous agents*, which can rely on their own definition when not being directed by a coordinating agent.

The responsibility of these agents is typically to portray either *instantial story content* (i.e. any system that employs a drama manger to dictate pre-authored story content) such as the beats used in Façade[13] or the planning operators used in [23], or *procedural character content* (i.e. story content generated from agent behaviors or a story generation algorithm) [5]. Research on story generation has examined how to procedurally create stories, but typically in a non-interactive fashion and with limited successes to date. In other words, creating interactive stories that incorporate both a high degree of procedurality, such as in the story generation community, and

R. Aylett et al. (Eds.): ICIDS 2010, LNCS 6432, pp. 165–175, 2010.

high-level story structure and goals, such as what is seen in weakly autonomous and semi-autonomous approaches to interactive narrative, is a difficult task not dealt with in current approaches.

We contend that the study of people engaged in real life interactive narrative experiences, such as tabletop roleplaying [6] or improvisational theatre [11], can elicit useful knowledge about how to create intelligent agents that can help tackle the problem of creating procedural experiences in interactive narrative. Improvisational actors construct a story for an audience in real-time without the benefits of explicit coordination or pre-planning. The result is that all of the actors hold a potentially high degree of agency in developing the story. An adaptive, story-rich experience with high agency for all agents involved makes improv theatre a real world example of what some interactive story researchers attempt to create [21]. This paper discusses our work on studying the cognition underlying theatrical improvisation as a means to better understand how improvisers reason about *narrative development* at an atomic level. This would ideally result in practical implementations of improvisational methodologies for computational development of narratives.

There are multiple conditions when an interactive agent may require improvisational behavior:

*Story space breached by user*: The user in an interactive story has executed a series of actions that has led to a world state not covered by authored story content. This could mean anything from physically altering the environment or a character (e.g., the canonical example of shooting an important character) to being in an unexpected social situation or conversation.

*Story space breached by environment*: Some series of events in a dynamic environment has led to a world state not covered by authored content.

*Story generation recovery*: An interactive story that has been generated (e.g., by a planner) cannot currently replan given a story state breach. An improvisational agent could keep the story goals in mind while improvising and keep *a story* going, even if not the one explicitly pre-authored. In the case of an educational application, an improvisational agent may be able to keep the desired pedagogical goals in mind while improvising a story, even though the initial dramatic goals can no longer be fulfilled.

*Improvisational theatre*: If authors want to create an improvisational theatre experience in computational fashion (e.g., [4]) it is unclear what approach would be more appropriate than to create improvisational agents for the performance.

It is with these situations in mind that the *Digital Improv Project* has sought to better understand human improvisation with the goal of creating improvisational agents.

Our previous work [3] has established how improvisational theatre fits into traditional narrative concepts and structures. However, just as having a field of narratology has not made creating interactive narratives a simple task, this narrative analysis of improvisational theatre did not lend itself readily to computational representations. Just as Mateas and Stern reduced narrative moves in *Façade* to dramatic beats or Riedl and others have used planning formalisms, it is necessary to understand the proper atomic 'moves' that improvisational actors make so we can begin to understand how to formalize their decision making process and create improvisational agents.

Our work on narrative development in improvisational theatre has investigated the cognitive processes performed during an improv performance [11]. We collected retrospective protocols from individual improvisers and conducted group interviews post-performance [3]. Participants were prompted to continuously reflect on the performance as they watched it with little to no additions by the interviewers. Follow-up questions for clarity or depth were the only questions asked aside from prompting. The responses elicited were then annotated via an iteratively-developed coding scheme. We analyzed this data by applying a bottom-up (data-driven) and top-down approach (using the Soar [10] decision cycle as a procedural framework, since our aim of this work is to build computational agents) for organizing and explaining our findings.

We were able to deconstruct narrative development in improvisational theatre at a high level. This enabled us to assess how basic narrative elements are created, developed, and implemented in an improvisational performance theoretical perspective [3]. We mapped these findings of an actor's individual decision process onto the Soar decision cycle of receiving external inputs, proposing a new operator to execute, elaborating internal knowledge, selecting an operator to execute, and finally executing that operator. This allowed us to formalize the offers made in a scene from input to execution (along with possible, but rejected actions).

We found, not surprisingly, that the discourse of improvisation was unique in that the content of the scene (the script or dramatic text's equivalent) was generated ad hoc. This involved multiple performers making and accepting offers (which became narrative events) over time. Sometimes performers would choose reportedly suboptimal narrative choices with the intention of keeping the scene from stalling (instead of advancing the scene) or getting a laugh from the audience. However, the main objective of improvisers was reportedly to make "strong" offers that would advance the scene. If the development and interaction of strong offers is the objective of improvisation (which our data has reflected), then a method for recognizing and formally modeling that concept is needed, more than our past work has exhibited. In other words, our initial narrative deconstruction was not robust or detailed enough to allow us to formally represent what a "strong" offer would be with a computational improvisational agent. Therefore, we have conducted a follow-up post-performance interview with local improvisers at their theatre to get more detail on, among other things, how they reason about their narrative decisions on stage. The interview questions assumed the full knowledge of our research up to that point and focused on character development, offer strength, tilt (emphasis of the scene), reincorporation, and scene development while attempting to leave them as open-ended as possible.

## 2 Related Work

The body of improvisation research has most notably come from studies of music improvisation. This work has yielded several general findings on the nature of improvisation as a creative human act. Improvisation is a constant process of receiving new inputs and giving new outputs [16]. An improviser must, in real time, be aware of one's fellow performers, interpret their actions, make both decisions about current events, make predictions about future events, remember what has already happened in the performance, correct errors, control their own physical movements, and integrate this process into a performance. There are a few methods for easing this cognitive workload. For instance, in musical improvisation, verbal commands can be exchanged to help smooth this process out [17], [1]. However, since all communication in theatre improv is diegetic, this method cannot be used. However, other tools of musical improvisation are still available to the theatre improv troupe; they may communicate with body language, domain-specific cues, and referent use [8], [22], [14]. A referent provides material for variation, allowing the performer to create a palette of pre-performance structures. An example of this behavior would be stock characters or mutual knowledge from outside of the scene.

There have also been implementations of theatrical improvisation in computational systems, however these systems tend to focus on creating experiences based on some particular aspect of improv techniques (e.g. character "status" [15]). In general, other virtual improvisational theatre systems have focused moreso on a shallow understanding of single aspects of improvisation, basing their work on improvisational texts or conventions, as opposed to understanding the cognitive mechanisms employed on stage [2], [19], [4].

Interactive story research is similar in many ways to the field of computational theatre systems [2], [19], [23].The goal of interactive story systems is to attempt to tell a story in which the user has some agency (by performing actions or making decisions) in influencing the direction and/or outcome of the story. Swartjes' investigation into improvisation noted that several improvisation techniques (such as offer negotiation) would be useful in developing interactive narrative systems [21]. He proposed that work in the future would benefit from developing a system architecture that implemented improvisation techniques.

However, none of these projects have a) reached a deeper or more complete formal understanding of what improvisers do on stage at the individual or group level or b) attempted to computationally represent narrative understanding in improvisational agents, which would allow them to have more control over the progression of the story and work as a cohesive group to procedurally construct a story without relying on instantial story units like beats or plot operators. Our work on studying improvisational actors aims to address both of these points.

## 3 Narrative Units in Improvisation

Improvisational writings (such as Johnstone's *Impro: Improvisation and the Theatre* [9]) and our data from studying expert and intermediate improvisers, have commonly pointed to improvisers consistently making and accepting "offers" in an effort to "move the scene forward" across a variety of different kinds of scenes and situations, as well as coming to some functional understanding of what the scene is about. Johnstone describes an offer as "anything an actor does [is] an 'offer'. Each offer can either be accepted, or blocked." Improvisers have reported a similar definition, but within the specific context of an offer being something that is intentionally given to another performer (sometimes being described as "a gift given to your fellow performers"). Both from how improvisation is taught and practiced, the *offer* is a reasonable place to start with a narrative deconstruction. Without a formal understanding of what constitutes an offer in improvisation, it is immensely difficult to build computational improvisational actors who can reason about narrative schemas, conventions for improv games, etc. Subsequently, the response to an offer, typically referred to by the improvisers we interviewed as *accepting* or *rejecting* the offer, should also be included. However, an offer can be nearly any action executed by an actor in a scene; the term by itself is not useful as a formalism. The way in which an offer is interpreted and implemented in the scene is what actually constructs the narrative, therefore offering a formalism that is useful. The following subsections are an initial attempt at deconstructing the *offer / response* pairs seen in improvisational theatre into grounded atomic actions that can be subsequently used in computational theatre.

## 4 Construction of Narrative

As stated above, we are attempting here to formalize the different kinds of *offer / response* pairs we have observed by their reception rather than simply how the offering actor intended. Narrative is heavily constructed on stage by improvisers through this interaction of offering and accepting. The three types of responses are classified by how they interact with the offer: *Yes, And* (Accept, Augment), *Yes, But* (Accept, Redirect), and *No, But* (Reject, Redirect). This means that an offer is only canonically relevant to the narrative after it has been verified by another performer as actually true in the frame of the stage. Therefore, we define the offer / response pair as the core narrative move in improvisational theatre (as opposed to the sole canonical offer) and describe the different kinds of these moves below. By breaking down the concept of "offer" into individual classes based on the recipient's response, we can eventually better represent this narrative move in a computational framework.

### 4.1 Yes, And

The most common offer response that improvisers refer to is called *Yes, And* (or *Yes, Anding*). It consists of verifying that the offer's information is correct in the scene, and then augmenting that offer. For example, in one unconstrained scene of *Game* (which is defined to the improvisers as "perform a scene" with either no constraints, a location and relationships given, or an entire plot given by the game host), E3 sits down on the ground as E2 and E1 begin to pantomime as if cleaning the floor. After being requested to move, E3 offers that she has "nowhere to go". E1 says, "I feel what you're saying, but …y'know… not everyone can win an electoral race. Somebody's gotta be the loser." With this statement, E1 has verified that what E3 has just said about having nowhere to go is true, and augmented her offer by building on top of it more information (why she is there and has nowhere to go). This is the process of *Yes, Anding* in improv and is commonly associated with the concept of offers in improv theatre.

### 4.2 Yes, But

A less commonly observed type of response involves verifying and then redirecting an offer. This could be described as *Yes, But* (which is not to be confused with the blocking game of a similar name). This type of response to an offer describes a behavior observed within our data, but not necessarily an explicit strategy that improvisers report being aware of. When an improviser employs *Yes, But,* they are accepting an offer but redirecting the implications of that offer and therefore recontextualizing the other's offer. In one scene from our study of improvisers at their theatre, the performers were playing a game called *Blind Scene*. It consists of two performers developing a narrative by playing their characters in a scene whose content is suggested by the audience. However, only one of the performers knows the situation. The other performer is therefore 'blind' to the platform (i.e. general information about the scene such as characters, relationships, location, etc.). The improviser who knows the scene's context will try and inform the other performer about aspects of the scene while it plays out (such as their relationship and the situation they are in). In this example, the performer in the know is cast as a man who is in love with (and occasionally sleeping with) his landlady, who is the so-called blind actor. The improviser in the know described in the interview how the exchange of information develops in the scene, reporting that it was not his role to reject his fellow improviser's offers, but to accept them and somehow make them true in spite of her perceived original intentions.

One example of this is when the blind actor makes an offer of, "Oh my god! This is great you built a checkers table right in!" He affirms this as true to the scene, but redirects her exclamation with, "It's from the Renaissance Hotel," inferring that he has furniture similar to that of the other properties she owns. The performer in the know explained in his interview that he accepts her offers as true, but tries to redirect their meanings from what she most likely originally intended. This is different from a *Yes, And* where one builds off of the offer in the direction intended by the other performer, by instead taking that offer and using a particular interpretation which is (in his view) useful for the scene to advance.

### 4.3 No, But

The *No, But* is more typical in certain improv games, such as the game *Improbable Mission* featured on the television show *Whose Line is it Anyway?* Essentially, this involves making an offer, it being rejected, and then an alternate situation to the scenario being provided. An example of this comes from a game of *Narration Switch*. The way this game works is that two improvisers are on stage while two improvisers are off stage. The two off stage narrate the scene where the two on stage play characters. The host will call "Switch!" at various times causing the improvisers on and off stage to switch places (therefore, an improviser who has previously been a narrator would then go up on stage, while his vacancy as narrator would be filled by the former character's improviser). A cigarette becoming a snake horrifies a character in the scene, Maybury. The narrator states that Jesus "calms her down, showed her that the snake was nothing to be scared of." The performer rejects Maybury's offer of being afraid and redirects the scene in a different direction. None of the improvisers interviewed consider this type of redirection a block, but they do acknowledge it as a redirection in the scene.

This is because it gives the other performer what is needed to develop the scene. Keith Johnstone [17] said once in a retreat, "Does saying no give [your partner] what they want?" This may seem counter-intuitive, but is illustrated both above and in one of our earlier data collections which involves a rejected offer being met with a *No,* *But*. In a scene set in a zoo, two friends are picking on their third friend, implying that his wife is mannish. D7 (the one being picked on), responds with, “Maybe I like it rough, ever think of that?” D5 pauses and then says, “…I’d honestly never considered that. We kinda just thought she was just beating you up emotionally.” D7’s offer was firmly rejected by D5, but an alternate suggestion was offered in its place that opened the scene to a new and interesting path for the improvisors. D7 described this in the interview as a great offer because it caused the scene to develop, “[he] takes it to a great place, which is I’m actually an abused husband.” D5 and D6 begin to soften their tones and ask, “Does she hit you?” and “What’s going on?” as D7 turns away from them and says, “I don’t want to talk about it, guys” and then turns back to them saying, “let’s talk about what you did to that lion” which rejects their offer and tries to return the scene to an earlier topic (throwing snow cones at lions). D5 then rejects that rejection and redirects the scene towards the issue of D7 being abused.

This is a narrative example of the *No, But* behavior which the improvisers would not consider blocking because it gives the other performer what they want for the scene to develop: conflict. Understanding this as a separate kind of offer / response pair from the previous two pairs allows us to consider how to represent the cutting off of proposed narrative directions and the mechanism for proposing new ones.

## 5 Micro-agent Implementation

With the aforementioned offer / response patterns in mind, we have created a computational agent that would help us explore these narrative moves. Our work has currently focused on the development of *micro-agents*, which are agents that represent a single aspect of our formal findings [12]. The benefit of creating micro-agents is that it allows the exploration of individual cognitive concepts and all of the issues involved in creating an agent (e.g. interaction design, knowledge representation, environment design, etc.) without the overhead of building a more complex and less understood agent. We decided to initially focus on a very physical *No, But* interaction akin to the *Mission Improbable* game. That game consists of two performers trying to accomplish mundane tasks while each performer introduces a *No, But* solution to each problem. An example of this type of interaction would be one performer says, “Okay, let’s take your car.” The other would respond with, “Oh no! My car’s in the shop. But, it’s a good thing I installed rockets in my boots!”

The narrative platform for this micro-agent is that the cat is in its tree and the two agents below it want to get the cat out of the tree (see Fig. 1). The first agent is aware that it must *be at the same height as the cat* and must have something to *obtain the cat* (either by grabbing it or luring it). The agent will then make an offer of acquiring an item to be at the same height as the cat (which comes from a library of possible actions). The other performer either allows this offer, or rejects it with a contextual reason (e.g. the trampoline has a hole in it and cannot be used) redirecting the situation. This effectively exhibits a *No, But* behavior. If none of the prior attempts succeed, then the final attempt at locating working equipment shall succeed. After getting into the tree, therefore being at the same height as the cat, the agent can then obtain the cat (such as by using the cat magnet).

The Soar agent (which controls both of the visualized agents on screen) makes decisions for each of the characters, who take turns in the scene. A decision for either character is sent to Processing which then animates the action for the given character on screen. One agent, the “savior”, is given the goal of trying to save the cat caught in the tree while the other agent, the “trickster”, takes the goal of conducting adversarial planning to potentially keep the cat from being saved. More specifically, the trickster agent reasons about the effects its actions has and selects actions that can block the other agent’s proposed actions for saving the cat. If an offer by the savior is rejected, the trickster then calls upon one of its pre-defined “but” redirections. These are essentially new offers that point to an alternative route for saving the cat. The visualization of these interactions essentially comes across as offers by the savior that are either accepted or met with a *No, but* response by the trickster.

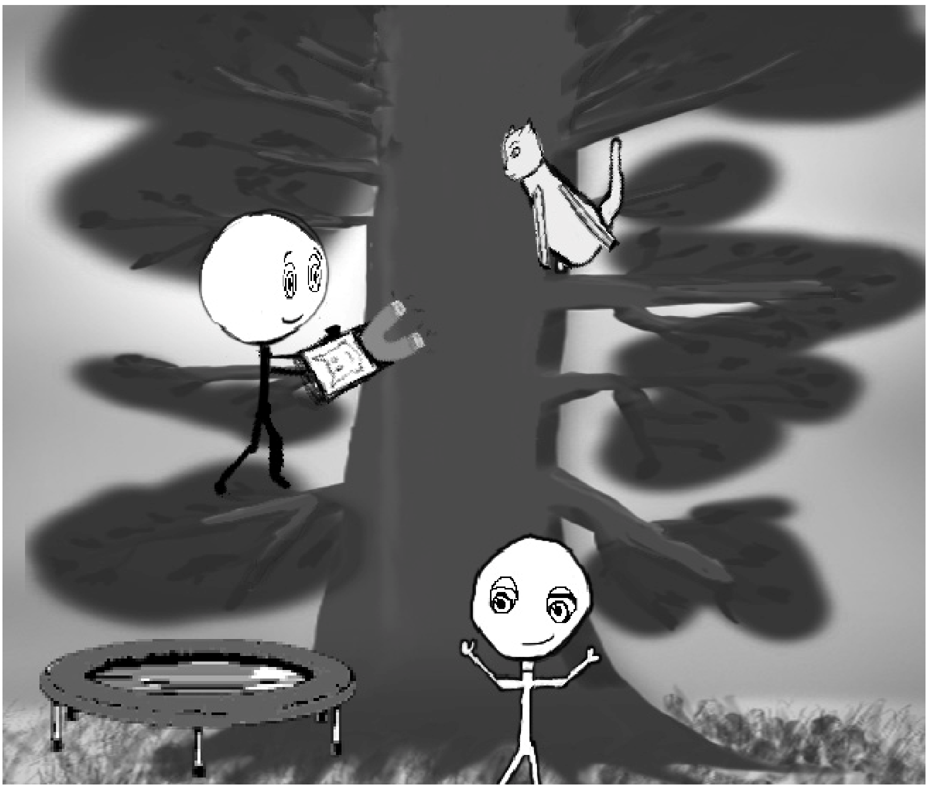

**Fig. 1.** The first agent is using a cat magnet after a series of offers have failed

The program uses one instance to control the behavior of both agents, but it could be easily developed to control two different agents. This type of behavior is intended to model a variation of an adversarial search that would “maximize interestingness” by following the pattern of conflict seen in the aforementioned types of improv games [20]. Rather than possibilities being minimized until success cannot be achieved, instead success is met with conflict to stimulate interest. Interestingness in this situation can be described as an agent's schema of appropriate actions (or plans) being violated in such a manner that it contextually makes sense to the narrative while simultaneously raising an appropriate emotional response (in the user/audience) to the scene. The micro-agent currently creates the plans from a prescribed library of Soar operators. While functionally similar to other planning schemes, its focus is different in its attempt to model the very physical *No, But* behavior (redirecting failures rather than procedurally attempting to convey a whole narrative with employing or modifying plans). While currently the micro-agent blocks and accepts offers due to purely random bias, future implementations intend to subject the agents to narrative preferences which would intentionally heighten drama through conflict and yield a more satisfying ending through reincorporation (such as an object's failed use earlier in the scene being implemented in the climax).

## 6 Future Studies

Our main goal in our future research is to implement practical uses of improvisational methodologies for development of interactive agents who can exhibit improvisational behaviors while reasoning about narrative. However, while this work has focused on *what improvisers* do, there is little understanding concerning *why* they do what they do (e.g. why do *Yes, And* versus *Yes, But* in response to an offer?) To clarify: consider the question of when does an improviser respond to an offer with *Yes, And* versus *No, But*, and why? If different strategies had been employed in the examples above, the scenes would have been quite different. That is why this line of questioning is what we are currently trying to address and explore. The continued cycle of collecting data from real world improvisers, analyzing that data, then grounding that data that data in computational micro-agents (which in turn helps us better understand our data so we can then build more complex agents, etc.) will yield a better understanding of this phenomenon.

There are two significant next steps in our work on narrative and improvisation. This first is to form a synthesis of this and past work on narrative structure with the main group decision making that improvisers employ – the process of building shared mental models during performance [7]. This synthesis will help tie together the narrative structures and moves that improvisers reason about as individuals with the process of executing actions in a group setting in an effort to establish a coherent and interesting story.

The second step in our work is to begin to look at more affective features of improvised stories – i.e., how do improvisers make stories interesting? One commonly reported feature is the concept of a "tilt." The "tilt" of a scene happens after a platform has been established and "something interesting" happens that serves as the focus of the scene. Tilts are established through the processes listed above – making and responding to offers and reaching a shared mental model about the platform for the scene (i.e. where the scene takes place, who the characters are, etc.). Tilts seem to be common for quality scenes; understanding how they are negotiated and constructed will be crucial to creating a complete model of improvisation and narrative. This model can then be used to build computational agents who can improvise their own scenes.

## Acknowledgements

We would like to thank the faculty and students of the Adaptive Digital Media Lab for their tireless efforts on this work, especially Alexandra Bullard for her efforts involved in coding. We are grateful for this work being supported by NSF IIS Grants #1036457, #1032776, #0929178, #0840122, and #0757567.

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# Towards a Theoretical Framework for Interactive Digital Narrative

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**Abstract.** The emerging artistic practice of interactive narrative in digital media marks a profound departure from traditional narrative. The application of traditional narrative theory for interactive narrative is problematic, since the affordances of digital media challenge many underlying assumptions of theories related to non-digital media. This paper proposes a theoretical framework for interactive storytelling, which addresses these concerns by foregrounding system (the digital artifact) and process (the user interacting with the system) over the product-centered view of legacy media. On this basis, protostory, narrative design, and narrative vectors are proposed as new terms to more adequately describe the structure of narrative in interactive digital storytelling. This move is also relevant for practical design given the influence theoretical concepts have on concrete implementations.

**Keywords:** Interactive Storytelling Theory, Interactive Narrative, Digital Media, Story, Plot, Legacy Media, Instantiation, Protostory, Narrative Design, Narrative Vectors.

## 1 Introduction

Interactive digital narrative (IDN) in its many incarnations as interactive drama (e.g. *Façade* [1]), hyperfiction literature (e.g. *Afternoon* [2]), interactive fiction (IF) (e.g. Zork [3]) and other variants such as interactive cinema (e.g. *A City in Transition: New Orleans 1983-86* [4]) and narrative games (e.g. *The Last Express* [5]), heralds not only a change in the technology of representation, and in the opportunities for artistic expression, but also a challenge to existing concepts in narrative theory, such as the role of the author and the concept of a single unified plot. So far, these challenges have been approached by modifications to established theories. A first milestone was set by Brenda Laurel's re-working of Aristotle's Poetics [6] based on an understanding of digital interactive narrative as similar to the stage play [7, 8]. Laurel's theoretical approach was used as the basis for practical experiments by Carnegie Mellon's OZ group under Joseph Bates [9], which eventually led to the first fully realized interactive drama, Mateas' and Stern's *Façade* [1] Similarly, a post-structuralist perspective articulated by Jacques Derrida, Michel Foucault, Roland Barthes, Umberto Eco, and Jean Baudrillard led to the development of the Storyspace platform and to the creation

R. Aylett et al. (Eds.): ICIDS 2010, LNCS 6432, pp. 176–185, 2010.

of hyperfiction works like Michael Joyce's *Afternoon* [2] and Shelley Jackson's *Patchwork Girl* [10]. A third approach has drawn on non-literary and non-western concepts of narrative – for example African aboriginal or diasporic oral narrative traditions – as a theoretical basis of IDN. Pamela Jennings' work *The book of ruins and desire* [11] and Fox Harrell's *GRIOT* system [12] implement this approach. Finally, an approach based on narratology as devised by Barthes and Claude Bremond and further developed by Prince, Genette, Chapman and others is proposed by Nick Montfort [13] for IF and by Marie-Laure Ryan [14, 15] as a general model for IDN.

To start with any established theory of narrative has clear advantages. Terms, categories, and methods of analysis already well understood can be used to analyze and describe phenomena in interactive digital narrative. On the other hand, analyzing IDN within the frameworks of theories created to describe narrative in traditional media carries the danger of misunderstanding or underestimating the nature of the change. For example, once we understand IDN to be similar to the ancient Greek stage play we can become entrapped in this analogy and overly wedded to the framework of Aristotle's Poetics. Consequently, aspects that do not fit that particular frame of reference (for example digital media's capacity for an encyclopedic treatment of a given topic vs. Aristotle's notion of a complete action that only includes necessary elements) might be misunderstood as minor or even excluded altogether, thus limiting our ability to fully capture the potential of IDN. To overcome these limitations I propose a more adequate framework as a step towards a fully developed theory of IDN.

## 2 An Initial Approach towards IDN

The analysis in this paper is guided by a framework provided by earlier and contemporary work in the understanding of computers as digital media [8], the affordances and phenomenological qualities of digital media [16] and aspects of the experience and the design of IDN [16, 17] and narrative [18]. This approach takes narrative as a cognitive structure that can be evoked in different ways. It also understands digital media as separate and distinct from legacy media such as the printed page, film, or electronic media. Additionally, digital media is understood to have specific affordances, which consequently make IDN a form of expression that tightly integrates interactivity and narrative.

Janet Murray's descriptive framework starts with her understanding of a computer's ability to "execute a set of rules" [16] and to be an engine that runs instructions as the procedural affordance. The participatory affordance captures the computer's ability to react to user input, and respond in a predictable manner. The spatial affordance denotes the ability of computers to represent space and allow a user to traverse this representation on the computer. The encyclopedic affordance is Murray's term for the computer's ability to handle and present huge amounts of data.

Murray then defines the phenomenological categories of agency, immersion, and transformation to constitute the aesthetics of digital media. She sees agency as the experience a user gains by "making something happen in a dynamically responsive world" [17] if the digital artifact reacts in a coherent and predictable manner. Immersion is the ability of a digital artifact to hold our interest, and minimize distraction by offering an "expansive, detailed, and complete" [17] experience.

Unlike Ryan and some game theorists, Murray sees no conflict between "interactivity" and "immersion" or interactivity and narrative. Computer-based narrative is created by exploiting the affordances of the digital medium, and is reinforced by participation, so that the interactor experiences agency that is based on arousing and rewarding narrative expectations, and the active creation of belief in the story world. From this perspective the compound term "interactive narrative" is perhaps misleading, since it can be misunderstood in a way that takes interactivity as an "added feature" for narrative. On the contrary, the perspective taken here understands interactivity and narrativity as inseparable, mutually reinforcing aspects of the emerging expressive form of IDN.

David Herman [18] augments narrative theory with additional aspects drawn from cognitive science. Overall Herman describes narrative as a cognitive structure that can result from different coding strategies and forms, a position echoed by Marie-Laure Ryan [15]. In this vein, Herman defines narrative as a "forgiving, flexible cognitive frame for constructing, communicating, and reconstructing mentally projected worlds." [18] This definition de-couples narrative from specific forms or media and opens up the space for experiments. It also removes the requirement for specific roles of narrator and narratee and is therefore compatible with Murray's framework of affordances. Consequently, Herman's definition serves to define narrative in my approach towards a theoretical framework for IDN.

## 3 Towards a Theory of IDN

The starting point for a specific theory of IDN is a change of perspective. Instead of understanding IDN to be similar to narrative in legacy media, interactive digital narrative is taken as dissimilar. Both the material basis in digital media and the conceptual backdrop of IDN as a participatory transformational experience merit this change. This stance does not represent a departure from earlier approaches but rather a radical continuation based on more than two decades of theoretical and practical research.

In this fashion, Nick Montfort's distinction between an IF work and an ordinary narrative is especially productive: "A work of IF is not itself a narrative, it is an interactive computer program" [19]. However, he still considers narratology a useful framework for the analysis of IF works:

> An IF work is always related to story and narrative, since these terms are used together in narratology, even if a particular work does not have a 'story' in this ordinary sense. [13]

What is embedded in his observation is a distinction between the material artifact as a computer program and its output as a particular instantiation. This distinction is true for IF and other kinds of IDN. Another important aspect of IDN is in the relation between theses two categories. IDN assumes interaction and thus a participatory process in which a participant engages with the computer program to produce the output.

The product of an IDN work – a recording of a single "walkthrough" - might be understood as a narrative in a more traditional sense and could be analyzed with the

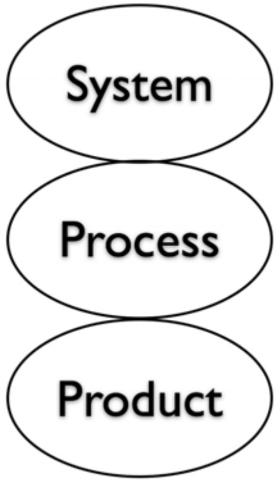


**Fig. 1.** High-level view of IDN

tools and methods of classical narratology. However, the same theoretical framework does not account for the digital interactive system that enables the production of the narrative in the first place.

A crucial step towards an adequate theory of Interactive Digital Narrative is to understand IDN works as comprised of *system*, *process*, and *product* (see Fig. 1).

This model of IDN is inspired by Roy Ascott's theory of cybernetic art [20]. Ascott advises artists to look at the scientific discipline of cybernetics, the study of "control and communication in the animal and the machine" [21], and create art inspired by cybernetics' concern with the behavior and regulation of environments, and with organizational structures. Espen Aarseth must be credited with the introduction of cybernetics to IDN. He derives his term Cybertext explicitly from cybernetics and describes the "cybertextual process" [22] in which a user affects the narrative in a cybernetic feedback loop. Ascott's definition, however, provides a better basis for a theory of IDN, as he improves upon Wiener's mechanistic concept by merging it with artistic sensibility. His "cybernetic art matrix" [23] proposes a tight integration between art and the computer and foreshadows the importance of interaction for digital media. Furthermore, Ascott understands cybernetic art to represent a change in the artistic focus from product to process and from structure to systems, which will turn the "observer" into a "participant" [24].

Ascott's vocabulary therefore can be used productively for the definition of a framework for IDN. I propose *system* as a term to describe the digital artifact, as it exists on a digital storage medium combined with the hardware on which the artifact is executed. This includes the executable programming code and assets - digital representations of pictures, movie clips, sounds, and text, as well as network links to more assets on a local network or the Internet. Additionally, it also includes the connected hardware – keyboards, mice, displays, and other hardware (eg. sensors) used in a digital installation. The *system* contains "potential narratives", a term Montfort derives from the Oulipo group's notion of "potential literature" [see 19].

Once a user starts to engage with the *system*, a *process* is created. The actions of the user as interactor, and the opportunities provided by the system define and shape the process. The resulting *product* of IDN represents an instantiated narrative.[1] Instantiation here describes the quality of IDN to produce very different results or narrative products from the same source (the system) through a participatory process. Each single instantiated "walkthrough" could be recorded and may be analyzed in terms of traditional narratology, as a linear narrative. While any single product is an integral element of any IDN, it is important to realize that it represents only one particular instantiation that can and will change as soon as the process changes. In terms of theoretical analysis the product alone is therefore severely limited as a representation of an IDN work. A full analysis of any IDN needs to include an examination of process and system.

From this perspective, theoretical approaches based on theories for legacy narratives are problematic since they foreground the analysis of the product of IDN. A potential criticism of this view is the argument that IDN's process represents the equivalent of the cognitive process of understanding literature and other narratives as described by the reader-response theory [26] and contemporary cognitive narratology [18]. The model proposed here does indeed take the creation of meaning of a narrative in the mind of a recipient as an active process. However, potential narratives in IDN provide an additional mental plane for the participant. Not only does the participant create a mental model of the emergent story, she also speculates about the consequences of her own actions for the narrative, assesses her level of control, and as a result formulates and executes strategies of interaction. This additional plane of consideration and control is an important factor that distinguishes IDN from legacy non-interactive forms such as the novel, or the movie. While this plane does also exist in participatory theater, improvisational performances, story games, and "choose your own adventure" books, these non-digital interactive forms differ from IDN in their material basis in legacy media, and consequently do not share the same affordances as digital media.

As a result, IDN can now be defined more clearly as an expressive narrative form in digital media realized in a system containing potential narratives and experienced through a process that results in products that represent instantiated narratives.

### 3.1 Protostory, Narrative Design, and Narrative Vectors

Given the flexible and malleable quality of IDN afforded by procedurality and participation, neither story nor plot/discourse can adequately describe an IDN work, as the fixed story (or "content plane of narrative" in Prince's terms) of legacy media gives way to a space containing potential narratives. At the same time, plot/discourse as the fixed material manifestation gives way to a flexible presentation of narratives while they are being realized. Additionally, a neat distinction between the two categories is no longer possible, since the IDN *system* contains and encodes aspects of story and discourse by supplying both content and structures of the concrete expression. These aspects need to be reflected in terminology that intends to adequately describe IDN.

[1] Noah Wardrip-Fruin [25] shares the concern for process, which he distinguishes from "output." He describes the aesthetics of "expressive processes" and foregrounds the evaluation of a work based on these aesthetics.

I propose the term *protostory* to describe the concrete content of an IDN *system* as a space of potential narratives. Any realized narrative experience is related to the respective *protostory* through a process of instantiation. The term *protostory* shares the aspect of a malleable formation with the concept of prototype-based programming (sometimes also called instance-based programming). In this variant, not only the content (as with classes), but also the behavior and structures (called prototypes) itself can be changed at runtime [27]

This model more adequately describes the flexible relationship between an IDN system and a particular realized narrative and clearly distinguishes it from any kind of mechanical reproduction that produces the same copy every time. The *protostory* then is a prototype, or a procedural blueprint, that describes the space of potential narrative experiences contained in one IDN system. However, *protostory* is more than just a computer program, as the term encompasses not only the concrete programming code and interactive interfaces, but also the artistic intent that enables a participatory process of instantiation that results in the realization of potential narratives.

The concept of plot as separate from *protostory* is problematic given the compound nature of potential narratives, which contain both structure and content. Instead, I propose *narrative design*[2] to describe the structure within a protostory that contains and enables a flexible presentation of a narrative. This includes the segmentation and the sequencing of elements and the connections between them. Additionally, the procedural logic applied in the presentation of elements is part of the narrative design (see Fig 2).

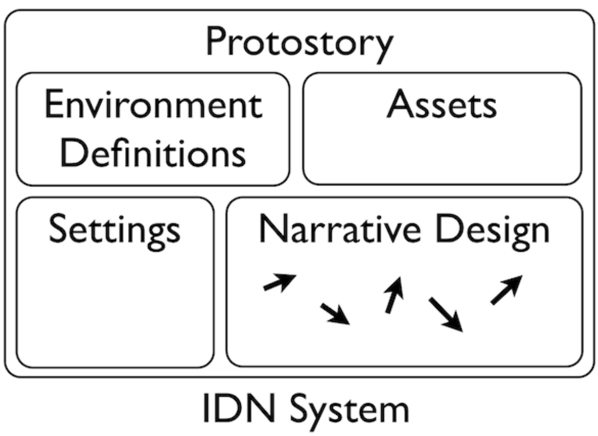


**Fig. 2.** Protostory and Narrative Design in an IDN System

The term *narrative vectors* describe sub-structures in a narrative design that provide a specific direction for the narrative. *Narrative vectors* work not as isolated structures, but rather in connection to the preceding and the following parts of the narrative. The purpose of such structures is to convey important aspects to the interactor, to prevent an interactor from getting lost and to help to retain a level of

[2] In contrast, Mateas uses the same term to describe narrative segmentation [see 1].

authorial control. For example in an IDN murder mystery, a narrative vector could be the occurrence of a murder or the disappearance of an important victim, and also a breakdown of the interactor's car that prevents her from leaving the crime scene before all clues are gathered. *Narrative vectors* are roughly functional equivalents to the term plot points in legacy media [see 28]. The term plot point has been used to describe positions within a story that are created by the author in order to propel the narrative experience forward.

As a next step I will test this new terminology by applying it to two disparate examples.

### 3.2 Examples: *Afternoon* and *Façade*

In Michael Joyce's *Afternoon*, the *protostory* is the space of all lexias and hyperlinks together with the possible paths an interactor can take and the author's artistic intend to let the interactor experience a fragmented narrative of a psychotic state. An interactor instantiates a particular realized narrative by reading lexias and following hyperlinks. The *narrative design* in *Afternoon* describes the segmentation of lexias as well as the hyperlinks connecting them and the guard fields that generate conditional links. *Narrative vectors* in *Afternoon* are combinations of lexias and links that are designed to create specific experiences, for example the re-visiting of a particular lexia after the interactor has gathered additional knowledge (see Fig. 3).

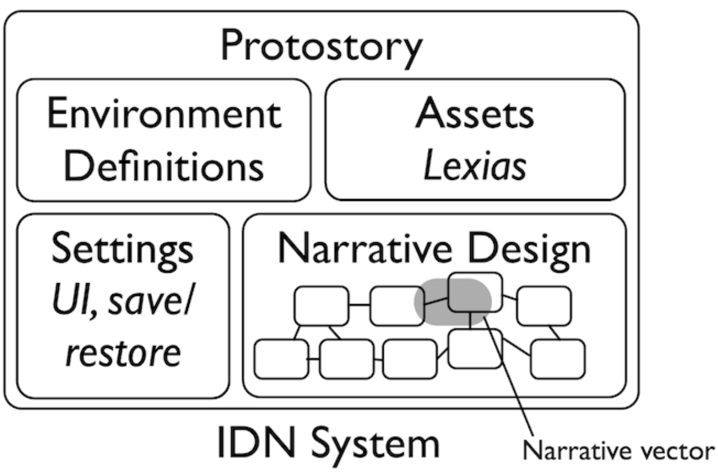


**Fig. 3.** Protostory, narrative design, and narrative vectors in *Afternoon*

Mateas' and Stern's work *Façade* [1] applies sophisticated artificial intelligence to create a richly varied range of narrative possibilities. The *protostory* in *Façade* is the space of possible stories described by the contents of the beats (narrative units), the drama manager's restrictive rules and goals and the artist's intent to let the interactor experience a marriage falling apart and attempt to save it. By communicating with Grace and Trip, the two other characters in *Façade*, and by moving within the space of their apartment, an interactor instantiates a realized narrative, which could for example lead to the couple breaking up or throwing the interactor out.

The narrative design in *Façade* is comprised of the different beats, the concept of a story arc and pre-authored goals. Narrative vectors are formed by the drama manager component as a result of the interactor's input and by consulting pre-authored goals as well as distinct phases in the story arc. Narrative vectors (see Fig. 4) in Façade determine if an interactor is kicked out or if she reaches the therapy part in which Grace and Trip are able to rescue their marriage.

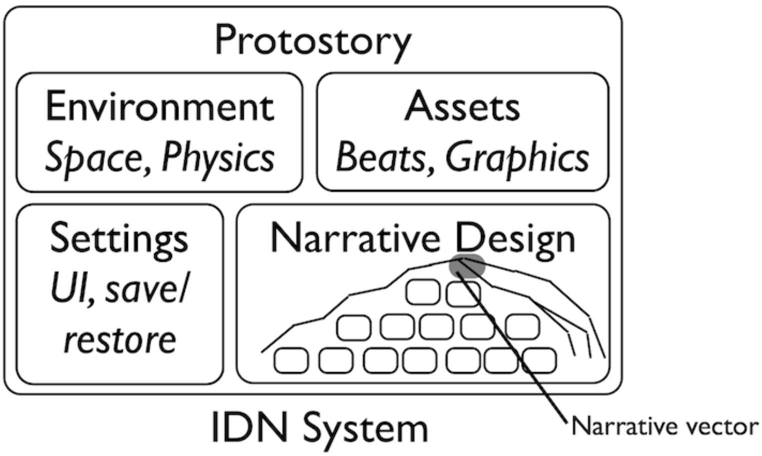


**Fig. 4.** Protostory, narrative design, and narrative vectors in *Façade*

Understanding the two works in this way also facilitates the exploration of questions about the content of an IDN work outside of the narrative design, which so far has been mostly overlooked. For *Afternoon,* the aesthetics and participatory possibilities provided by the Storyspace authoring system and its playback component can be analyzed as environment definitions and settings. Similarly, for *Façade*, the virtual space of the couple's apartment and the possibilities afforded by the physics engine become an integral part of the examination of the protostory as aspects of the environment and allow a more complete understanding of the work.

For both examples, the narrative design is seen as a complete structure comprised of narrative vectors, which enables a classification independently of legacy story structures – *Afternoon* no longer has to be understood as rhizomic and *Façade* can be classified independently of legacy dramatic structures. Additionally, narrative vectors comprised of lexias and links or the combination of the drama manager and specific beats allow us to examine the particular narrative strategies of *Afternoon* and *Façade.*

## 4 Conclusion

The addition of *protostory*, *narrative design*, and *narrative vectors* to the theoretical vocabulary of IDN, together with the understanding of IDN as comprised of *system*, *process*, and *product* creates a rich descriptive framework for IDN that forms the beginning of a more fully developed theory. The brief analysis presented here of real-world artifacts in the form of two examples (*Afternoon* and *Façade*) is an early testimony to the applicability of this framework to diverse works within the IDN spectrum. The inclusion of *environment*, *assets*, and *settings* as integral parts of the examination of digital artifacts enables a more complete understanding of IDN works, while *narrative design* and *narrative vectors* allow an understanding of narrative structures beyond legacy notions of story structure and dramatic arc.

Further work in this area should analyze the primitives and the segmentation of protostories and create a taxonomy of narrative designs to identify forms and genres. P*rocess* should receive additional focus, to arrive at an analysis that enhances the understanding of the interactor's mental processes while experiencing IDN works. This analysis should also examine the relationship between computational and mental processes in more detail.

In practical terms, the clear departure from legacy narrative opens up a space for bold experiments in IDN that do not need traditional narratives as a yardstick to measure against. The theoretical framework proposed here changes the focus of evaluation: not in computational complexity, not in "discourse" or language/images in which a story is told; but in complexity and coherence of protostory, the aesthetics of narrative design, and the richness of narrative vectors as creating expectation and occasions for dramatic agency.

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# A Data-Driven Case-Based Reasoning Approach to Interactive Storytelling

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**Abstract.** In this paper we describe a data-driven interactive storytelling system similar to previous work by Gordon & Swanson. We addresses some of the problems of their system, by combining information retrieval, machine learning and natural language processing. To evaluate our system, we leverage emerging crowd-sourcing communities to collect orders of magnitude more data and show statistical improvement over their system. The end result is a computer agent capable of contributing to stories that are nearly indistinguishable form entirely human written ones to outside observers.

**Keywords:** interactive storytelling, case-based reasoning, natural language processing, crowd-sourcing.

## 1 Introduction

The primary allure of digital interactive storytelling has been the vision of completely immersive environments that present the participants with the same richness of interactions in the virtual world as they experience in the real world. Over the years, incredible progress has been made in modeling the physical characteristics and the graphical interfaces with which we are submerged into these virtual worlds. However, progress in developing narrative technologies that allow complex social interactions with non-player characters and free interaction with all aspects of the environment has been much more arduous and less fruitful.

One of the primary reasons why progress has been slow, and many existing interactive storytelling systems do not come to life in a truly dynamic way, is that the development of these systems has been remarkably similar to those of traditional media. A movie, for example, typically has a primary author and a small team of additional writers who refine and shape the screenplay into a single coherent narrative. Similarly, a group of writers for a typical interactive narrative also begins with a single core idea, but instead breaks it into multiple narrative threads, or beats [11], that enable different storylines based on narrative decisions inferred by the system. Through manual analysis and the use of specialized tools, an effort is made to identify places in these narratives that the user can move from one thread to another without breaking the coherence of the entire story.

R. Aylett et al. (Eds.): ICIDS 2010, LNCS 6432, pp. 186–197, 2010.

This is both a natural and well understood approach, but there are several problems that are immediately apparent limiting its effectiveness. For example, a traditional movie takes many months or even years to author and yet is only the manifestation of one static narrative thread. An interactive narrative of the same magnitude requires an enormous amount of extra effort, not only because of the additional content but also because of the extra verification required. To further complicate this already monumental hurdle, there are very few authors trained for this genre and even fewer standardized tools to help facilitate their creation. Given these limitations, it is important to explore new architectures for digital interactive storytelling that do not have such a tight coupling between the content authoring process and the narrative decision process.

Swanson & Gordon [16] first proposed a large-scale data driven approach that decouples the authoring process from the narrative decision process by completely separating the content authoring from the mechanics of the narrative engine. Instead of using a relatively small knowledge-base of highly structured rules and content, they leveraged the massive amounts of natural language personal stories on the Web. Even though some control must be given up in directing the plot, the amount of content available enables players to explore a rich virtual world full of the complex social interactions and emotion that make traditional narratives so compelling.

Their previous research has shown that this is a promising direction to pursue, however, there are several shortcomings that we address in this paper. We will first give a brief overview of the system and work done to recreate the *Say Anything* system using a new story corpus and information retrieval toolkit. Sections 2.3 and 2.4 describe new work that addresses several shortcomings of the previous version of *Say Anything.* In the following section, we will show how to use emerging crowd-sourcing communities to obtain orders of magnitude more evaluation data for only a few hundred dollars. We will use this data to show significant improvements over the previous system and will be able to produce stories, like the one below, that raters have judged nearly indistinguishable from entirely human written personal stories found on ordinary people's weblogs, but where every other sentence (in bold) was authored by our computer agent.

> The baseball player swung at the pitch, but missed by a lot. **The home plate ump checked with the third base ump who said Casto had fouled the ball off.** With that call, the game was still going and Casto had another chance to win the game for his team. **The Giants had a young guy named Sanchez pitching who did well.** With Casto's repuation as a good hitter, this was an intriguing and exciting matchup - who would win the battle and therefore the game? **Who would get it?!!** The suspense seemed to grow with each second and each movement of the pitcher, catcher, or batter. **Cursing myself for not having a camera with me, the camera phone would have to do, and snapped the photo above.** That photo showed the elation on Casto's face after getting the game-winning hit off of the tough pitcher Sanchez.

## 2 System Architecture

The style of game-play and system architecture described in this paper follows the *Say Anything* system developed by Swanson & Gordon [16]. Similar to their system, our system is a textual, turn-based game in which a human participant and a computer agent alternate writing sentences of a developing narrative. The objective is to develop a system that can generate a coherent sentence during each turn and enable the human to experience an interactive story adventure, as a whole, that is driven by their interests and desires. Our system can be thought of as a return to early text adventure games such as Adventure [6] with two primary exceptions. First, the story is not known in advance and second, the user is not limited to the actions hard-coded and preauthored into the system, but rather the user is free do anything they feel is appropriate given what has happened so far. To this end we are not concerned with attaining long narrative experiences or artifacts, as long as the user is able to enjoy their interaction and the resulting stories are judged to be of sufficient quality.

To achieve these goals, our system breaks from the standard representation formalisms typically used for interactive storytelling and narrative generation and instead, we follow a data-driven philosophy inspired by Case-Based Reasoning (CBR) [13]. In Cased-Based Reasoning new problems are tackled by starting from a known solution to a different but similar problem and then adapting that solution to fit the unique particulars of the current problem at hand.

Predicting what happens next in a narrative chain of events is a complex task that requires, at least, a deep understanding of the causal and temporal relations implicit in the discourse. An ideal representation of these relations for our case library would be discriminative enough to operate at this level of event structure. Although annotated corpora modeling these types of relations exist, unfortunately the performance of automated systems on general web text is not adequate at this time.

Instead, we make two simplifying assumptions that enable a more practical solution. First, we assume that narratives are told in temporal order and second, that events are adequately represented as entire sentences. Although neither is entirely true, the consequences of their approximation are not detrimental to the success of our system. However, they enable us to use a large corpus of stories written in plain English that we treat as perfect solutions to our turn based game. When the user types a sentence during their turn, our system will find the most similar sentence and story in our corpus to what the user has written so far. This story will act as a proxy for the user's story and the next sentence after the one retrieved will be used as the basis for the computer's contribution.

The remainder of this section will describe the three main components of our case-based architecture, briefly outlined above. The first is the creation of the case library that acts as a repository of previously solved solutions to the problem. The second is a retrieval phase in which we find a similar case in our library to the one the user is currently working on. The final step is to adapt and change portions of the retrieved sentence from phase two so that it better fits the new sentence the user is actually writing.

### 2.1 The Case Library Story Corpus

The reasoning capabilities of any case-based system are critically determined by the composition of the case library and so its creation is extremely important to the success of our system. Traditionally, these case libraries have been built by hand, however this will not provide us with the depth of content we been arguing for. Instead, we follow a similar approach to Swanson & Gordon [16] and mine the social web for personal stories written by ordinary people on their weblogs. We roughly define a personal story to be a first person description of temporal and causally connected sequence of events that the author actively participated in. For a more complete definition see [16].

Our case library was constructed by mining the 25 million English language blog posts between August 1 and October 1 2008, provided by Spinn3r.com as part of the ICWSM Dataset Challenge [2]. Each of the extracted blog entries identified as a story was treated as if it were a perfect solution to the turn-based game and added to our library.

To automatically identify stories in the ICWSM corpus we followed a similar approach to Gordon & Ganesan [8], which takes a binary classification approach to the problem. However, in our work, entire blog posts are labeled as a positive or negative instance of a personal story, as opposed to extracting smaller segments from the text. We developed a new gold standard training corpus from a small randomly chosen subset of 5,270 weblog entries to train our classifier. Each of these entries was annotated using a similar definition to the one proposed in Gordon & Ganesan. In order to assess inter-annotator agreement and to obtain a high quality training corpus the subset of entries were hand labeled by both of the authors in an iterative process until all the examples were give a category both annotators could agree upon. On the first iteration, we found a similar level of agreement as Gordon & Ganesan's previous work (Cohen's $\kappa$=0.68). However, after two more iterations we were able to come to an agreement on all 4,985 entries[1], of which 267 were labeled as stories.

The completed training corpus was used to train a Confidence Weighted linear classifier [7], which was used for its efficiency and highly competitive performance. A wide variety of feature sets were explored to find the best combination with our classifier. These ranged from simple lexical based features and a set of hand crafted "narrative" words capturing the idiosyncrasies of this particular genre. In addition to simple lexical based features, several syntactic and discourse features that attempt to model implicit structural elements of the document were also compared. These included the relative frequency of grammatical dependency triples obtained using an automated dependency parser [14]. Finally, a set of features that capture structural information across sentences were also considered primarily based on Barzilay & Lapata's Entity-Grids [1].

Our training corpus was divided into a development set consisting of 250 weblog entries, a training set of 3,985 and a test set of 750. The highest performing feature set included a combination of all the features. The final performance of our system with this combination of features was a precision of 0.591, recall of

[1] Entries no longer available on the web at the time of annotation were disregarded.

0.414 and an $F_1$-score of 0.487. Applying this classifier to the 25 million weblog entries in the entire Spinn3r.com dataset, and holding out about 5% for development data, produced a corpus of 1.5 million stories comprised of about 42 million sentences.

### 2.2 Retrieval

Given our corpus of stories, it is necessary to develop a method for identifying similar stories and sentences to the one the user is currently writing. Fortunately, finding information in large collections of data is a well studied area in Computer Science. Many efficient algorithms have been developed in the Information Retrieval (IR) community that solve large scale document retrieval problems in fractions of a second. Manning, Raghavan & Shutze [10] provide an overview of some of the fundamental algorithms that are widely used. Many toolkits exist that implement these and other more sophisticated techniques, and for this work we chose to the Terrier toolkit [12] because it was far more efficient than any other software package we tried.

This information retrieval mechanism provides the base algorithm for our generation method. First, the user's most recent sentence is passed into our system. This sentence is then preprocessed to remove stop words such as determiners and other low value tokens from the input. The remaining words are lowercased and used as keywords to the Terrier retrieval component, which returns a ranked list of sentences from our database and the top 10 are returned to the user in ranked order. We present a choice of sentences to the user for two primary reasons. First, we would like to give the user a reasonable chance of finding a suitable continuation for their story, so that they do not become frustrated early in the process. Second, every time the user chooses a sentence other than the top ranked candidate selected by default we gain a valuable piece of information that we can exploit to further improve the system.

### 2.3 Reranking

Although Swanson & Gordon [16] showed that even a simple technique like the one described in the previous section can be quite effective, many of its problems should be readily apparent. The first thing to notice is a limitation of the IR mechanism itself. Keyword based systems suffer from relatively poor recall, because many sentences in English can express the same thought or meaning using an entirely disparate set of words. The reliance on a single sentence to determine the similarity between a preauthored story and the user's developing narrative is also problematic. Swanson & Gordon tried combining two separate indexes to address this problem but found a simple combination is not sufficient because the proper weighting is not known *a priori*. Finally, regardless of how similar the retrieved stories and sentences are, so far there have not been any checks to ensure that what the system returns is actually coherent with what the user has written up to this point.

This remainder of this section will describe a unified framework that is capable of addressing each of these issues, while still maintaining nearly the same (real-time) latency as the simple retrieval approach described in the previous section. This new approach is nearly identical to the simple IR based algorithm, but adds one additional phase after retrieving the candidate sentences from Terrier, but before returning them to the user. In this second phase, the retrieved candidates (which there can now be more than 10) are reordered based on a new set of arbitrary features using a machine learning reranking algorithm.

For this work we chose an algorithm similar to the one described by Collins [4], because it supports online learning, is extremely efficient and usually performs competitively. Similar to supervised classification algorithms, our reranking algorithm requires a set of labeled training examples in order to learn a model that can be applied to new data. To collect training data for our ranking algorithm, we used the trace of our system from the simple IR based method described in the previous section. Every time the user selected an alternative sentence we obtained a training instance in which the (partial) ranking was known. Although we may not know the absolute ranking of all the sentences, we do know that the user preferred their selection more than the current best guess of the system.

During the first stage of our evaluation process we collected 1,168 stories using only the information retrieval method. During the process of writing these stories, people took a total of 5,310 turns writing sentences with the system. Of these 5,310 turns the user selected one of the other nine alternatives 4,395 times. Following a standard approach, a development, training and testing dataset were created to test our feature sets offline. The development set was composed of 100 stories and a total of 381 sentence pairs. 3,305 sentence pairs from 900 stories were included in the training set. The remaining 184 stories and 688 sentence pairs were used for the test set.

A wide range of features were explored for this task that cannot be fully explained in detail. These features tried to address the issues raised at the beginning of this section, such as using more contextual information. Discourse features developed in the coherence modeling community, such as Entity-Grids [1] and machine translation models [15] were also included. Additionally, several other novel feature sets were also investigated, such as variation in sentence length, coreference heuristics, and the transition of verb tenses across sentences.

Although all of the features in isolation showed some improvement over the baseline, the Entity-Grid based features were by far the most predictive. On average, the candidate sentence that the person actually chose for their story was the 4.7th sentence in the list (from 0 to 9). After applying the reranker trained using Entity-Grid features alone, it was able to reorder the candidate sentences so that the person's selection was almost always presented near the top of the list (0.33th sentence on average). Although this is an astounding improvement, we should not necessarily expect such a dramatic effect during actual online interaction with the complete system. Ultimately, we chose an aggregate feature set that performed nearly as well, but included several lexicalized features we hypothesized would work well in combination with the adaptation component described in the next section.

### 2.4 Adaptation

There are many ways in which a retrieved sentence could fail to continue a user's story in a coherent way. The system could fail completely in finding an adequate sentence. There could also be more subtle errors due to an implicit mapping problem between similar semantic classes (e.g., football and baseball stories). Sometimes, however the errors are due to more surface level criteria, such as differences in the pronoun or verb agreement, such as third person versus first. Although the ultimate goal would be able to address all of the failure types, this work only considers the more surface level changes that could be performed.

The algorithm for fixing these types of shallow errors is a five step process. Step (1) begins by identifying all of the pronouns and proper names used in the subject or object position in the grammatical parse tree of the sentence. For each identified position, a set of valid replacement words is created using a replacement table for each type of word that could appear. The first set of tables correspond to five different classes of pronouns: subjective (e.g., I, he, she, we), objective, reflexive, possessive and possessive determiners. If the target word is contained within one of these tables, then this set is used for the candidate replacements. Proper names are handled similarly, but can also be replaced by any previously mentioned proper name (i.e. the cast of characters).

Step (2) involves generating a new sentence for every possible combination of the replacements in each target word set. Unfortunately, the number of combinations for sentences with more than a few target replacement candidates becomes prohibitively large. To prevent the set of candidates from exploding, a simple heuristic was used to limit the total number of possibilities. For any given target word, a maximum of two alternatives were selected as possible replacements. These alternatives were chosen by sampling the entire set of valid possibilities based on each word's relative frequency of occurrence in the entire story.

It is hoped that the characters participating in the events of one of these alternative sentences (or the original) will more closely adhere to the narrative intentions implied by the user's story. However, small changes to the subject of a verb can lead to ungrammatical agreement between the two. For example, when the subject of the sentence

*I* have more than one lemonade.

is changed to *He*, then the new sentence is no longer grammatical.

Step (3) combats this issue with a special dictionary [5] that provides, where applicable, the number, person, gender and tense for every lexical entry in the dictionary. The entry containing all lexical variations of any verb whose subject has been adapted is looked up in the dictionary using the number and person information available from the unaltered sentence. The lexical variation corresponding to this entry that matches the number and person information of the new adapted subject is then used to replace the previously ungrammatical verb.

In addition to ungrammatical verb agreement, altering a noun in the sentence can disrupt the coreference interpretation within the candidate sentence. Step (4) attempts to preserve the coreference interpretation of the unaltered sentence with the adapted one. A simple co-reference resolution algorithm, similar to the one proposed by Hobbs [9] was used to identify co-referring pronouns and proper names in the original, unaltered document. Once identified the number and gender of the appropriate pronouns was changed to reflect the alterations made in the previous steps. However, this may also cause problems with the verb agreement in the sentence and is addressed in the same way as step (3).

After applying these 4 steps to a candidate sentence a potentially large number of variations are produced. Step (5) uses a simple heuristic to prevent a candidate sentence template from dominating the results shown to the user.

## 3 Evaluation and Results

Evaluating interactive storytelling applications can be almost as challenging as developing the system itself. The success of a system is nearly always defined by a set of subjective criteria that requires human judges to evaluate. Without a fair amount of hand-waving, it is often difficult to show convincing results, because obtaining a large enough pool of independent testers to obtain clear and statistically significant data has typically been expensive and time consuming.

As a solution to a broader superset of problems, which are generally trivially easy for humans to solve, but still to difficult for automated systems to complete, Amazon created the Mechanical Turk website. In essence, it is a centralized cyber-location where *requesters* post work to be done (**H**uman **I**ntelligence **T**asks) and *workers* complete the jobs for a small monetary reward. Requesters are free to offer whatever they believe is a fair price for the task and workers can choose to work on HITs that interest them. The use of Mechanical Turk in academic studies has been steadily increasing and it has been shown with enough safeguards and redundancy, near expert quality annotation and data can be obtain from non-expert Mechanical Turk workers [3].

Mechanical Turk was used for both collecting a large sample of stories written with our system, and to collect subjective ratings from an independent set of users. Four different sets of stories were collected, during two phases, using variations of the generation mechanisms described above. To prevent Mechanical Turk workers from clicking through the HIT and ensuring some basic level of effort with the system, an 8 sentence (4 turn) minimum story length requirement was imposed on the workers. After each story was successfully completed the user was asked to answer several questions about their story on a scale from 1 (bad) to 5 (good) that tried to assess different aspects of the process:

1. *Does the story make sense? (Coherence)*
2. *Is the story believable? (Believability)*
3. *Did you have fun writing the story? (Entertainment)*
4. *How easy was the story to write? (Usability)*

Although other, potentially better, metrics for evaluating the narrative qualities of the story exist, these were chosen because they are not overwhelming and are easy for a non-technical person to understand.

**Table 1.** Author rating results from 1 (bad) to 5 (good)

| Model | # Stories | Coherence | Believability | Usability | Entertainment |
|---|---|---|---|---|---|
| Unigram | 601 | $3.46 \pm 1.11$ | $3.53 \pm 1.16$ | $3.08 \pm 1.19$ | $3.99 \pm 1.05$ |
| Bigram | 567 | $3.63 \pm 1.11$ | $3.59 \pm 1.20$ | $3.27 \pm 1.19$ | $4.14 \pm 1.02$ |
| Reranking | 443 | $3.51 \pm 1.15$ | $3.62 \pm 1.20$ | $3.85 \pm 1.05$ | $4.38 \pm 0.83$ |
| Adaptation | 429 | $3.46 \pm 1.07$ | $3.55 \pm 1.19$ | $3.90 \pm 1.02$ | $4.33 \pm 0.85$ |

In the first phase, only the retrieval mechanism was used to generate sentences, without reranking or adaptation. However, roughly half the stories were generated using query terms based solely on unigrams (601 stories) and the other half using bigram phrase queries (567 stories). In the second phase, a bigram retrieval model was used to collect 443 stories that included the reranking component and 429 stories that included the full adaptation component.

After the two story collection phases were complete a new batch of HITs were published to Mechanical Turk to obtain a separate set of independent judgments about the stories, using an analogous set of questions. Each story was rated by a maximum of 8 unique raters in order to provide more reliable statistics for each story and model. Additionally, as a baseline, a little more than one hundred stories from our held out weblog story corpus were included in the mix.

The results of the authors' subjective ratings on their own stories is presented in Table 1[2]. Considering only the usability and the entertainment ratings, these results are very encouraging. The usability of the system increases for each of the models tested and there is a dramatic increase when the reranker is introduced. Similarly, the introduction of the reranking system significantly improves the enjoyment the users have in writing their stories. Looking at the coherence and believability measures are not as clear cut, however, and there is actually a slight decrease in coherence from the Bigram to the Reranking model. The reasons for this are not fully understood but will be discussed later in this section.

In addition to subjective ratings obtained by the story authors, several objective statistics about the stories can also give us a better understanding of the characteristics of each model. Some of these statistics are presented in Table 2[3]. **Max** is the maximum story length (in total sentences) that was written with the model, while **Avg** is the average total number of sentences $\pm$ the standard deviation. Although the reranker was able to pick out the user's selected sentence after it had been selected (see section 2.3), the mean reciprocal rank **MRR** statistic shows that it is not able to predict which sentence the user will pick. The **Time(s)** is a measure of how long it took for the user to accept the HIT until they submitted their results and **(s)/Sen** is a similar measure normalized by the length of the story. Despite writing slightly longer stories, it actually took

[2] $p < 0.05$ ($\chi^2$) between the reranking and retrieval-only models for everything other than Coherence and Believability.

[3] $p < 0.05$ (t-test) between the the retrieval and the reranking models for the time based statistics.

**Table 2.** Story authoring statistics

| Model | Max | Avg | MRR | Time(s) | (s)/Sen |
|---|---|---|---|---|---|
| Unigram | 27 | $9.41 \pm 2.31$ | $0.36 \pm 0.30$ | $460.6 \pm 411.8$ | $44.9 \pm 32.0$ |
| Bigram | 25 | $9.50 \pm 2.51$ | $0.34 \pm 0.29$ | $492.4 \pm 463.7$ | $47.9 \pm 35.6$ |
| Reranking | 27 | $9.53 \pm 2.68$ | $0.28 \pm 0.07$ | $399.2 \pm 294.3$ | $40.1 \pm 22.8$ |
| Adaptation | 36 | $9.63 \pm 3.07$ | $0.23 \pm 0.04$ | $406.1 \pm 286.5$ | $39.3 \pm 20.6$ |

the users much less time to complete. Given that the quality of the stories from the authors perspective over all the models are at the very least on par with each other, this seems to suggest that the reranking and adaptation models are returning a set of sentences that are easier to choose from.

The subjective ratings from the authors' perspective and the objective statistics about the stories start to shape our understanding of these different models are operating. However, some doubts remain because of the somewhat contradictory results in which the user's rated the stories equally coherent, yet found the reranking based systems much more usable, entertaining and easy to write. Examining the judgments of independent raters can provide a different perspective and are presented in Table 1[4]. To account for a slight bias toward lower ratings introduced by a combination of dishonest workers and the layout of the rating form, the average rating for each of the models was performed in the following way. Each story only contributed one rating to the average over all stories in the model, which was determined by the rating with the most votes. If there was no single winner then an average of the tied values was used. On the left side of the graph is a baseline of completely human written stories. These are complete stories entirely written by a single human from a held out portion of our weblog corpus described above. Although it would also be interesting to compare our system to a human-to-human collaboration, our baseline provides an adequate upper-bound for coherence at a minimum. These human authored stories achieved a 3.9 Coherence, a 4.1 Believability and a 2.9 Entertainment value. In contrast, the readers found the stories written with the Unigram model much less coherent (3.4), believable (3.5) and entertaining (2.7). Although using bigram queries improves the situation a little bit, the reranking based model is less than 0.1 points away from human written stories in coherence, which has reduced the gap to the upper bound by 82%.

These results, along with several of the author ratings and story statistics clearly show the reranking based model generates a better set of candidates, which result in stories that are nearly indistinguishable from personal stories found on ordinary people's weblogs. However, this does not resolve why authors did not rate their own stories more coherent when using these models even though other indicators suggest they do. One possible explanation supported by this data is that the authors are using a different definition of coherence than was originally intended. Unlike

[4] $p < 0.05$ between the retrieval-only models and the reranking model for Coherence. $p > 0.05$ between the human stories and reranking model except for Believability.

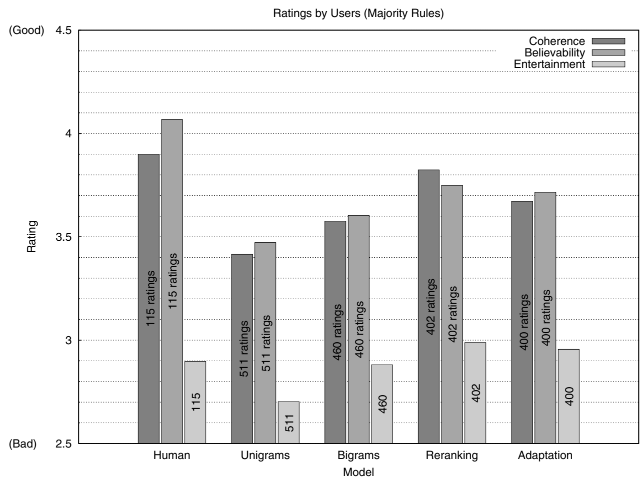


**Fig. 1.** Independent story rating results (1 to 5)

independent readers, the authors enter into each turn with an agenda. Regardless as to whether any of the candidate sentences continue the story in a linguistically or logically coherent way, the user may still feel a disconnect between what they wanted to say and what their available options are and rate the coherence lower than an objective outside observer would do.

## 4 Conclusion

In this paper we have furthered the open-domain interactive storytelling paradigm developed by Swanson & Gordon by addressing some of the major shortcomings of their system. Unfortunately, the adaptation component was not able to provide additional performance, but its potential benefits are worth exploring in future work. However, the machine learning approach to reranking candidate sentences enabled us to more accurately balance the weight between local context (a sentence) and broader context (an entire story), which was not previously possible. Additionally, this approach supplies a unified and well founded way to include other arbitrary features to improve the quality, such as the discourse coherence features discussed in section 2.3. Using data obtained from a trace of the system provided enough training data for our reranker that it was able to allow users to author stories with our system that were nearly indistinguishable from entirely human written stories.

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# Something's Gotta Give - Towards Distributed Autonomous Story Appraisal in Improv

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**Abstract.** One can see interactive Storytelling (IS) as a process where participants and system (through its setting, characters and events) cooperate in order to converge towards a good story experience. The notion of good story experience is very subjective and controversial, not only because it's directly related to participants' sense of logical and chronological sequence but also to their model of human experience [22]. Recent IS research inspired by improvisational theatre (improv) has taken this problem to a new level where the IS process occurs in extremely dynamic environments. In this paper we approach the theoretical groundings towards the design of a story appraisal mechanism for autonomous agents in an improv environment.

**Keywords:** Interactive Storytelling, Improv, Autonomous Agents.

## 1 Introduction

One can see interactive Storytelling (IS) as a process where participants and system (through its setting, characters and events) cooperate in order to converge towards a good story experience. The notion of good story experience is very subjective and controversial, not only because it's directly related to participants' sense of logical and chronological sequence but also to their model of human experience [22].

Considering story convergence as a satisfying agreement over story development between an IS system and its participants, we observe that story convergence has been pursued in many different ways. Previous attempts to pursue this explored: the use of strongly supported and detailed character behavior [7]; mediation techniques to directly manipulate characters inner state, world state and interaction state [24]; manipulation of event outcomes or re-planning [25]; representing story content in dynamic clusters of detailed story units [16] or in conditioned episodes [10].

A direct consequence of the approaches mentioned above is a process where the user is led to believe on the impact of his perspective on story content and outcome, originating a sense of agency [19], when in fact his behavior has been predicted in authoring time. In this case we can say that convergence is achieved when the system reaches a satisfying balance between two forces: 1 - the user willingness to accept the logics of the story world, and to create expectations over it; 2 – the system's ability to detect and adapt to user expectations maintaining story consistency from an authorial perspective.

R. Aylett et al. (Eds.): ICIDS 2010, LNCS 6432, pp. 198–203, 2010.

In a conceptual perspective this mechanism of balancing expectations between a creator and his audience, is not new to other story media whose theory supports some of the above approaches. In the Art of Dramatic Writing [9] Egri tackles this issue defending that every good story must have a clear central premise, a driving force that motivates a consistent story movement and captures audience attention. In film writing McKee recurs to the principle of Creative Limitation [18] to defend that story consistency is related with the creation of limited and very strict story worlds, with few characters and well-defined rules and relations. This limitation allows the audience to detect the forces that move the story in a very clear way and engage with it. Ryan also addresses this issue by stating that a narrative "isn't just an evocation of a sequence of events but also of the world in which the events take place" [13].

This line of thought seems straightforward if we approach story development from a well-defined solid story world, but what happens when we consider dynamic story worlds?

Improvisational Theatre (Improv) is a current object of study for Interactive Storytelling research [1], [8], [23], [5], [6],[11], [16] where this mechanism is also present. When players make offers to each other they are not only adding content but also cues about their own expectations to a play. When they accept offers from other players they are looking to converge expectations with their partners. The main difference in the case of improv is that because the story world is being created at run time, new forces emerge in this world, and sometimes a player detects several different possibilities to continue the story and has to decide which event would make a better story.

In our research we've been addressing this issue from an autonomous agent perspective. We want to create autonomous improv agents, autonomous agents specifically designed to act as players in an improv scenario that can build up character, a story world, and achieve story convergence. In this paper we propose a theoretical grounding for a story convergence mechanism that would endow autonomous agents with the ability to evaluate story development in a dynamic story world according to a model of story expectations. The aim is to allow characters to evaluate the state of a story while it emerges, and decide the best actions to execute in order to achieve a better story convergence with other participants.

## 2 Related Work

To create a story appraisal model we need to define two major elements: an instant insight in the story elements, which we call a *story state* representation, that encodes the story values at any slice of time; and the *story evaluation* metrics that are used to appraise the current *story state* or sequence of *story states* similarity with the author's intentions.

In early approaches based on optimal searches over directed acyclic graphs (DAG) [5], [24] each story state corresponded to fixed plot points associated with predefined values given by the author. Once optimized, these approaches didn't offer much on line flexibility to user actions. The evolution to planning based approaches, such as IDA [4], introduced more flexible story representation models where plot events included logical preconditions that used dynamic variables. These approaches enabled dynamic features such as: on line re-planning [25] to include user interventions; discourse level manipulation to generate suspense and surprise [8]; on-line story manipulation according to each character's perspective [21].

Most of the authoring effort of the above mentioned work relied mainly in causation at an action level, ordering events and keeping track of the state of story existents. In FAçaDE [17] the authors enriched this story representation with the inclusion of character values, such as love, hope or anger. In this case, clusters of story beats designed to affect the characters values, directed the story towards tension development and resolution. Some subsequent approaches brought the use of other story values out of the action level to their story representation. Pizzi et al. [20] recurred to the author notes in the literary original versions of the stories to encode the characters emotional values in the story state. The affective model used in FearNot!'s [3] autonomous characters included 21 emotions that that were used to generate behaviors consistent with the characters affective state. Louchart's Double Appraisal Mechanism [1] extended this architecture with a module that calculates the emotional impact of an event in other characters, and used it to select actions based on this impact. Also the I-Shadows [10] system used the affective user input and the emotional state of its characters as a measure for the story development. Summing up, IS research as covered pretty much of the existents and events in story space, as well as some story values in story state representations, in stories with well defined story spaces and settings. However, most of this research did not approach the problems posed to these representations by more dynamic story environments such as improv environments.

## 3 Essential Elements for Representing Story State and Perspective in Autonomous Improv Agents

Specificities of *autonomous improv agents*, such as, their independence, dynamic character and story setting build up, story space redefinition, hinder straightforward conversion of the story state representations and processes presented earlier. In this section we propose a set of possible concepts and metrics to use in such a particular scenario.

### 3.1 Consistency

In common interactive storytelling, among other things, the author seeks to define a consistent story world for the user interaction. This way he assures that some logic and comprehension is achieved by establishing causality links between future and past events. In improv approaches, story world and story space are in constant change, consequently story consistency is permanently under pressure. One way of looking for consistency is to calculate causality links between events. We propose that, an improv agent should be able to evaluate at each step the current story consistency, as a function of the inverse relation between the number of consistent events (events that have non-contradictory causality links established with passed events), and the total number of events occurred ($\{E\}$). Further, we propose that measure of relevance for each event should be used to weight the value of each event (1) (2).

$$E_n = \{event_0, event_1, ..., event_n\} \tag{1}$$

$$\text{Consistency}(E_{t=n}) = \frac{\forall \textit{consistent Event} \in E_{t=n} \sum_{i=0}^{n} (relevance_i)}{\forall event \in E_{t=n} \sum_{i=0}^{n} (relevance_i)} \tag{2}$$

### 3.2 Relevance

Relevance is probably the most subjective element to consider in this context, but it isn't new in interactive storytelling. Louchart et al. [2] tackled this issue with the concept of dramatic impact. In this work each autonomous character planning process included an evaluation of the emotional impact of a personal action in each of the other autonomous characters. This approach only considered the personal actions directly performed by the character role played by the autonomous agent, which is not enough for an improv agent, because improv agents build their own character, other characters and story world on the fly. It seems to us that an improv agent should be able to reason and act beyond character scope, adding elements to story world and to its own character build up.

Establishing a measure of relevance for story events can be a very subjective matter. It is our belief that event relevance is related to the impact that the event has on a story world, and consequently the impact that it has on story space consistency and on character state(3).

$$\text{relevance}(\text{event}_i) = \text{consistencyImpact}(\text{event}_i) \times \text{characterStateImpact}(\text{event}_i) \tag{3}$$

**Consistency Impact.** We argue that *relevance* is directly related to the impact that an event has on the consistency of past events; the more it affects consistency the more important it becomes. This is different of stating that relevant events diminish consistency, because it also states that events that affect consistency in a positive way are important. Also due to the specific nature of continuous story space manipulation, the *consistency impact* should be a dynamic value reevaluated at each story step (4).

$$\text{consistencyImpact}(event_{t=i}) = \left| consistency(E) - consistency(E \setminus \{event_i\}) \right| \tag{4}$$

**Character State Impact.** Previous work on improv agents [12] used the theory supported concept of character *status* [14] to affect each character's story planning in a master servant scenario. Story world events may affect this property, but not only, they can also affect the story world state and consequently the character's *affective* state resulting from his appraisal of the new world state. Implicitly related with status is also the type or *relation* established between characters. For the sake of paper objectivity we will not address a deeper analysis of a model for interpersonal relations in an improv context, we will just focus on the need to represent and evaluate these relations.

A function of Character State Impact should consider the impact that the event has on character status, affective state and relations (5).

$$\text{characterStateImpact}(\text{event}_i) = \text{var}(\text{status}) + \text{var}(\text{relations}) + \text{var}(\text{affectiveState}) \quad (5)$$

## 4 Conclusions and Future Work

The quest for creating autonomous improv agents able of reasoning about good story development is still in a very initial phase. This work was focused on defining a theoretical grounding that supports our approach to some of the challenges that this quest presents.

Assuming that the selection of elements to add to a story is related to its consistency and its impact on the story elements, we propose a model that identifies two major variables for evaluating story convergence that we name relevance and consistency, as well as the metrics for each these variables, and supported these with theoretical background.

For the moment consistency and relevance implementation is dependent of the definition of our characters inner state representation. Our next step is to design and implement an architecture for autonomous improv agents that considers a representation of relations, status and affective state that can feed the metrics presented in this paper. We also expect to use the results of this implementation as the input for a story convergence cooperation mechanism between autonomous improv agents.

**Acknowledgements.** The research leading to these results has received funding from European Community's Seventh Framework Program (FP7/2007-2013) under grant agreement n 215554, and by scholarship SFRH/ BD/ 37476/ 2007 granted by FCT.

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# A Simple Intensity-Based Drama Manager

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**Abstract.** We have implemented an action-based role-playing game, called Wind's End, that incorporates a simple, practical algorithm to enforce rising dramatic intensity during game play by controlling the choice of goals by nonplayer characters.

**Keywords:** story generation, drama management, demonstrations.

## 1 Introduction

As a contribution to the field of drama management, Wind's End is a small, but practical step forward. Given an existing goal-based action game, organizing the goals into pre-defined intensity levels is an easy-to-understand concept for authors, and the drama management algorithm is straightforward and degrades gracefully.

Most other work on drama management is much more ambitious than ours. Other drama managers have used a variety of sophisticated AI techniques, including planning [6], optimization search [3], case-based reasoning [5], reinforcement learning [4] and player modeling [2]. In comparison, our approach is extremely cheap and simple, but provides a definite benefit.

## 2 Wind's End

In order to explain the examples of our drama manager in operation, we need to introduce a little bit of story content. Wind's End Bastion is a medieval town suffering a severe drought. The basic story dynamic is a competition between various factions (militia, cult, thieves, goblins, etc.) for resources and the allegiance of the townsfolk. Each faction has a leader: Sir Neil Riese leads the militia; the beautiful Mistress Anne Sidora leads a cult who believe the drought is due to the lack of proper rituals to the fertility goddess; George Emmor, leader of the thieves, believes that the militia is responsible for the lack of food; the goblins, led by Nak Brightfeather, have begun to steal food from local farms. Other prominent townsfolk also participate in the action (see example story in Fig. 3).

The player is an adventurer who arrives in town at this highly charged moment in its history. The player can move around in the environment and interact with

R. Aylett et al. (Eds.): ICIDS 2010, LNCS 6432, pp. 204–209, 2010.


**Fig. 1.** Screen shot of Wind's End game

other characters through combat and conversation. Wind's End is implemented as a Warcraft III "mod" (see Fig. 1) and uses the Warcraft III combat system. We also implemented, but cannot describe here, a novel mini-game that provides rich and flexible conversation between characters without requiring open-ended natural language understanding. Both the combat and the conversation system are supported by a typical statistics-based representation of traits, moods and relationships (e.g., character x *likes* character y to a degree between -10 and +10), the details of which are not important here.

## 3 Goal-Driven Architecture

Each nonplayer character is autonomous and is controlled by a goal-driven architecture similar to the one described in Chapter 9 of [1], which has three main functions: selecting goals, decomposing goals into subgoals and actions, and executing actions. Of these, goal selection is the most relevant here. In Wind's End, each goal has a *desirability* function that returns a number between 0 and 100 indicating how desirable it is for the given character to undertake the given goal at the current time.

In the absence of a drama manager, the goal-driven architecture for each character simply loops through all the character's potential goals and selects the one with the highest desirability value. This goal is then decomposed into subgoals and eventually actions, which are then executed. Actions include moving around in the world and interacting with objects, as well as fighting or exchanging information with other characters.

The player's interaction with characters and the environment affects the values returned by the desirability functions of various goals, thereby changing the flow of the story. Even if the player does nothing, some sequence of events will always unfold in Wind's End, due to the goals of the autonomous characters. However, the problem is that, even with a lot of story content (as sketched above), these events do not usually add up to a dramatically satisfying experience for the player. Typical difficulties with this kind of totally autonomous goal-driven architecture include either too few or too many interesting things happening at the same time, and the interesting events not happening where the player is currently located. The drama manager, described in the next section, is designed to address these difficulties.

## 4 Drama Manager

The basic idea of the drama manager is to enforce a rising arc of dramatic intensity. The first step in doing this is to assign an *intensity* value to each character goal. This value is usually a constant, but can in general be computed by a function associated with each goal. Table 1 shows the six-level dramatic intensity scale used in Wind's End, along with a high-level description of the types of goal at each level. The game starts at level zero and progresses through to level five as described below. These six levels are not based on any narrative theory we know of, but rather our first ad hoc attempt to implement the idea of intensity levels. In retrospect, we would probably collapse levels three and four, because we often had a hard time deciding between these two levels for specific goals.

Table 2 shows the intensity values for some sample goals for various characters. Notice that some goals, such as going home, are used by multiple characters. In total, the Wind's End characters use over fifty different goals.

**Table 1.** Dramatic intensity scale in Wind's End

| | | |
|---|---|---|
| **0** | OPENING | doing nothing important |
| **1** | BUILDING | prepare situation |
| **2** | SERIOUS | set events in motion |
| **3** | HEATED | complete an objective |
| **4** | INTENSE | town threatened |
| **5** | CLIMACTIC | final confrontation |

**Table 2.** Example goals and intensities

| *Character* | *Goal* | *Intensity* |
|---|---|---|
| | go home | 0 |
| | get drunk | 0 |
| Neil Riese | attack goblins | 2 |
| | assassinate faction leader | 4 |
| Anne Sidora | recruit cult member | 1 |
| | summon goddess | 5 |
| George Emmor | steal food | 1 |
| | steal sacred relic | 3 |
| Nak Brightfeather | overrun farm | 3 |
| | breed rapidly | 3 |

```
1  if it is time to increase intensity
2      then
3          intensity ← intensity + 1
4          if intensity ≤ 2
5              then limit ← intensity − 1
6              else limit ← intensity − 2
7          protagonist ← null
8  Sort characters in descending order of importance
9  max ← 0
10 foreach character
11     if character = protagonist ∨ protagonist = null
12         then
13             i ← selectGoalMax(intensity)
14             if i = intensity then protagonist ← character
15         else i ← selectGoalMax(limit)
16     if i > max then max ← i
17 if max < intensity
18     then
19         foreach character
20             if selectGoalOnly(intensity)
21                 then
22                     protagonist ← character
23                     exit
```

**Fig. 2.** Drama manager goal selection algorithm

The drama manager operates by replacing the default goal selection policy of the goal-driven architecture, i.e., always choosing the most desirable goal for each character, with a policy that allows at most one character to have the currently most intense goal at any moment in time, and incrementally ramps up the intensity of that highest goal. Fig. 2 shows the pseudocode for this algorithm, which has three key state variables:

– *intensity* - highest intensity currently allowed
– *protagonist* - character that currently has the active *intensity* goal
– *limit* - highest intensity currently allowed for non-protagonist characters

Two other key concepts in the algorithm are the time to increase intensity (see line 1) and the current importance (see line 8) of each character.

By default in Wind's End, the highest allowed intensity is increased based on a timer: 1 minute for OPENING, 2 minutes for BUILDING, 3 minutes for SERIOUS, and 5 minutes each for HEATED and INTENSE. The timer is adjusted, however, whenever combat or conversation occurs. Combat advances the timer more quickly, causing the next increase in intensity to happen sooner. The timer is stopped during conversation mini-games, but then a fixed advance is added at the end of the conversation, so that the more conversations the player has, the more quickly the story will evolve. The game has been designed overall for a typical play-through of 15 to 20 minutes.

Notice on lines 5–6 that the gap between the highest intensity allowed the protagonist versus non-protagonist characters is increased to two near the end of the game to prevent overwhelming the player with dramatic action.

The concept of character importance mentioned in line 8 is not primarily about the relationship of the character to the plot, which could be complicated, since the plot typically differs with each game play. Character importance here primarily addresses the problem of making interesting events occur in the vicinity

OPENING

Player successfully praises self to blacksmith.

BUILDING

Neil Riese tries to recruit innkeeper.
Player successfully slanders milita to innkeeper.
Neil Riese fortifies town.
Player successfully recruits Neil Riese to player faction.
Anne Sidora tries to recruit Jonathan Mostan.
Player successfully slanders cult to Jonathan Mostan.
Player successfully recruits Meredith Neinir to his party.

SERIOUS

Player and party go to lower town.
Player and party are attacked by Rissa Emmor.
Goblins attack the farm.
Player kills Rissa Emmor and fights off townsfolk.
Anne Sidora sends cult to lower town.
Player and party go to farm.

HEATED

Player engages in combat with Nak Brightfeather.
Cult attacks the forest.
Anne Sidora tries to recruit townsfolk.
Nak Brightfeather is killed in combat.

INTENSE

Townsfolk capture the farm.
Thieves attacks the upper town.
Player and party go to lower town.
Player follows Anne Sidora around.
Thieves attack the castle.
Neil Riese leaves player party and resumes position as milita leader.
Militia defends the castle.
Cult goes to the mountains to attack thieves.

CLIMATIC

Anne Sidora tries to summon the demon goddess.

Thieves attack the castle.
Anne Sidora killed by shopkeeper.
Thieves attack lower town. Player killed by thieves.

**Fig. 3.** Example of actual game play annotated with drama levels

of the player. The importance of a character is increased by being geographically near the player or having been recently been in combat with the player. (There is also a small importance bonus for characters being the leader of a faction.) The sorting on line 8 gives the characters closer to the player a better chance of becoming the protoganist.

The drama manager algorithm has two main loops. The first loop, on lines 10–16, is similar to the default goal-directed architecture selection loop, except that for each character, goals with intensity above a given maximum are ignored. The *selectGoalMax* function takes the maximum and returns the intensity of the most desirable goal selected.

The second loop, on lines 19–23, is only invoked when the protagonist fails to choose a goal with the maximum allowed intensity (because none are possible). This loop looks for another character that can become the new protagonist. The *selectGoalOnly* function ignores all goals that do not have exactly the intensity value provided and returns a boolean indicating if it selected a goal. Note that if no new protagonist is found, the behavior of this algorithm essentially degrades to the default goal selection policy.

## 5 Conclusion

Wind's End was play tested for four weeks by fifteen players of varying ages and gaming abilities, with many radically different stories emerging. Fig. 3 is a manually transcribed log of one such game play with the intensity transitions indicated. We believe we have successfully demonstrated how to achieve some degree of drama management with a very simple addition to a conventional goal-based architecture. On the other hand, a single rising arc of intensity is a simplistic story model. It remains to be seen whether it is possible to add intensity dips and peaks and a denouement without being forced into a fundamentally more complex approach.

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# Player Agency and the Relevance of Decisions

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**Abstract.** While many forms of storytelling are well-suited to the domain of entertainment, interactive storytelling remains unique in its ability to also afford its audiences a sense of having influence over what will happen next. We propose that the key to encouraging such feelings of agency in interactive stories lies in managing the perceived relevance of the decisions that players make while they play. To this end, we present the design of a system which automatically estimates the relevance of in-game decisions for each particular player, based on a dynamically learned model of their preferences for story content. By actively choosing among several potential consequences of a given player decision, the proposed system highlights the relevance of each decision while accommodating for its players' preferences over potential story content.

## 1 Introduction

Agency, being the ability to change the course of one's experience, has been found to promote well being in daily life [6], and is a central aspect of video games. Current commercial video games provide a certain type of agency, agency from gameplay, very well; by skillfully manipulating a game's input device, players can explore virtual environments, interact with virtual characters, and overcome challenges as they arise. In the field of Interactive Storytelling, one of the central concerns since its inception has been to provide agency of a different sort: agency from story [10]. Going beyond having players choose their responses to a particular sequence of events, efforts in interactive story generation aim to automatically build a set of many *possible* sequences of events, toward allowing the player's choices to determine which sequence is shown [1,5,8,9].

Is only *providing* players with agency via gameplay or story sufficient to induce strong feelings of control over their experience? Consider the distinction between two phenomena: *theoretical agency*, as one's (objective) ability to change the course of their experience, and *perceived agency*, as one's (subjective) perception of their ability to make such changes. Much research in story generation has focused on finding ways to efficiently provide the former, but always with the implicit assumption that doing so will effectively elicit the latter [5,8].

In this paper, we challenge this assumption, drawing on research in the field of Social Psychology to suggest that maximizing the perceived agency of players

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requires more than providing theoretical agency alone; the desirability of the consequences of player actions must be carefully considered as well. We propose an online algorithm to automatically learn these desires for any given player, and describe a new event-selection routine that dynamically estimates the relevance of each player decision toward increasing the agency of its players.

## 2 The Control Heuristic

Proposed as a way to model how individuals estimate their degree of control over the occurrence of given outcomes (i.e., perceived agency), the control heuristic was derived by Thompson et al. from an extensive synthesis and unification of prior experimental results [6]. According to the heuristic, one's judgement of control is influenced by two primary factors: their *intention* to achieve the outcome that occurred, and the *connection* that they perceive between their action and its outcome. Intentionality is influenced by three sub-factors: the *foreseeability* of the outcome, one's *ability* to make the outcome occur, and the *desirability* of the outcome for that particular person. If a desirable outcome can be foreseen and one seems capable of achieving it, then intentionality is strongly inferred; the strength of this inference decreases if any of these conditions are not met [6]. Connection is judged in terms of two subtypes: *temporal*, which is stronger the more times a desirable outcome has been observed to occur after an action was taken, and *predictive*, which is stronger when the outcome that occurs was predicted to follow from the action that was taken [6].

Framing Thompson et al.'s work in terms of maximizing the agency perceived by players, it seems that four conditions must necessarily be satisfied for the maximum to be obtained: *foreseeability*, *ability*, *desirability*, and *connection*. These conditions indicate that simply providing players with theoretical agency might *not* be enough to ensure that their agency is effectively perceived: while theoretical agency does grant players the ability to achieve various outcomes and (presumably) also demonstrates temporal connections (*ability* and *connection*), relatively little research to-date has explored how to ensure that the outcomes of player actions are both *foreseeable* and *desirable*. We propose a mechanism designed to address the second of these two conditions, that is, to ensure that the outcomes of player actions are desirable for the particular current player.

## 3 Related Work

In recent years, an increasing number of commercial video games have granted players the ability to cause multiple story-relevant outcomes [3,4]. The manner in which they do so, however, seems to be restricted to satisfying players with a particular set of preferences; there is no apparent consideration of which outcomes might be more or less desirable for each specific current player.

In the context of Interactive Storytelling, *GADIN* [1] constructs stories as sequences of difficult player decisions, but its method for selecting subsequent decisions is driven by static, author-defined annotations concerning a general level of interest in each surrounding event. Similarly, *Marlinspike* [9] relies on static annotations concerning the importance of each player action, toward choosing which actions to reincorporate into later story events. Although both systems attempt to provide consequences for player actions, they assume that all players share the same values of interest or importance for each event; we contend that this is not always the case. Mateas has proposed that players perceive agency when a balance exists between two sources of constraints on player actions [2]: the plot of the story (social situations constrain *probable* actions), and the elements of the environment (physical situations constrain *possible* actions). While Mateas' work mirrors the message of the Control Heuristic in terms of *foreseeability* and *ability*, it may yet be improved by considering *desirability* as well. Previous user studies conduced with *PaSSAGE* [7,8] have shown that automatic story adaptation can improve perceived agency for particular subgroups of players, and we extend that work in the sections that follow.

## 4 Proposed Approach

Interactive experiences are often conceptualized as a tree of possible states of the environment in which they occur [1,8,9], where nodes further from the root occur later during the course of the experience. Nodes represent possible states of the world, and each edge represents the execution of a decision made by either the director, being an Artificial Intelligence system designed to manage the experience (e.g., [5,8]), or the player. To manage the experience, directors are often able to create, destroy, and change the state of virtual objects in the environment (including virtual characters), as well as initiate story events.

Events in our proposed system are adapted from the *encounters* used in PaSSAGE [8], and can be well thought of as subtrees of the tree that makes up the entire interactive experience. Figure 1 shows examples of two events. Each leaf node of an event's subtree represents an alternate outcome for the event

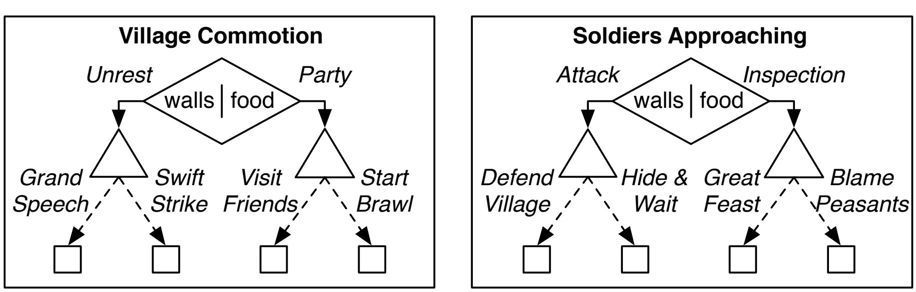


**Fig. 1.** Two potential events: VC and SA. Triangles are player decisions, dashed arrows are player actions, diamonds are director decisions (based on a prior player decision), solid arrows are director actions, and squares are potential outcomes.

(squares). Edges within an event represent either actions taken by the player (dashed arrows), or actions taken by the director (solid arrows). Players take actions in response to decisions that they are presented with (triangles), and the director takes actions to modify the current event in response to a decision made by the player during some *earlier* event in the story (diamonds). These director decisions divide each event's subtree into two or more components, which we refer to as *sub-events* (*Unrest*, *Party*, *Attack*, and *Inspection*). Labels on arrows describe their actions, and labels in diamonds describe the prior player decision being tested. To illustrate, consider the following hypothetical scenario.

*"As the leader of a large village, the player is faced with a dilemma. Rumours abound that bandits in the area have been gathering their numbers to launch an attack, but the village's walls are in a poor state of repair. The walls can be mended for a price, but the state's resources are very low, and the current drought has left the local peasants with very little to eat. Supplemental shipments of food can be ordered from the neighbouring provinces, but the cost of doing so is high. There is enough gold to spend on either the walls or the food, but not both; the player must choose between them."*

When choosing an event to occur in the future, the director could have two options, each having two sub-events to select from based on what the player chose to do. For example, one event might involve some commotion in the village that requires investigation, and another might involve reports of soldiers approaching the village walls (VC and SA in Figure 1). If the player chose to repair the village walls instead of feeding the peasants, then the commotion in the village would be the beginnings of a peasant revolt (Director Action (DA): *Unrest*), while the soldiers approaching would be bandits intending to attack (DA: *Attack*). If the player chose to feed the peasants, then the commotion would be the beginnings of a party in the player's honour (DA: *Party*), and the soldiers approaching would be the king of the land arriving to conduct an inspection of the village (DA: *Inspection*). The director's choices of sub-events (*Unrest* versus *Party*, or *Attack* versus *Inspection*) are determined entirely by the player's choice between repairing the village walls or ordering food for the peasants; this design provides all players with a non-trivial amount theoretical agency. The director's decision among *events*, however, is the means by which our proposed system aims to maximize the perceived agency of its players.

### 4.1 Using Desirability and Relevance to Increase Perceived Agency

Our general strategy is to use the Control Heuristic (Section 2) to improve players' perceived agency. Given its design toward estimating an individual's sense of control over a single outcome, we treat each sub-event as a potential (long-term) outcome of a prior player decision (e.g., walls vs. food in Figure 1). According to the Control Heuristic, perceived agency will be increased when players desire the outcomes (sub-events) that occur as a result of their actions.

**Desirability:** In *PaSSAGE*, the desirability of potential player *actions* is annotated by authors in terms of inclinations toward five different styles of play:

'Fighter' (F), 'Method Actor' (M), 'Storyteller' (S), 'Tactician' (T), or 'Power Gamer' (P) [8]. *PaSSAGE*'s underlying assumption is that each player can be modelled as a mixture of such inclinations, and that players' enjoyment can be increased by providing them with opportunities to play (i.e., take actions) according to their modelled styles. Taking *PaSSAGE*'s prior success with empirical evaluations as evidence supporting this assumption [7], we have adopted the same player modelling scheme, and so we define desirable sub-events as those which allow players to play in their modelled styles.

Leveraging PaSSAGE's automatically learned player model as well as its calculation of "encounter quality" [7], we propose that the desirability of each sub-event, $e$, can be calculated based on an inner product between two vectors: the current play-style inclinations in the player model, and the author-provided annotations on each of the sub-event's potential player actions (Equation 1).

$$desirability(e) = \max_{a \in Actions(e)} [PlayerModel \cdot Annotations(a)] \tag{1}$$

To illustrate, for the sub-event *Unrest* in Figure 1, we compute inner products between the player model's vector of inclinations (e.g., [F20,M10,S15,T0,P0]) and each player action's vector of annotations (*Grand Speech*: [F0,M1,S4,T0,P0] and *Swift Strike*: [F4,M0,S0,T2,P0]). Maximizing over the results $(\max(70, 80))$ then provides the desirability of that sub-event ($desirability(Unrest) = 80$).

**Relevance:** Using the above method to measure the desirability of the outcomes of player decisions, we propose that managing such desirabilities can be well thought of as highlighting the *relevance* of the decisions that players make while playing. Specifically, we define the relevance of a decision as the degree to which it affects the player's ability to experience desirable sub-events during the course of her experience. Given a particular player decision, $d$, (e.g., 'walls versus food'), we propose that its relevance with respect to a given event, $E$, can be estimated by the absolute value of the difference between the desirabilities of the sub-event within $E$ that it enables, $e^+$, and the sub-event within $E$ that it disables, $e^-$ (e.g., in Village Commotion (VC), 'walls' enables *Unrest* and disables *Party*).

$$relevance(d|E) = |desirability(e^+) - desirability(e^-)| \tag{2}$$

Whenever the director must choose a subsequent event, it calculates the relevance of every event that uses $d$ to distinguish between its sub-events (e.g., both events in Figure 1 use $d =$ 'walls versus food'), and chooses the event with highest relevance that also provides a desirable sub-event (i.e., $desirability(e) > 0$). Continuing our example, suppose that the player chose to rebuild the village's walls. The relevance of the two events in Figure 1 would then be computed with respect to this decision, as shown in Equations 3 and 4.

$$relevance(\text{walls}|\text{VC}) = |desirability(Unrest) - desirability(Party)| = 50 \tag{3}$$

$$relevance(\text{walls}|\text{SA}) = |desirability(Attack) - desirability(Inspection)| = 30 \tag{4}$$

Given that *desirability*(*Unrest*) = 80 (which is positive), the director would choose ‘Village Commotion’ (VC) as the event which best highlights the relevance of the player’s decision, while still providing an outcome that she in particular will desire. According to the Control Heuristic, she should experience increased perceived agency as a result. More formally, we hypothesize that for a given interactive experience having a fixed amount of theoretical agency, proactively choosing events to maximize the relevance of player decisions while providing desirable outcomes will increase the agency that players perceive.

## 5 Conclusion

In this paper, we posed the question of whether providing players with theoretical agency is sufficient for them to perceive that it exists. Drawing on literature in Social Psychology, we challenged this assumption, and suggested that players must additionally desire the outcomes of their actions to occur. Toward maximizing the agency that players perceive, we presented a method to automatically estimate the desirability of given event outcomes, and proposed the relevance of player decisions as a useful metric for selecting subsequent events. An empirical evaluation via human user study is forthcoming which, if successful, will provide evidence that adapting to players is important for perceived agency to occur.

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# Interactive Storytelling in Academic Teaching

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**Abstract.** In this paper, we describe an approach to use storytelling in academic teaching as a means for background research to hypermedia and virtual reality topics in computer science. Interactivity within this context means selective authoring rather than immersive interaction. In contrast to existing approaches a Hypermedia Novel environment allows an iterative approach to the narrative content, thereby integrating story authoring and story reception at any time. The narrative practice and background research as well as the resulting product can supplement lecture material with comparable success to traditional academic teaching approaches. In addition there is the added value of soft skill training and a gain of expert knowledge in areas of personal background research.

**Keywords:** edutainment, story authoring, hypermedia.

## 1 Introduction

Digital storytelling is almost always discussed in terms of interactivity. While non-linearity of reception is usually not considered actually interactive, options may go from simple branching to immersive role-playing games in a simulated environment inhabited by artificial intelligence (AI) characters. Besides, interactivity in a more global view has been part of storytelling for thousands of years when educated storytellers interacted with the public, adapting not the story itself but rather the way it was told to the particular background and interests of the audience. In addition, one could argue that changing the performance of a story does actually influence the reception of its content significantly.

A flexible switch from passive reception to active authoring and back has not yet been included in the international discussion – either because this also does not fit to the purist definition of interactivity, or maybe just because it has not yet been realized. Being able to adapt the presentation of story and information to one's individual requirements is at least a kind of interactivity that should improve learning in a narrative-based edutainment environment.

The success of E-Learning often suffers from a lack of motivation for self-conducted studies [1]. Motivation, however, can be improved by making things fun and playful [2], [3], [4], [5] and the reception of a well-told narrative can result in a

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high degree of emotional involvement. Such a captivatingly told story often triggers the motivation to learn more about the background facts, especially in a historical, scientific, or technological context. Hypermedia-based E-Learning environments are well-suited to fulfill the desire for background information directly related to narrative content.

When confronted with new learning paradigms, a particular motivation threshold often prevents adults from using such E-Learning facilities effectively [6]. Although this is less true for computer science students (and therefore difficult to evaluate in the context of this study) a unit with multiple teaching channels, combining traditional and E-Learning approaches to supplement or complement each other, may offer a solution to this problem.

Active research of literature as well as demonstrations and interviews with experts instead of passive reception of educational material also enhances learning [7], [8], [9]. Authors always have to know much more about the background of a story (including the facts behind the fiction) than they eventually tell the recipient. In addition, developing narrative content is a highly creative process, filled with emotion and – maybe even more important in terms of motivation – fun.

The potential of story-authoring in educational environments has been discussed earlier [10]. Even though most digital storytelling platforms support user interaction that can change direction and outcome of the story, there is no inherent support of contributing to the story.

The integration of modular story authoring and non-linear story reception in a Hypermedia environment linking narrative and informational content seems therefore to be a promising concept for edutainment.

## 2 The HyMN Platform

As an extension to previous storytelling paradigms that combine several media, the Hypermedia Novel (HyMN) has been introduced as a generic concept for digital storytelling [11], as well as a platform for narrative edutainment applications [12], integrating different user roles like receptor, author, and publisher in a single environment.

HyMN structuring is based on a combination of serial (sequential) and parallel (alternative) structure elements or “Narration Modules” (NarMo) as semantic units [13]. A NarMo can either be atomic, representing a particular part of the story through a single media (e.g. a movie sequence or a text) or contain a sub-structure of its own.

A typical HyMN offers at least one path with short textual descriptions, supplemented and/or augmented by alternative modules using different media like audio or video sequences (or even interactively explorable 3D scenes). Due to these alternatives, several different paths lead through a single story. Branching threads offer the possibility for interactive choices that may change the plot – and also for relating information material to the story. Recipients can either choose from a pool of predefined paths for a consistent sequence of NarMos, or find their own path by navigating via a visual representation of the story structure.

A graphical interface with drag-and-drop-functionality for moving, adding, or deleting NarMos or organizing them in a path offers the possibility for everyone to instantly switch from recipient to author by producing additional NarMos and placing them at the appropriate point in the existing structure, thus contributing to a growing story universe within one's own skills and temporal limitations. It can, however, be quite tricky to do so without the overall story losing consistency. Always providing a short textual description of every NarMo that contains all its important information may help. Such a "minimum story path" is a good practice for every HyMN anyway, allowing the recipient to skip elaborate NarMos without missing relevant information.

# 3 Edutainment Experiment

## 3.1 Edutainment Concept

Students were asked to produce multimedia content for NarMos extending a given exposé. The story was designed such that topics related to the teaching content were covered by essential stages of the plot, thus requiring deeper investigation of the subject in order to tell the story consistently. Different research assignments were distributed to several groups of students. Students with less creative interest could work on the development and improvement of the HyMN platform itself.

The HyMN structure is encoded in an XML file. User Interface and Content Modules are rendered with JavaScript in a frame-based HTML context using the most widely spread platform for interactive multimedia documents available.

## 3.2 Teaching Content

The lecture subject was "Advanced Hypermedia" (AHM). Topics included, advanced hypermedia application development and immersive virtual environments (VE) as a special hypermedia interface.

**Content Units.** The teaching content (in the VE area) was related to several chapters of a science fiction story ("Butterfly dreams"), covering the following aspects of VE technology and research, like Virtual TV studios (VTV), Immersive Virtual Environments (IVE) and Human Perception and Simulators (HPS).

Apart from learning and understanding Virtual Environment technology, students were required to acquire knowledge from the areas of Hypermedia technology (including XML, compression formats for multimedia data, etc.) and Storytelling theory (including dramaturgy, seeding and revealing information, script writing, etc.).

**Teaching Channels.** Teaching content was imparted through several different channels: some topics were learned only on a theoretical basis, through research, internal workshop presentations, traditional lectures, online material, and demonstrations in research labs. Others were handled more practically, working on improvements of the HyMN platform software.

## 3.3 Learning Success

The unit was carried out in four consecutive years in a similar way with computer science students in their second last term, all with the chosen major discipline "Media Informatics". Students had to improve and supplement an existing system, starting with just an exposé in the first year.

At the end of the term the students had to pass an oral exam. The results of this exam (AHM) were evaluated in comparison to another examination of the same group of students within the same time period and an identical amount of teaching time, also in the media informatics domain (subject: "Advanced Computer Graphics" – ACG). For a comparative chart of both exam results see Fig. 1(a), showing the results of all four consecutive units as the average of 16, 11, 16, and 19 individuals, respectively, together with standard deviation. Grades go from 0.0 (fail) to 4.0 (excellent). The figure shows no significant difference between both units, indicating that traditional and innovative teaching method are equally successful.

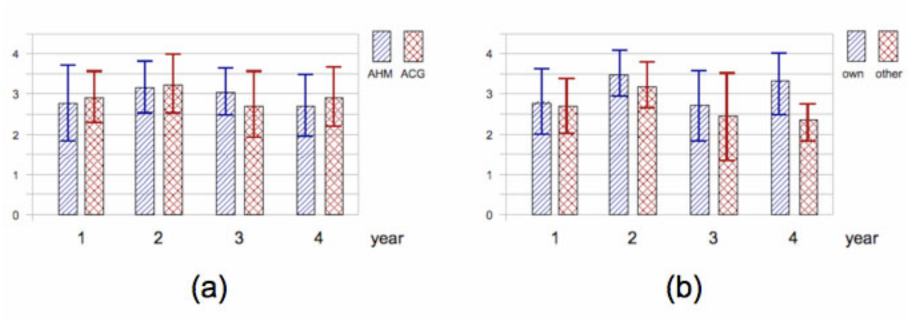


**Fig. 1.** Statistics. (a) Examination results in edutainment teaching of four units given in consecutive years, showing AHM (left) vs. traditional teaching ACG (right). Bars with standard deviation, ranging from 0 (fail) to 4 (excellent). (b) Performance in own research area (left) vs. other topics (right).

Special consideration was given to the preparation of the exam. Each content unit was rated from 0 to 4 points. The performance of the participants is given in Fig. 1(b), favoring slightly the own research topic.

### 3.4 Multi Channel Information Resources

The average evaluation results for the use of resources are displayed in Fig. 2. While the lecture material was always used as the major source of information (44%) and the portion of active research remained practically constant (17%), a tendency to more intense usage of the HyMN itself (15% to 20%) could be observed in the last evaluation period. "Other" sources were the field trips and Wikipedia.

### 3.5 Added Value

The Edutainment approach as presented here has been shown to lead to learning results neither better nor worse than a traditional academic teaching style. Possible areas of added value could be *motivation*, *efficiency*, and *soft skills*.

**Motivation.** Over the complete evaluation period about 80% of the participants expressed their preference for the described edutainment approach compared to traditional

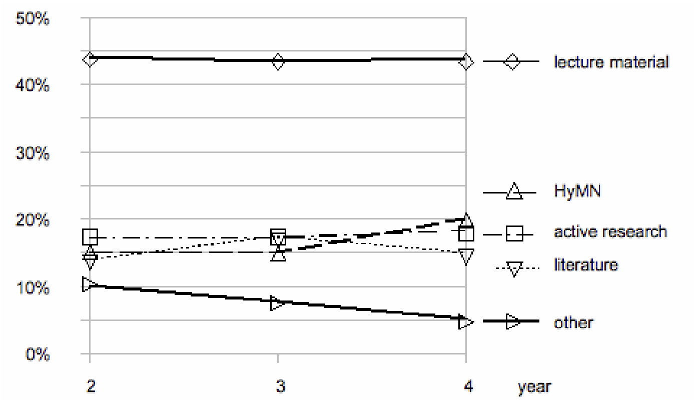


**Fig. 2.** Use of different information resources for exam preparation, varying from year 2 to 4

lecture-and-practice units. Students motivated by the edutainment subject were expected to deliberately spend more time and effort for the project than for other units in the faculty average. Such a tendency could, however, not be observed.

**Efficiency.** Although the examination results do not differ significantly from those of the compared traditional unit, here a large amount of learning content in various areas was covered. An examination on storytelling theory indicated a knowledge gain comparable to the other areas, although more focus was on the technical issues.

**Soft Skills.** It has not been evaluated yet, whether the edutainment teaching participants gained superior skills in writing as compared to other students. An evaluation of writing style in the final thesis might give an answer to this question.

## 4 Conclusions

The evaluation of comparable units over four years gives some interesting indications, although much more elaborate research will be required for reliable conclusions.

An obvious observation is that when left to their own choice, students tend to primarily use teaching material that is easily available (like lecture slides and top level links from internet queries). However, sources like Wikipedia can be replaced or complemented by hypermedia documents provided (or developed) in the unit.

The examination results indicate that this form of teaching seems to perform equally well as traditional academic teaching in terms of gaining knowledge and skills on a technical level, with some added value provided by the non-technical content (e.g. storytelling theory) learned on the way together with the training of soft skills through teamwork in a project-oriented context. However, the expected improvement of results, in particular for weaker students, as a consequence of enhanced motivation, could not be observed. This observation correlates to earlier findings indicating limitations of the applicability of "fun" as motivational source for learning [14]. Therefore there is still much potential for improvement.

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# Teaching English as a Second Language Utilizing Authoring Tools for Interactive Digital Storytelling

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**Abstract.** This paper presents first results from an ongoing research initiative to develop an interactive storytelling application to support teaching English as a second language for children in schools. Considering the necessity to accommodate to both students' and teachers' needs, we provide a summarized review of relevant systems and discuss the envisioned challenges concerning the specific aim we are addressing. Furthermore, we present different usage scenarios closely related to the concept of role playing and its application within this problem space.

**Keywords:** Interactive storytelling, virtual actors, authoring, e-learning.

## 1 Introduction

Interactive Digital Storytelling (IDS) couples dramatic narrative with users' active participation and even creation that in most cases enables high levels of engagement. It also connects game-elements with stories, utilizing inherent structural elements of both domains. IDS has also been applied in the educational domain, but technologies and concepts still need refinement in order to be effectively used in mainstream classroom settings.

In this paper we explore the possibility that second language learning can be facilitated with dedicated digital storytelling tools and applying "teaching through role-playing" methods. These are closely related to simulations and drama techniques in the Communicative Approach. All these techniques "give students an opportunity to practice communicating in different social contexts and in different social roles" [12] thus providing a genuine context for communication and making the target language more real. Research suggests that there are many benefits of using role play. Furness [11] stated that a child can enjoy and profit from a role play experience "in terms of

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improved communication skills, creativity, increased social awareness, independent thinking, verbalization of opinions, development of values and appreciation of the art of drama". Studies in using drama in English as a foreign language (EFL) teaching indicate that drama seems to foster students' language skills: speech acts [15], pronunciation and intonation [13], and discourse strategies [14].

However, the adaptation of teaching methods to new technical opportunities is a challenge, as well as the development of age appropriate user interface (UI) solutions. Our specific goal is to develop tools and concepts that would be clearly useful for second language teaching at schools. The main idea is that students will be able to develop dialogues, and possibly even storylines for virtual actors in English language utilizing an IDS framework with animated 3d characters, text-to-speech support, and corresponding authoring tools.

This paper presents our current understanding of the problem space and explores a set of different use cases, explaining the corresponding requirements in some detail. Moreover, challenges with respect to the design of an appropriate UI are discussed.

## 2 Related Work

The creation of authoring methods or generic tools for IDS, however, is still a challenge. A large number of IDS systems still provide authoring on the level of script or rule authoring only, thus requiring programming skills and restricting the group of possible authors. Most of the few systems that support a graphical editing employ directed graphs (e.g., Cyranus [5], Scenejo [1]). Other systems provide spreadsheet-like interfaces to ease entering declarative information needed by some agents (e.g., Thespian [10]). Finally, there are some examples of systems with tools for graphical programming of conditions for actions, conversational flows/dialogue states, or facts and propositions as fundamental information for planning-based approaches (e.g., [3]). There also have been several approaches to apply IDS methods and technologies in the classroom. An example in this domain is FearNot! [1], which provides children with various pre-authored scenarios about bullying behavior. However, none of the current approaches aims at facilitating authoring of dialogues as part of second language school teaching. Furthermore, no tool seems to allow for teaching method variations exploring the possibility of using both linear and branching stories depending on particular teaching goals and activities.

## 3 IDS for English Learning as a Second Language

A central objective in the field of second language learning is the improvement of comprehension and communication skills. However, while this objective is generally accepted, most students fall short to acquire the corresponding skills until leaving school. There is general agreement that the reasons for this lie in a domination of text-based speaking and teacher-student dialogues in class [8], and independent and free speaking for instance in role-playing like scenarios for a given situation are not sufficiently being trained [2]. A reason for this is that it is usually difficult to apply role-playing in a larger scale with school students, because of the organizational overhead, and because only a few students are involved at a time.

In our approach, students develop dialogues for virtual actors in English language utilizing an IDS framework with animated 3d characters, text-to-speech support, and dedicated authoring tools. Besides increasing motivation using this Edutainment-like approach, we see the following advantages:

- It helps teachers to use role-playing methods in classroom;
- Students can develop and test dialogues that are automatically correctly spoken out and enacted;
- It fosters thinking in alternatives and functional equivalences, thus arguably enhancing dialogue skills;
- It provides a means for self-directed learning.

We envisage the following usage scenarios that are all related to role playing, and that shall train the dialogue skills in English as a second language:

- **Linear dialogues between virtual actors alone** in movie-like scenes: Students create dialogues and define the behaviors of the virtual actors, similar to common text writing assignments, but with the possibility of “testing”. While interaction is restricted to the creation phase, iterative production processes are supported.
- **Interactive dialogues** between a student and virtual actors: Dialogues and their possible small variations are prepared by students, and then “tested” by other students. In this scenario, both the preparation and the interactive usage part provide learning effects. In the testing phase, input could be made via speech recognition, or alternatively with typed text.
- Dialogues performed by the students and recorded are **(semi-) automatically animated based on the speech input**. This functionality may extend the previous scenarios, stressing pronunciation and intonation training.
- **Collaborative setting**s, where dialogues are developed by a group of students. The idea is to investigate to what extent collaboration leads to the emergence of varied dialogues and perspectives increasing learners' engagement. To explore this potential the system will allow for branching dialogue structures to incorporate the different alternatives and perspectives.

We intend to investigate to what extent the tools designed foster language learning and explore new ways to scaffold the learning activity with simple feedback strategies. More specifically, the initial aim is to see if simple feedback strategies work with a shallow modeling of the activity instead of full-blown user models.

## 4 The IDS-Tool: User Interface Aspects

In relation to technological issues, we would argue that the main challenges are related to the graphical user interface and interaction design, whereas necessary fundamental IDS functionalities are available. Specific requirements include

- **Assisted animation** of communicating virtual actors. Students shall be able to produce appealing animations that they are able to control to some extent. Some level of automatic animation by the system is required, but heuristics and a limited set of behavior templates should be technically sufficient for satisfying results. Students should be able to define emotions that express personality, and control prominent non-verbal signs, e.g., a sudden astonishment or a sign of strong rejection.

- **Narrow interactivity** for *virtual actor – student* dialogue scenarios. When a virtual actor enters into a "dialogue" with a student, we assume that the student and the virtual actor both follow a basic script and play narrowly specified roles, and that only minor variations are allowed. For example, a student may create as homework an interactive *virtual actor-student* dialogue for other students to enact; the assignment requires reusing previously employed material on "how to shop at the grocery"; the material deals with a limited set of phrases, dialog elements, and words only.
- **Manual branching** in scenarios where students create *virtual actor – virtual actor* dialogues. Here, the story is variable, but students choose the way to follow – there is no automatism involved. Automatic random choices or the option to depict all available branches represent possible extensions.

With respect to the user interface design, these are main requirements:

- It must be possible for a student to enter **linear dialogues**, which then could be rendered and performed by the virtual actors. This involves the definitions of interactions and animations that are coordinated to the speech.
- Students shall be enabled to integrate **dialogue patterns with "wildcards"** to branching structures, developing dialogues with branching variants.
- **Flow control** to enable students to create and present variable, branching stories.

These requirements to UI design are in practice quite complex. The creation of linear dialogues suggests the usage of a timeline, but it is still an open research question whether an explicit timeline representation, where time is isomorphic to length of a user interface element, would be easily understood by young students. In fact, while explicit timeline representations and the depiction of independent channels for animation represent the industry standard for user interfaces in the field of computer animation (e.g., Maya, Blender), children software with animation functionalities regularly seems to avoid this representation (e.g., KidPics). Apparently, timelines and animation channels are assumed to be a too complex metaphor to be presented to children. Possibly, a more simple representation must be found, for example with larger time slices and more global parameterization, e.g., with sentences as minimal elements and global emotional parameters that are applied to the sentence as a whole, and not to parts of it.

Another difficult user interface problem is related to the representation of branching structures in dialogues. As mentioned above, graph-like representations are often being applied in the field of IDS authoring tools. Graphical programming languages for children also provide solutions for the visualization of branching structures. Languages such as Lego Mindstorms NTX-G [7], Squeak [4], and Alice [6] apply more iconic representations with special elements for branching structures.

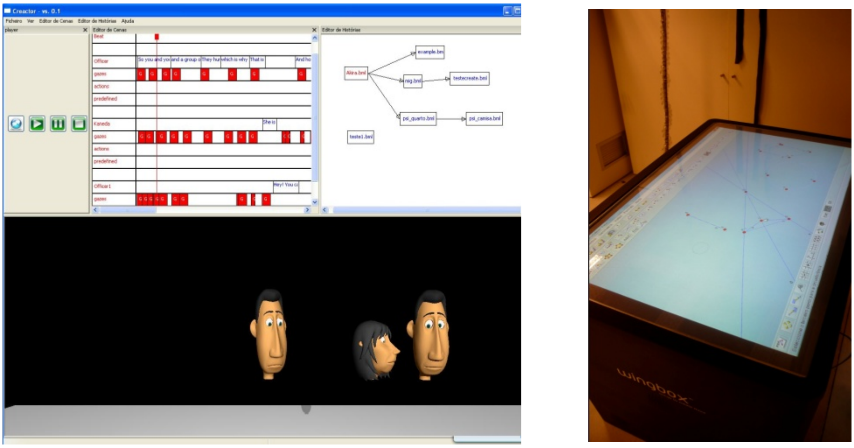

**Fig. 1.** (left) Creactor user interface with timeline and branching authoring support; (right) Multitouch table of CCG. Collaborative scenarios pose additional challenges that are best coped with appropriate devices. Multi-touch tables and whiteboards are becoming wide spread and enable simultaneous work and physical gathering of the students. In particular multi-touch tables may support the utilization of physical devices, e.g., physical building blocks that represent dialogue parts, and that students can assemble to story structures.

In IDS, we can find combinations of both, directed graphs for branching structures and timelines for linear dialogues / actions (e.g., Creactor). However, it is not clear whether this form of combined representation would be understood and accepted by students. Integrated representations of structural views with temporal aspects are in general rare, and in the field of IDS completely missing. One of the few examples in visualization literature is the UML activity diagram based on swim lanes. Currently, we are investigating the acceptance of a combination of graph and timeline vs. an integrated representation utilizing iconic elements. We expect first results from usability tests with children in the near future.

Speech technologies also play a major role in our concept. In fact, speech recognition may develop the potential to support a much wider range of scenarios based on our storytelling concept in the future. However, while progress has been made in this field recently, the requirement to operate also with wrong sentences and pronunciations prohibits a central role of such technologies for now. Consequently, we selected usage scenarios that could be realized based on text-input and more reliable text-to-speech technologies only.

## 5 Conclusions and Outlook

We are currently working stepwise towards an understanding of the IDS tool requirements of various aspects of employing role playing metaphors for second language learning at schools. Our next step will consist in devising and testing tools for linear story (movie) creation within this second language learning context. The results shall provide also key interface elements for probably every other envisaged scenario. For this first step, we will build upon our previously developed IDS-tools (Scenejo and Creactor). They were not originally devised for children, and we will recur to user centered design methods to understand if and how our existing user-interface elements can be reused in this context, in particular to understand whether and when a timeline is an appropriate representation for school children of different ages. We aim at strengthening role-playing and storytelling methods at schools by IDS technologies. As a final result, we expect to be able to provide IDS concepts and tools that are flexible enough for several learning scenarios, and that are proven to be useful and easily usable within second language teaching at schools.

**Acknowledgments.** This research was partly funded by the Portuguese research foundation FCT through the project VirtualActor, PTDC/EIA/69236/2006.

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# Textual vs. Graphical Interaction in an Interactive Fiction Game

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**Abstract.** In this paper, we present a preliminary evaluation of a text-based and graphical version of an interactive fiction game that we created to look at how the user experience varies across the different mediums and modalities.

**Keywords:** interactive fiction, graphical vs. text-based interface, evaluation.

## 1 Context Overview

Interactive fiction (IF) is a story-based genre of games where the user is given a more active role than, for example, a mere reader who turns on the pages of the novel while reading the story. These games started primarily as text-based and only later shifted to a more graphical representation with advances in graphical technology. Even though a graphical medium looks more attractive and appealing, this can also quickly become a bottleneck since within a short period of time most graphical games become outdated. Text-based versions do not suffer from such an issue. Each medium presents its own advantages and disadvantages in terms of creating a story-based game. The same case applies to the use of a choice-based menu or a natural language-based input interface. Each input modality has its own benefits and drawbacks. The use of medium and modality in creating story-based games has been long debated but several interesting questions have not been addressed empirically. For instance, there has been little investigation in finding how the user experience changes for IF games with a) text-based versus graphical as output representation medium and b) choice-based menu versus natural language as input modality. In this paper, we have focused on this latter question by presenting the user with the same game using text-based and graphical interfaces with different input modalities. We looked at both media and tried to see qualitatively the issues and benefits that they offer from a user experience perspective.

We developed a subset of the *Anchorhead* interactive story game created by Michael S. Gentry [1]. Notably, we focused on a subpart of the story as identified in [4].

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Graphical as well as text descriptions of the current scenario are presented to the player, who then enters commands in textual format, e.g. "*enter the mansion*" or "*take the key*". While designing the two different versions of the game, we have kept their content equivalent in order for them to be compared in this study. The game plot is the same for both interfaces. The interaction approaches are also equivalent, since the set of commands that have an effect on the game and can be recognized by the natural processing modules is the same as the set of commands that can be entered with the menu-based interface. Commands recognized by the natural language components but without counterpart in the menu-based interface do not have any effect on the game.

We created two versions of the game. One version is a text-based interface where the user selects actions among a set of options. The other version is more elaborated since it presents the game through a graphical interface and the user can enter commands through typing English sentences. To evaluate our approach we developed a generic interactive stories architecture and plugged the two different interfaces to it.

## 2 Experiments

We conducted two separate sets of experiments. The objective of the first experiment was to look at the question of input modality with respect to its effect on player experience. The objective of the second experiment was to understand the player experience-based on the choice of medium. For both experiments, each player was provided with an explanation on *Anchorhead* and asked to sign a consent form before starting the game. The player filled a background questionnaire to obtain subjective information such as previous gaming experience or preferences to specific types of games. During each experiment, a researcher monitored the game session and produced a log with observations related to the player actions and reactions. On an average, a complete player interaction lasted for about 45 minutes each.

### 2.1 Experiment 1: Language Understanding vs. Choice-Based Menu

For the first set of experiments, we invited 30 people. The first 15 people were asked to play the text-based version with a choice-based interface and the other 15 were asked to play the graphical version with a natural language interface.

We transcribed the player responses from the interviews and observed players' actions during the game episodes. As our focus was to understand the qualitative differences for the user experience when the input modality is varied, we discuss the results from the qualitative analysis. We analyzed the data using a qualitative analysis method known as Grounded Theory [6]. The results from this analysis reveal that:

***Language modality is a more natural way to interact.*** Users felt that using language was a more natural way of interacting with the system, giving them a feeling of being more immersed in the experience. Users commented that the language interface made the experience more interesting and expressive. The choice-based menu, on the other hand, was considered more restrictive. An open-ended natural language interface made the players more engaged in the game. Users reported that the characters and the overall game looked more alive using the language-based version. This latter interface also provided the player with an illusion that it could handle a larger range of input commands. At the same time, when input was misrecognized, this illusion resulted in a break of the playing experience.

***Open-ended language interface makes it difficult to figure out appropriate actions.*** The open-ended nature of the language interface, made it difficult for some users to figure out appropriate actions. In the choice-based interface, users knew exactly what could be done at any time since they were provided with list of choices. In our previous work [5], we have reported on a Drama Management (DM) module integrated with our architecture that guides the user through his experience in order to deal with this issue. When the DM detects that the user is lost (i.e. when he has not typed in for a certain long time or is not able to provide the right set of inputs to the system), the DM itself provides guidance given the current context and situation.

***Open-ended language interface creates false expectations.*** Some players were frustrated when they tried and failed to interact freely with other game characters. The open-ended natural language interface creates a false illusion and sets up higher expectations in user's mind on the system's capabilities. When the input is not recognized and/or is not properly handled with, the interaction flow breaks down, resulting in a frustrating user experience. The key issue here is how to appropriately handle out of domain topics. One possible way to deal with the issue is to increase the range of conversational topics with viable approaches used e.g. for chatter-bots [2] or resort to freely available web resources as proposed in [3].

### 2.2 Experiment 2: Text-Based vs. Graphical Medium

For the second set of experiments, we run a preliminary evaluation with 6 players. They were divided into two groups. Players in first group were asked to play first the text-based version and then the graphical version. Players in the second version had to play in the opposite order. The specific scores that players assigned to the different parts of the game are summarized in Table 1. Quantitative results from the experiment indicate that the in terms of overall rating, players found the graphical medium more attractive (a 17.17% increase). A qualitative evaluation shows that:

***Visual Cues help the user navigate more.*** Graphical adventures provide the users with a visual reference of the environment, their location and possible movements in the game. The graphical version of the game offers users the possibility to explore the system visually and see the consequences of their actions. In the text-based game, users felt that everything was left to their imagination.

***Text-based environment provides an opportunity to players to flex their imagination.*** Some users felt that text-based adventure stimulates their imagination much more than graphics. A graphical game presents all the possibilities pictorially leaving fewer things to their imagination. Presenting the output in textual format forces the user to resort to his imaginative skills.

***Visual representation of the graphical version is more appealing.*** The graphical version of the game aroused a stronger sympathetic response, a sort of 'coolness' effect generally associated with a more visually appealing game experience. Users judged the text version and its simple representation as less attractive compared to the graphical version which biased them towards preferring the graphical version.

**Table 1.** Participants' overall game rating, on a 5-point Likert scale (0-4), with corresponding weighted rating average for both the text-based IF interface and the graphical IF interface

| | Text IF | | Graphical IF | |
|---|---|---|---|---|
| Player | ***Rating(R)*** | ***Confidence (C)*** | ***Rating(R)*** | ***Confidence (C)*** |
| P1 | 2 | 3 | 2 | 3 |
| P2 | 2 | 3 | 4 | 4 |
| P3 | 3 | 2 | 3 | 3 |
| P4 | 3 | 3 | 2 | 3 |
| P5 | 2 | 3 | 2 | 3 |
| P6 | 3 | 3 | 4 | 3 |
| ***Weighted Average*** | $\Sigma_i (R_i * C_i) / \Sigma_i C_i$ 2.47 | | $\Sigma_i (R_i * C_i) / \Sigma_i C_i$ 2.89 | |

## 3 Conclusions

We presented the qualitative results from a pilot study to look at the choice of output medium and input modality in terms of user experience. Despite the limited statistical validity of the experimental corpus, the results point out some interesting findings.

The large majority of users find natural language a more comfortable, and familiar way to interact. Natural language might produce false expectations and should be coupled with hinting mechanisms to proceed in the game. Concerning the medium, players usually prefer the graphical interfaces because it generates visual cues that help them navigate the game and is also more appealing. However, players agreed that the text interface stimulates their imagination more. In future settings, we plan to keep modality and medium completely separated from each other.

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# Motivations for Rereading in Interactive Stories: A Preliminary Investigation

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**Abstract.** This paper describes a preliminary investigation into the concept of rereadability in interactive stories. Through a close reading of the text-based interactive fiction *Alabaster*, seven possible motivations for rereading an interactive story are identified. This close reading suggests that, while there are many ways in which rereadability in interactive stories is similar to rereadability in traditional (non-interactive) fiction, there are also forms of rereadability that are unique to interactive storytelling.

**Keywords:** Rereading, interactive fiction, player motivations, close readings.

## 1 Introduction

In literature, the tendency for readers to want to reread a work is often seen as an indicator of the quality of the work [1, 2]. Similarly, rereadability can be seen as an important aspect of interactive storytelling. Despite this, there has not been much work done to look at rereadability in interactive storytelling [3]. This paper describes a preliminary investigation into this issue, looking specifically at the motivations for rereading the text-based interactive fiction *Alabaster* (2009), a retelling of the traditional fairy tale "Snow White" created by John Cater, Rob Dubbin, Eric Eve, Elizabeth Heller, Jayzee, Kazuki Mishima, Sarah Morayati, Mark Musante, Emily Short, Adam Thornton, and Ziv Wities.

## 2 Motivations for Rereading

As a result of the close reading, seven possible motivations for rereading were identified. These motivations will now be described in detail.

*Making Sense of Things*
As with a traditional work of (non-interactive) fiction, the player may be motivated to revisit *Alabaster* in an attempt to *make sense of things*. In the process of moving through the story, the player encounters numerous fragments of text, either in the form of dialogue with Snow White, or as descriptions of the setting, objects and characters in the storyworld. These fragments need to be reconciled into an overall understanding of the story. This can be compared with the process of reading a traditional

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text [4]. As each new piece of information in a story is encountered, the reader must fit that information into her existing mental model, and possibly revise that mental model to accommodate the new information. Particularly if the discourse structure is complex, a second (or third) reading may be necessary to clarify causal relationships between events.

*Finding Out More*

Rereading to make sense of the work is similar to rereading in a non-interactive work. In addition, a player of an interactive story may reread to *find out more*. As there are numerous fragments of information contained within the story, many of which require that the player's character ask specific questions of Snow White, it is possible for the player to finish the story without encountering every text fragment. In addition, there are frequent indications that there is more to the story than can be seen on the surface, suggesting that there is the possibility to unlock additional information if the player can discover the correct questions to ask or actions to take. For example, the story contains a number of interwoven subplots: the King's disappearance, the Queen's madness, Snow White's possible demonic possession and/or vampirism, the disappearance of the huntsman's dogs, and so on. All of these subplots provide reasons for the player to go back and try to dig deeper to uncover hidden information.

*Trying Out "What-if" Scenarios*

In addition to taking action to find out more information during a rereading, the player may want to *try out "what if" scenarios*. Unlike a traditional story, an interactive story presents the player with choices that can lead to different outcomes. There are certain points in *Alabaster* where the player is given very specific choices. For example, when deciding to return to the palace, the player is asked whether she will do so with or without Snow White. There is a very clear connection between this decision and the way the endgame plays out. There are, however, more subtle decisions that the player has to make throughout the course of the story that may or may not impact the outcome. For example, the type of questions that the player asks Snow White and the information that the player mentions to her will subtly change Snow White's disposition. The player may be motivated to experiment with different choices to see whether there is a change in the direction and outcome of the story.

*Seeing Things from a Different Perspective*

The active search for additional information and different paths through the narrative described above leads to a further motivation for rereading: the desire to *see things from a different perspective.* The events and information revealed in an initial reading may suggest a reframing: a radical revision of the player's model of the storyworld, the characters' personalities and motivation, and the causal connections within the narrative. Reading through the story a second time can lead to the meaning of events shifting based on new information that was not available to the player in the first reading. This process of rereading from a different perspective is similar to the process of making sense of things discussed above. However, rather than trying to reaffirm a stable mental model, in the case of rereading from a new perspective there is a complete reworking of the player's understanding of the story.

In the context of an interactive story such as *Alabaster*, this change of perspective can also have an impact on the choices that the player makes in the story. For example, throughout the story there are suggestions that Snow White is a vampire. From this perspective, the reader may feel justified in carrying out the Queen's command to kill her. However, when the player discovers in one of the endings that the main character is actually the King, and that Snow White is his daughter, what earlier seemed like a simple decision becomes more complex. When rereading, the player will have a very different perception of the events leading up to this final action, and may be inclined to make different choices.

*Looking for Deeper Meanings*

Beyond attempts to see things from a different perspective, the player may also be motivated to reread the story to *look for deeper meanings*, attempting "to structure the meaning potential arising out of the multifarious connections between the semantic levels of the text" [5]. Posner (quoted in [5] p. 92) sees the search for a "secondary" code beneath the primary code or schemata of a text as the source of aesthetic pleasure for a reader. The further pursuit of this secondary code, the process of looking for an interpretation of the text, can provide motivation for rereading.

The motivation to look for deeper meanings can be seen in the vampirism/demonic possession subplot in *Alabaster*, which makes reference to Biblical tales and to Christian and Jewish mythology [6]. Symbols that are drawn from both the Biblical story of the Garden of Eden and the original fairytale "Snow White", such as the apple, provide additional layers of meaning. These suggestions of deeper meanings and intertextuality motivate the player to explore these connections through rereadings of the work.

*Reflecting on the Techniques Used*

The player may also be motivated to *reflect on the techniques used* in the text. This involves stepping back from the text and appreciating or critiquing the ways in which the text achieves its effects. This process of reflection is something that can often only be done during rereading, as "only successive readings will allow us to focus on the development of events and characters, significant patterns of imagery and ideology, modulations of tone, and whatever else makes the story act on us as it does" [7] (p. 494). In *Alabaster* the player may start to notice, for example, the way that the system encourages the player to pursue certain topics by making suggestions as to follow-up actions. The player will quickly come to realize that these suggestions can lead to a sequence of discoveries, opening up new pathways through the story. The player may also notice that the system subtly resists changes of subject, attempting to direct the player down specific paths planned by the author. Once these patterns become visible to the player, she may be motivated to go back and play again to reflect on how these patterns affected her choices, and to look for other patterns and techniques.

*Figuring Out How the System Works*

Reflection on the techniques used in the work may, in addition, encourage the player to reread a work in an attempt to *figure out how the system works*, in terms of the underlying rule system that governs the way the system responds to the player's actions. This motivation is, by its nature, very specific to interactive stories. Players tend to bring a set of initial expectations to an interactive work, expectations that may or may not be satisfied as they encounter the work [8]. As the player observes the system's responses, the degree to which these expectations are met shapes her understanding of the underlying computational model. For example, the "hints" system in *Alabaster* provides a glimpse of the underlying conversation mechanism. As the player becomes more familiar with the conversational mechanism, she comes to understand the ways in which certain actions can trigger desired responses. Through repeated rereadings the player can, with some confidence, manipulate the direction of the story. This provides a strong motivation to reread.

## 3 Conclusion

The close reading of *Alabaster* presented in this paper identifies a number of possible motivations for rereading interactive stories. Certain motivations - *making sense of things*, *seeing things from a different perspective*, *looking for deeper meanings*, and *reflecting on the techniques used* - are common to both interactive and non-interactive stories. The remaining motivations - *finding out more*, *trying out "what-if" scenarios*, and *figuring out how the system works* - can be seen as exclusive to interactive systems.

Note that these latter motivations apply equally to narrative and non-narrative forms. Further work needs to be done to explore which, if any, of these motivations apply exclusively to narrative forms, and to determine if these motivations can be generalized beyond *Alabaster*. Work is also needed to identify the techniques used to elicit these motivations in readers, and to describe these techniques in the form of design knowledge that can be used by authors to create rereadable interactive stories.

**Acknowledgments.** This work was funded under a Singapore-MIT GAMBIT Game Lab research grant, "Tools for Telling: How Game Development Systems Shape Interactive Storytelling." Thanks to Ismail Talib for his comments and feedback on an earlier version of this paper.

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# The Haiti Earthquake Experience: A Case Study

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**Abstract.** The author summarizes his experience creating a story-based simulation from raw documentary footage taken in the aftermath of the 2010 earthquake in Haiti. The use of Propp's typology to create a heroic framework within which to organize the material is explained. The author introduces the concept of Negotiation Clouds to improve a fold-back story structure and create meaningful agency for the user without compromising author control of the narrative.

**Keywords:** Negotiation clouds, simulation, Haiti, Zapdramatic, Fold-back story, Propp, Inside Disaster, Michael Gibson, role-play, documentary.

## 1 Introduction

A PTV documentary crew led by director Nadine Pequeneza went down to Haiti a day and a half after the 2010 earthquake and spent two weeks filming the efforts of the International Red Cross. They returned to Canada with over two hundred hours of material to create the documentary film, *Inside Disaster*. Our job was to support the film by re-purposing the footage to create an interactive simulation that revealed the complex interdependencies of a Survivor, Journalist and Aid Worker. The challenge for us was to imbue the video fragments with the character arcs and plot twists that would keep the user engaged from beginning to end. Our goal was to create an interactive experience that not only revealed the false assumptions made by first responders that led to significant strategic errors but also to do so is such a way that the user was given agency in the execution of those errors and thus achieved a valuable virtual life experience without the consequences of the real world.

### 1.1 Structuring a Role-Play Documentary

What would you do if you were an inexperienced humanitarian, moved by the horrific images of suffering in Haiti, to organize a shipment of relief items only to discover that once you arrived you had to compete for logistical support with the 900 other NGOs on the ground? If you were a journalist, how would you make sense of the chaos? If you were a survivor who lost your home and family members and everything you owned, how would you react to the foreigners invading your city, who seemed to be working at cross-purposes, bearing grossly inadequate amounts of food, water and medical aid? These were the questions that we sought to make live for our users. To do so, with documentary film, we needed to construct a narrative out of disconnected video fragments. An interactive experience where the user is given agency imposes additional challenges because the agency to do one thing or another

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can quickly create holes in our story that were not filmed. To address this issue we needed a linear structure where the content, the characters and events, could be interchanged but the functional sequence of the story remained consistent.

### 1.2 Propp's Typology

In his book, *Morphology of the Folktale,* Vladmimir Propp identified 31 sequential story elements that were consistent in 100 popular Russian folktales. Propp's research suggested not only that every good story contains most of these elements or functions, but also that the functions are always arranged in the same sequence. These functions are "independent of how or by whom they are fulfilled" (Propp 1968, p.21). Interactive designers have used Propp's typology before, notably Eudaemon (Tomaszewski & Binsted, 2007), GEIST (Grasbron and Braun 2001; Spierling, et al. 2002) and OPIATE (Fairclough 2005). Propp's typology is useful because the narrative progression depends on function rather than content. The functions are arranged in a consistent sequential order but the content within the functions can change. It thus allows us to swap content without derailing the narrative arc of the story. Tomaszewski and Binstead in their paper[1] describe the limitations they found applying Propp's typology. However, we found it useful because each of our three stories closely aligned with Propp's Hero's journey.

### 1.3 Learning Outcomes

Once we'd sketched out our stories from the video footage, we had to determine the key-learning outcome that each story could deliver to the user. We decided that in each case it would be based upon a common false assumption that we observed led to a bad strategic choice, which in turn, led to a negative outcome. To be effective, we wanted to ensure that most users initially made the wrong choice and experienced the negative consequences of a poor strategic decision. Our belief was that failure is the best teacher because it stings and makes us sit up and pay attention and demand to know what we did wrong. To achieve this objective we needed the simulation to mimic the rationalizing mental chatter that precedes a strategic mistake despite our better judgement. In essence, we needed the simulation to set up a realistic set of circumstances that would lead the user into making a false assumption and a strategic mistake. If the user by chance or otherwise chose the correct strategy then we needed the simulation to, in essence, negotiate with her to change her mind based on the exigencies of the moment. For example, in the Aid Worker story, the learning outcome was that despite the urgent need, best practices dictated that aid should be sorted in advance of distribution because some items such as baby formula can actually do more harm than good. In Haiti there was scarcity of clean water and formula mixed with contaminated water could cause disease and possibly death. Many of the Aid groups arrived with containers full of mixed donations, some of which were inappropriate for the specific needs of the Haitian people. If the user made the correct decision to sort the donations, we designed the simulation to respond by serving up realistic circumstances to frustrate that intention such as congested roads, a lack of

[1] http://www2.hawaii.edu/~ztomasze/argax/pubs/2007-TomaszewskiBinsted-ProppLimitations.pdf

secure warehousing and inadequate logistical support. We supposed that only the most resolute of users would not give in and choose to acquiesce to the clamour of demand on the streets.

Propp's functions enabled us to weave unrelated video clips into a linear narrative but we still needed a means to allow user agency without an exponential growth of the size of the simulation or a confusion of the learning outcomes.

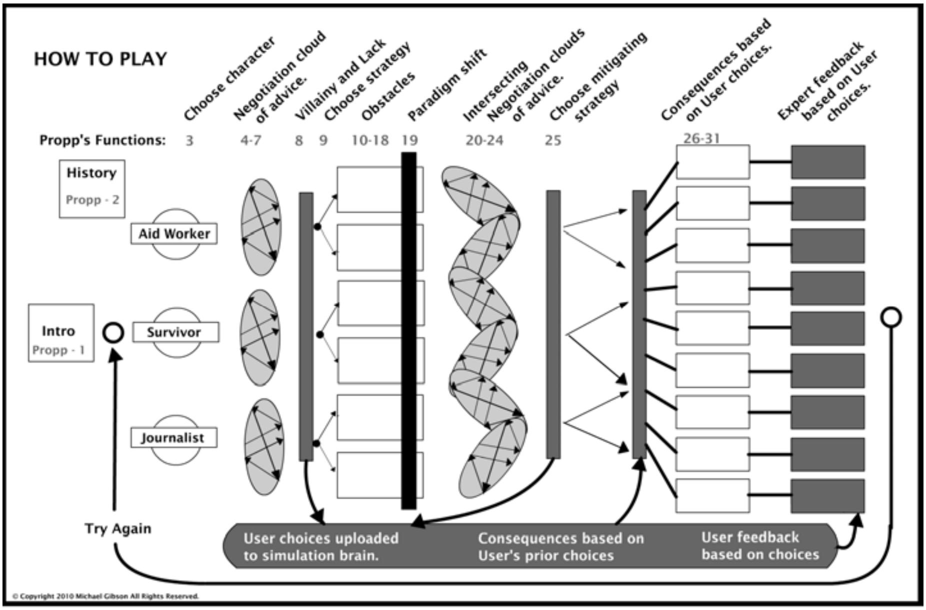


**Fig. 1.** The diagram above shows the linear timeline of the simulation with Propp functions and the two strategic decision points preceded by the interactive negotiation clouds

## 2 Foldback Story and Negotiation Clouds

Ernest Adams in his book *Fundamentals of Game Design* describes a structural approach called Foldback[2] story that addresses the issue of interactivity in a linear narrative. Essentially, the author can create a rich narrative structure and then at various points along the way, enable the User to branch off and make choices, creating the illusion that the user is in control only to have the narrative fold back by an inevitable pre-scripted event. In his analysis of the drawbacks of this approach he suggests that the user may feel cheated when she suspects that her illusion of choices actually has no consequence to the overall narrative. This sense of being cheated is exacerbated if the user is led to believe that every decision is strategic. Our script used a refinement of the fold-back story structure where we reduced the strategic decisions to one per role-play with the possibility of revisiting that decision after experiencing an initial

[2] Fundamentals of Game Design Second Edition, pages 170-175.

consequence. The bulk of the user interactivity was not strategic but rather took place in what we call a negotiation cloud of information and advice and/or argument. The user enters the cloud purposefully and encounters circumstances and arguments contrary to that purpose. We call it a cloud because the duration and navigation of the user's stay is dependent upon the user's inquisitiveness and resolution to the initial strategy, not the game architecture. The primary purpose of the negotiation cloud is to educate and engage the user in a strategic argument. By creating a realistic environment where the user commits to a strategic mistake, the user then benefits from the negative experience when the virtual consequences ensue. A virtual experience while mirroring real life, doesn't pack the same life-changing consequences that the same mistake in the real world would bring about, the very mistake that the simulation is designed to correct.

## 3 Conclusion

We found that the use of Propp's typology was helpful to organize unrelated documentary footage into a coherent narrative experience. We also found that confining user interactivity to one of two types, Negotiation or Strategic, and by tying the strategic decisions directly to the learning outcomes, we were able to provide the user with meaningful agency in the negotiation clouds without losing narrative control or obfuscating the intended learning outcome.

The Haiti Earthquake Experience will launch in October at http://www.insidedisaster.com.

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# First Person Victim: Developing a 3D Interactive Dramatic Experience

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**Abstract.** Interactive Drama in 3D worlds has great potential for communicating serious themes, however it can become challenging to organize the content in such a way that the theme is communicated clearly while maintaining the feeling of free spatial navigation in the 3D world. In order to address this problem, and to propose a way to structure content, we have developed the Interactive Dramatic Experience Model, which attempts to organize narrative events in a 3D world while keeping the freedom of spatial interactivity. In order to exemplify this model, we have chosen to oppose the classic genre of violent interactive shooter experiences by allowing the participants to experience the feeling of being a victim of war. An evaluation of the implementation indicated that participants experienced free spatial interaction, while still being able to acquire an understanding of the theme being mediated.

**Keywords:** Narrative, Drama, Interactive, Emergent, Experience, Engagement, Victim.

## 1 Introduction

In traditional linear non-interactive media, the author is fully in charge of choosing how a theme is to be conveyed as he or she controls how the audience is supposed to be involved in the dramatic actions [1, 2].

In non-linear interactive media applications, interactivity can be referred to as the freedom of self-expression [1, 2] related to the freedom of the participant, where the author cannot always control how the theme is communicated. Traditional plot based narratives and the freedom of interactivity are thus considered by some scholars as being inversely proportional [1, 2, 3].

Our exploration of combining interactivity with a plot-based narrative will attempt to structure content in emergent narratives and is focused on *spatial* interactivity, thus giving the participants freedom to navigate in an open environment, while still letting the author control the communication of a theme.

## 2 The Interactive Dramatic Experience Model

To address the balancing of free interaction through spatial navigation and plot-based narration, we propose the Interactive Dramatic Experience Model (IDEM) that is

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inspired by, and is an attempt to implement the “Flying Wedge” plot model introduced in the seminal work by Laurel [4]. This model was originally proposed in order to illustrate how a participant constructs his or her own narrative progressively, starting with the initial state of having unlimited possible events, narrowing down to fewer probable events, and finally ending with a single necessary event, the climax.

In our implementation, we have experimented with the model by taking it literally and are using it as a conceptual framework where actual narrative events are added to the model (see Fig. 1). In the current implementation there are six scenes (the columns from A-F), each with seven dramatic narrative events (the circles) which are triggered by a drama manager.

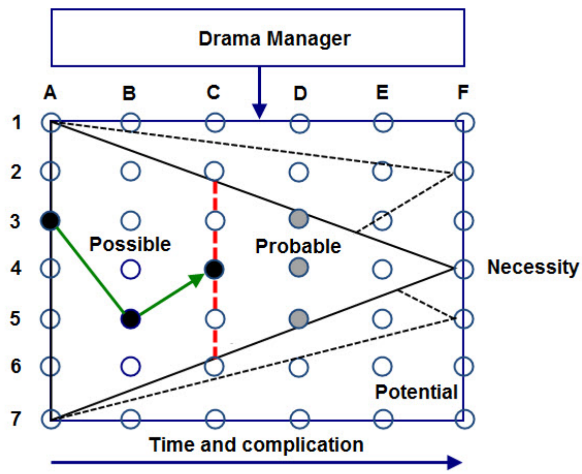


**Fig. 1.** The flying wedge eliminates the available possible events to few probable ones, and finally to a single necessity (the climax)

The arrow in Fig. 1 depicts the story-path of the participant’s chosen and executed actions. These actions and the gradual sharpening of the wedge and its direction determine the amount of fewer and fewer narrative events (the grey dots) available for the participant at the current point in the narrative (represented by the last black dot).

The dashed vertical line that separates many possible events from fewer probable events represents the level of an inciting incident where the events start to rise in tension towards the highest level (the climax).

The direction and the functionality of the wedge is spatially applied to the 3D world assuring the increasing necessity, while the overall story starts and ends in a specific spatially defined place. The assigned events and the availability of the interaction inside the wedge is not possible to predict for the participant because it is dynamic and triggered by the drama manager based on the factors of time, space and the participant’s spatial navigation and/or executed actions.

## 3 The First Person Victim Experience

To communicate the experience of being a victim of war during an air strike and the following invasion, the events, locations and the overall theme of each narrative event provided throughout the experience introduce the participant to a war zone situation. The experience is implemented using the game engine Unity, which makes it possible to create a high level graphical 3D FPS-style environment.

The narrative events in the IDEM are located in both time and space and can consist of a) interactive objects that allow participants to obtain particular information, for example a radio where the aggressors' reasons for the attack are provided in a speech; b) text, for example mobile phone text messages from an upset girlfriend; c) audio-based narrative elements, for example phone calls from worried relatives, or d) enactments by real actors projected onto a 2D plane in the 3D world, for example a neighbor, who tells the participant to get out of the apartment before the building collapses. The communication of the characters to the participant is one-way and triggered by the drama manager based on time, former actions, and the participant's distance from specific zones around the characters.

The events are causally related to one another, and this congruent causal relationship between events in the IDEM provides the participant only with narrative events that can make sense in relation to the previously executed actions maintaining thereby the narrative coherence. For example Fig. 2a shows an example of a possible event that the participant might experience, namely to witness his neighbor being executed due to an escape attempt from the town. To emphasize causal coherence this event can only be available if the participant has an encounter with the neighbor at the beginning of the story.

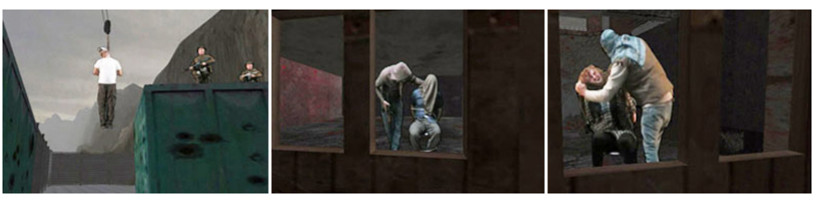

**Fig. 2.** An event from the fourth scene - the neighbor is hanged (a) and two different story endings: climaxes (b and c)

The events will thus appear as eventual causes that will stimulate curiosity and inspire the participant to go on to discover the potential effects. For example when a participant triggers one out of the seven (to him unknown) events of the first scene (e.g. a TV speech by a politician announcing the airstrike) a rough notion of the whole action will emerge and he begins to have expectations of what lies ahead. As the story unfolds, the actions performed by the participant decrease the numbers of possible events by eliminating some and making others more probable. In other words, the events which have occurred will further constrain what may follow. At the final level - the necessity - all the competing probable lines or the probable narrative events are eliminated except one. At this point a single event which represents the end or the climax of the story remains to be experienced by the participant. This event is at the highest level of tension (following Laurel's model [4]) and is in our case a tragic open ending like in Fig. 2b where the participant witnesses his brother being humiliated during interrogation or in Fig. 2c where his girlfriend is being tortured.

## 4 Evaluation

A quantitative questionnaire (n=19, frequent gamers) inspired by the Game Experience Questionnaire [5] investigated to which degree the participants became engaged in and acquainted with the underlying theme. The results showed that participants were motivated to explore the 3D world (also more than once) due to their interest in the encounters with other characters, and they were curious to know the final outcome (the end) of the story. They were also emotionally engaged in the events that involved other characters as they often attempted to help them. This result was supported by statements from the open questions such as "There was a guy hanging, I tried to get in, and interact to get him down". Additionally a series of supportive qualitative interviews (a focus-group (n=3) and single respondents (n=11)) supported these findings, as exemplified by one respondent's statement: "The map seemed very big, and I wanted to explore, I felt that I was in a path and I didn't reach it yet to see where it ended".

The test and interviews demonstrate that the IDEM and the current implementation of the First Person Victim Experience provide each participant with a unique experience when they traverse the narrative network. Our results suggest that the participants are provided with a high level of navigational freedom which makes them want to get involved in varying causally related events, and thereby constructing different narrative experiences within the communicated theme. Our findings also indicate that although the theme was communicated and understood, and the participants experienced navigational freedom through the interaction, other types of interactivity could be included to enhance the experience further.

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# Combining Explicit and Implicit Interaction Modes with Virtual Characters in Public Spaces

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**Abstract.** Improving the visiting experience of exhibitions and public spaces in general has been the subject of several studies over the past years. In the study presented here, we were particularly interested in understanding the potential of combining explicit and implicit interaction modes between virtual characters and visitors. We present in this paper scenarios that exemplify the combination of these interaction modes, and an initial study with user involvement, based on a software platform that we are currently developing. We report on first feedback from users about the system-level interaction, usability, and visiting experience. The tested case study should create a sense of ubiquity of the virtual characters throughout the visit, and take advantage of their communication skills, at the same time giving freedom to visiting groups to interact with each other and to make visits to the exhibition place at the order they desire.

**Keywords:** Virtual characters, public spaces, museum, interactive storytelling.

## 1 Introduction

Enriching the visitor´s experience in exhibition spaces such as museums with the help of new technologies has been the subject of many studies. However, the introduction of these technologies into a real world context still represents a complex challenge, concerning technological, usability, exhibition space organization issues and the interrelation of these factors. The research that we present here addresses the question of how to apply new technologies in a sustainable and service oriented manner (in the sense that the content, and not the technology is on focus) to real exhibitions, satisfying all the requirements of technology, usability, and organization of the exhibition space. Our research addresses the perceived gap between academic concepts for exhibition spaces and technologies that actual museums (and other spaces) are able to employ. Our software platform and approach shall enable simplified prototyping for uncovering the finer grained concepts and dependencies that can make a solution sustainable and attractive for the exhibition organizers.

We are studying particularly the combination of explicit and implicit interaction modes with virtual characters, i.e. process virtual character's reactions based on visitor's

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activity sensing (implicit and unintentional communication) and explicit and intentional communication between virtual characters and visitors. The virtual character system shall be capable of monitoring individuals and small groups, processing, at each moment of the visit, information about their location.

"Implicit interaction" implies for example that virtual characters have knowledge of the location and route of individual visitors or groups of visitors, and can use this information to try to gain attention of specific visitors when they are passing by, reacting to their behavior, adapting the presentations to what they have already seen and so on. The issues related to "implicit interaction" are, for instance, which technology to employ, and what is the minimum reliability required; how to handle when in a museum individuals and different small groups get mixed up; how to transmit to groups and single persons that they are being specifically addressed, e.g. when a virtual character calls on a specific group to pay attention.

"Explicit interaction" refers to situations where users explicitly communicate with the virtual character, e.g. speak to them, if voice recognition is used. Issues of explicit interaction include the choice of technologies and input channels – Voice? Tangible interfaces? Gestures? – and how well this choice would work according to requirements of a real exhibition, where for example crowds of loud people might interfere both with computer vision and sound based input. We assume that the technologies employed for explicit and implicit interaction can be different, for a single system and exhibition, e.g. computer vision combined with tangible interfaces.

Our base working scenario for addressing the research questions contains several interpretation points in different rooms of an exhibition space, and visits by small groups. We also assume that in each of these rooms at least one screen exists where the virtual characters will appear to interact with the visitors groups. We chose to explore a solution that had no need for personal devices such as mobile phones. Given the focus on group visits, we decide to use public displays as the only output technology, mainly because they allow shared experiences among elements of a visitors group, bypassing the danger of alienating the group's members from each other, e.g. through the use of personal devices. Other reasons to opt against individual devices stems from practical problems like high costs and fragility of the devices if provided by the museums or incompatibilities if mobiles of visitors are involved.

Within the overall goal, we have implemented a first version of the system in order to acquire first feedback from test users.

## 2 Related Work

The most closely related work is [1], Rocchi et al. The authors have proposed a system for museum visits that consists of the visitor's mobile device and of public screens located at specific points. The mobile device allows presentations using virtual characters, which are generated dynamically by the system. Visitors can choose their character, which is used as a metaphor to distinguish the interests of visitors. The visitor has control over the presentation, and the system also has the capacity to recognize when it is close to a screen, and automatically makes the transition from a character visible on the mobile device screen to the display which is closest to the visitor. The focus of our work is more oriented towards design and usability studies, because we aim at a flexible platform that allows us to study different configurations, technologies, concept and design settings, in order to find out the best balance of elements for sustainable museum and public spaces applications.

## 3 Scenarios

Our first question addresses the best usage of implicit and explicit interaction modes with virtual characters and public displays. We believe that this combination has much potential to enhance storytelling aspects of applications for exhibitions and public spaces, because it combines the (implicit) story of the visit with the (explicit) story of a virtual character.

Our base scenario encompasses virtual characters that detect the presence of visitors near interaction spots (implicit interaction), employing non-intrusive behaviors, and invite them to hear their story and to interact with them. The visitors interact explicitly with the help of tangibles like brochures containing pictures, or similar objects that can be shown to the characters.

In a variation of the base scenario, teachers with limited knowledge of the subject of the exhibition accompany their class. In this scenario, the virtual characters have a complementary role, supporting the teacher in transmitting information to the group.

In another variation of the base scenario, virtual characters are not so much complementary, but function as main opinators. Each character indexes some particular aspect of the visit and is able to express a particular perspective and point of view, i.e. it is assigned a particular narrative role. Consider for instance characters that belong to different fractions of a conflict. The different characters will express conflicting views on specific content of the exhibition. The visitors would have to decide to which character they want to listen to, assuming that each public display shows a different, single virtual character. An example would be a museum about the history of operating systems, where there would be two characters impersonating Bill Gates and Steve Jobs, competing for the visitor´s attention, and giving their diverging opinion about episodes of the history of operating systems.

For explicit interaction a booklet can be handed over to the visitors, with information and images about the artifacts found in the public space. The visitors can interact with the virtual characters with the help of the booklet, showing to them images of the booklet, in order to get additional information about the artifact, for example.

## 4 Preliminary Results

We have not yet conducted formal user tests, but have exposed users to an initial configuration of the system, in order to acquire first participatory feedback. Our first question was whether explicit interaction via booklets would be feasible, and how to conciliate implicit interaction and group visits. Our software system is based on a platform of virtual characters called Creactor, developed within the project VirtualActor [2]. The test system employs screens arranged at various places of a public space, in which the interactive virtual characters appear. The system uses sensors and status information about visitors that is being stored throughout the visit.

The implicit sensing is used by the system to detect the proximity of a group of visitors. Group identification is made by RFID. A RFID tag would be integrated into the booklet that is provided at the beginning of each visit to a group of visitors, though the RFID module was only simulated at this stage ("Wizard-of-Oz" method). The explicit interaction relies on computer vision. The virtual characters provide information depending on the marker seen on the booklet. The tangible (booklet) could have been otherwise designed and adapted to the physical space of the visit, and be chosen such as to be related to the very theme of the visit.

## 5 Conclusions

Our visitors were subjected to an interview. We tried to understand if visitors actually understood that the system had individually reacted when they approached the screens (implicit interaction). Surprisingly, most did not realize that a specific virtual character, that was meant to be the guide to this specific group, had appeared and reacted in an individual and adapted way. Visitors believed that generic characters were already there when they arrived. As indicated by Bitgood [3], one of the most important factors for the visiting experience is related to social contact. In fact, in the course of this first user test, most elements of the groups interacted with each other, which is an encouraging observation.

The first user feedback also suggested that the objects used to interact explicitly (tangible devices) can greatly influence the experience of a visit. After this very first round of informal user enquiry, we are giving more emphasis on tangibles that are closer related to the exhibition theme. More care must be taken to assure that visitors perceive the virtual character as addressing them specifically, and not other groups or individual visitors.

**Acknowledgments.** This research was partially supported by the project VirtualActor, PTDC/EIA/69236/2006 that is financed by Fundação para a Ciência e Tecnologia (FCT) and by the project GUIDE, 248893, that is funded by the European Commission under FP7 - 2007-2013.

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# Louis, Mr. Dog and Rabbit: Metalepsis in Interactive Narrative

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**Abstract.** The author proposes a hypothesis that metalepsis by the narratee into the diegetic level of the story and therefore into the intradiegetic narratee position is a major ingredient in what makes some interactive narratives compelling, and that the move into this position is unconscious and a function of the porosity between narrative layers that interaction can engender in narrative. He illustrates his proposition with a storytelling ritual that is played out between a six year old child and himself.

**Keywords:** metalepsis, the diegesis, intradiegetic narratee, participation, agency, engagement.

**Glossary of narratology terms**
*the diegesis*: the world of the story. There may be more than one diegetic level: a story within a story.
*metalepsis*: a breaking of the boundaries that separate different diegetic levels in a narrative.
*narrative; narrator; narratee*: all that the telling (narration) of a story involves; the one who is telling it; the one to whom it is being told.
*intradiegetic narratee*: a narratee who has entered the world of the story.

## 1 Louis, Mr. Dog and Rabbit

On the way to school, on the bus, 8.00am:

Louis (aged 6): Mr Dog and Rabbit story please.

Me (aged 60): Where were we up to?

Louis: Let's start a new story, Mr Dog and Rabbit go to visit Danny at the Natural History Museum. They find out that Danny's been kidnapped.

Me: Ok.

Me: Mr Dog and Rabbit were having tea. Mr Dog was eating a bone sandwich and Rabbit was having some carrot cake.

*Rabbit*. Great cake Mr Dog

*Mr Dog*. Mmm yes, I got the recipe from Buckle.

*Rabbit (mumbling with his mouth full)*. Haven't seen Buckle for a while have we Mr Dog?

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*Mr Dog*. Shall we go and visit him?
*Rabbit*. I know, let's visit Danny first and then all go round to Buckle's.
*Mr Dog*. Jolly good idea!

Later (8.30am, on the train):
Me: Rabbit stood by the Round Pond feeling worried.
*Rabbit*. Blimey, where's Mr Dog got to?
*Louis*. Watch out Rabbit! The black helicopter is coming towards you!
Me: Rabbit turned round and saw the black helicopter swooping out of the sky.
*Rabbit*. Blimey! I'd better get out of here quick.
Me: Rabbit jumped into a bush
Louis: no, he dives into the pond
Me: but you know how he hates getting wet.
Louis: it's better. Then Buckle can rescue him.
Me: Rabbit dived into the pond.
*Rabbit*. Blimey! It's cold!
*Louis*. How are you Rabbit?
*Rabbit*. I'm soaking wet and my mobile phone's stopped working.
*Louis*. Don't worry, Buckle's on his way.
*Rabbit*. Well he'd better be quick or I'll soak right through and sink.

## 2 Commentary

There's plenty to unpick here. Firstly, this is clearly an interactive narrative, although there's no technology involved. Louis interacts with the Interactive Narrative Engine (INE, i.e. me), intervening with choices about the theme and the subsequent evolution of the story. He is not dependent on the INE's database or framework but can introduce new themes, concepts, plot development and characters, relying on the INE to smoothly incorporate these into the narrative.

When we examine the example from a narrative perspective we quickly find that it consists of a very complex process, way beyond the capacity of classical narratology to describe, and the reason for this is the interactive status of the narratee, and the effect this status has on the diegesis.

Louis has three roles in the narrative process: narratee, author, participant in the story, although he does not necessarily distinguish between them. There is one role that he never undertakes: narrator. That is exclusively mine: the whole point of the exercise, for Louis, is to be told a story, to be the narratee. This is his principal role, but this narratee status, ostensibly passive, entails a continual readiness to leap into the active roles of author and character (performer). Most importantly, and this is where the transaction between Louis and me resembles technology based interactive narratives, this is a story over which he wants to have and has control. There are, indeed, a wide range of interactive narratives that offer various sorts of control, but the general principle exists: the narratee has some control over the unfolding of the story, and I am examining, with this example, how this might affect the narratee's relationship to the diegesis.

Genette (1980) defines narrative metalepsis as an intrusion by extradiegetic elements into the diegesis (and vice versa). He recognises that anyone or anything can slip from one diegetic level to another if the boundary between the levels is porous, and it worries him: "The most troubling thing about metalepsis indeed lies in this unacceptable and insistent hypothesis, that the extradiegetic is perhaps always diegetic, and that the narrator and his narratees-you and I-perhaps belong to some narrative".[1]

Exactly! Louis would agree: he experiences himself as neither limited to nor excluded from any role or diegetic level, except roles he does not want. He is not conscious of or interested in any segmentation or layering of his experience. One of the most compelling aspects of interactive narrative is its capacity to engage the narratee in a transaction that inevitably draws them into the diegetic level of the story and thereby renders the story and 'reality' inter-permeable. This engagement to actively participate places the narratee, as it were, in a diegesis at the next level up, by making 'control' demands of him/her. By breaking the barrier between diegetic levels, this engagement opens the door to further and more profound participation by the narratee, directly in the main diegetic level of the story itself, as a participant, even the protagonist (as in many games).

Some mapping of narrative levels in Louis' and my discourse will be helpful in clarifying this mechanism. In the example I work with the premise that the different worlds of activity can be described as diegeses. I have separated the diegetic levels by indents: the first level (which I only refer to obliquely) is the world as we collectively know it, containing things like buses, trains and this essay. The second is a ritual world which is iterated by Louis and me: our journey to school, on a train and then a bus and then another train.[2] Then, as an element within that ritual, beginning when we're seated on the bus, the sub ritual of Mr Dog and Rabbit Story, which is always initiated by Louis, and which is where

[1] Genette, G., 1980. (pge. 236)

[2] It is necessary to recognise that ritual is very important to children, and that constructing and having control over ritual structures is an essential part of the way children make sense of the world and feel powerful within it. Anyone who has spent time with young children will recognise this: the way that certain things or sequences of action have to be just so. For example, at the beginning of this ritual of Louis and I 'Going to School', he always stands in the same place on the platform, on a particular manhole cover. This creation of a world of ritual, and its extension into the world of story, is a magical act of power for the child. The writings of Bruno Bettelheim (e.g. The Uses of Enchantment) and D. W. Winnicott (almost everything he wrote, but particularly Playing and Reality) are very helpful in understanding such aspects of childhood, and have informed the author's development of his own ideas. It is also to be understood that such ritual activity is not confined to childhood, and it is part of the author's proposition that the 'magical', compelling nature of some interactive narrative experiences derives, at least in part, from a resultant unconscious reconnection with the magical world of power of the child.

we discuss aspects of the story development. This contains the narration which I perform, which itself contains the diegesis of Mr Dog and Rabbit story.

So to Louis' participation: he is in layer one along with all of us; layer two, the journey to school, is delineated by his and my activity but includes all the other people and things on the walk-train-walk-bus-walk-train-walk from home to school; the third level is exclusive to Louis and me, in fact it cannot take place unless we have a seat to ourselves on the bus and second train. This is the authorial layer, where Louis engages in the story planning, setting the basic plotline. He is not active at the level of narration, he's listening to me tell it. Then, at the level of the story, he can leap in and appear as a character (himself), and also send messages from where he is (the narratee position) to the characters, acting as a sort of Deus ex Machina; the discrimination between these two positions is subtle, and beyond the scope of this essay, but when Louis is participating in the story in either of these ways, he is an intradiegetic narratee, that is, he is inside the world of the story that is being told to him by me.

Which leads us to a seemingly trivial but important point, which is that Louis, of course, is completely unaware of all this narratological stuff, he's just doing Mr Dog and Rabbit story, moving fluidly between the various levels because that's what he wants to do. It is the operation of this unconscious fluidity in moving across diegetic boundaries that has captured the author's attention, and encouraged reflection on the experience of interactive engagement in the context of narrative. It would appear in the example that the movement between the playing out of different roles on different levels of reality is precipitated because both narrative and interaction are present. There has to be a story to enter, and interaction gives the narratee agency, the capacity to transform how the story unfolds, which itself precipitates this very different mode of engagement with the story. It would also appear that the experience of being inside a story that you are being told, of being the intradiegetic narratee, is compelling in a way that non-interactive narrative cannot be. This is not a question of intensity of engagement but of experiential and psychological position of engagement. One only needs to talk to gamers about their experience to see how this plays out, and how compelling it can be.

This is an anecdotal account; deeper understanding of how metalepsis and the intradiegetic narratee position work, and interact with other factors, in interactive narratives, is a matter of further research. Also of interest is the way some interactive narrative situations can feel 'magical', and how this may relate to the way young children spontaneously and habitually enter the stories they are being told.

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# Automated Storytelling in Sports: A Rich Domain to Be Explored

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**Abstract.** Sports broadcasting typically involves a play-by-play commentator and a color commentator. The color commentator's function is to entertain the viewer during the game. The prevalent way of doing so is by telling brief stories relevant to the game in progress. In this paper, we propose that storytelling in sports is a challenging and rich problem for Artificial Intelligence (AI) research for the following reasons. First, storytelling is considered to be a very "human" activity as it requires engaging the audience in a story and appealing to their factual as well as emotional sides. Thus, automating it will be an advance in AI. Second, while automated storytelling in general has received ample attention, storytelling in sports has seen much less research. Third, an AI storyteller can be used as an assistant to a human color commentator in a real game, or autonomously in the context of a sports video game. Fourth, the task is non-trivial as we demonstrate by applying off-the-shelf machine learning methods in an attempt to match baseball stories to baseball game states.

**Keywords:** storytelling, color commentating, machine learning.

## 1 Introduction

Commentary is an important element of the sports viewing experience. It has been found that during sports broadcasts, "...the words of the commentator are often given most attention" [4]. The commentary has the effect of drawing the attention of the viewer to the parts of the picture that merit closer attention [5], an effect called *italicizing* [1]. The descriptions given in a broadcast are so useful that fans often bring radios to a live game in order to listen to the interpretations of the commentators [7].

Sports broadcasting involves different ways of communicating information – play-by-play commentary, statistical analysis, humor, and our focus, storytelling. Professional sports have been around for over one hundred years, providing a large amount of material for stories to be told during breaks in play, or sometimes while play is in session. Stories from a sport's past help educate the listener about the sport in an entertaining way, while tying its present with its past.

Professional baseball is a billion dollar industry [8] that lends itself especially well to storytelling. It is a sport that involves ten minutes of action for every three

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hours of gameplay. This leaves ample time for the broadcast team to tell stories from baseball's past to amuse the viewers. The more popular broadcasters are known as "storytellers" [10], as they augment games they broadcast by adding stories that make a historical connection to the present game action.

## 2 Problem Formulation

Sports commentary typically involves two individuals - a play-by-play commentator and a color commentator. Play-by-play commentary is generally factual, describing the events of the game at hand as they happen, and providing statistics for the players involved. Color commentary, on the other hand, is much more subjective and broad, with the purpose being to add entertainment (i.e., "color") to the broadcast. This can be done in several ways, including deeper analysis of play, background information, and storytelling.

We focus on the storytelling aspect of color commentary. Drawing on their own past experiences, color commentators typically tell stories from a sport's past based on what is happening or has just happened in the game. For this reason, color commentators are generally former professional athletes in the sport that they are broadcasting, so that their past experiences are from the professional level. However, no single individual is likely to know and remember all interesting stories and incidents in a sport with over one hundred years of history. Thus, having a computer assistant with a large database of stories can give a color commentator a richer set of stories to choose from during a broadcast.

To avoid overwhelming a color commentator, such a system would have to offer only a subset of stories from its database, filtered to fit the current situation (state) in the game. Thus, the task at hand is to determine which (if any) story to tell, given a sport game state. We also must determine when *not* to tell stories, since we do not want to overload the viewer with information and disrupt the flow of the game. If we do choose to tell a story, it should have enough in common with the current game state that the viewer is not confused as to why it is being told, and entertained by the fact that the sport's past can be related to the current state in an interesting manner.

## 3 Related Research

To the best of our knowledge, there are no deployed Artificial Intelligence systems for color commentating in real-life sports broadcast. Thus, we turn to simulated games in the form of sports video games.

Modern commercial sports video games typically employ professional broadcast teams from television to provide commentary for the action in the game. This involves pre-recording large amounts of voice data that will be reusable for many different games. *MLB '09: The Show* [9] is often considered to be at the leading edge of baseball video games. Jon Miller and Joe Morgan of *ESPN: Sunday Night Baseball* provide the play-by-play and color commentary for this game, respectively. Most of the color commentary involves analysis of what has happened on the field and indirect suggestions to the player as to how to improve their play.

To the best of our knowledge, previous academic work in automated commentary for sports video games has focused primarily on automated play-by-play commentary. *Byrne*, *Rocco* and *Mike* [2] are three systems that produce automated play-by-play commentary for RoboCup simulator league soccer games. The three systems obtain their data from the Soccer Server [6], which summarizes the gameplay's main features – the player locations and orientations, the ball location and the score of the game. Each system generates natural language templates, filling in player and team names where appropriate, then uses text-to-speech software to verbalize the derived commentary.

*Rocco* and *Rocco 2* [3] make use of *a priori* soccer knowledge and an event hierarchy to shape their commentary. *Rocco 2* adds some biases to the commentators, using language that expresses emotion towards the teams involved. *Byrne* includes a human face that changes its expression based on built-in biases and what is happening on the simulated field. *Mike* makes use of six *Soccer Analyzer Modules* that perform different operations on the available data, communicate with each other, and make suggestions to the proposition pool, which leads to natural language output. There is indeed some color commentary in these systems as well, but no storytelling.

There has been much work on automated storytelling in non-sports video games. Such systems generate or adapt a story involving the player, creating a so-called interactive drama. However, this body of work is not directly applicable to storytelling in sports color commentating because (i) the storytelling system has no control over the sports game and (ii) the player is not involved in the story being told.

## 4 Our Approach

In our approach, we assume that a computer system has access to the game state as well as a library of previously written stories. The task, therefore, is to match the current game state to a story from the library. When a match of sufficiently high quality is found, the corresponding story is presented.

The scenario above fits the sports video games well because the (simulated) game state is readily accessible by a computer and the story can be presented to the viewer directly. In the case of a real-life game, we envision the system having access to the features of the game state (e.g., the current score) already entered into a computer for the purpose of the live broadcast. The story matches found by our system will then be presented live to the human color commentators who may decide to integrate them into their commentary.

Formally, we describe the game state $G$ as a vector of $n$ real-valued features: $(f_1, f_2, \dots f_n)$. In a baseball game, these features include items such as the score, the count on the batter (balls and strikes), and the career statistics for the batter and pitcher. A story $S$ can be described with features that match those in a game vector: $(f_1, f_2, \dots f_n)$ and additional features that do not map directly to game features: $(h_1, h_2, \ldots h_m)$. An example of an $h_i$ is whether the story involves a player leaving a game due to injury, since the game data may only state that the player left the game – not why.

Depending upon whether or not the story features can map directly to the game features, different techniques are available for determining relevant stories at any given time during a game. One simple method is to strictly match the $G$ and $S$, although this would likely lead to a very few matches, since the exact situation that led to $S$ is unlikely to occur again.

To increase the number of candidate stories, we define a relevance measure $D(G, S)$, which is a function of a given game vector and story vector, with stories relevant to a given game state yielding a higher value of $D$. There are two problems with selecting stories merely on the basis of such a relevance measure. First, the system would have to compute relevance between a game's current state and all stories in the database, which can be computationally expensive. More importantly, computing relevance for all stories in the database increases the chances of a bad match due to errors in the relevance function. As a result, a story completely unrelated to the game's state can end up selected for broadcast. To address these two problems, we compute the relevance between game state and stories only for a subset of the database — the stories that fall in the correct category (e.g., "Marquee Matchup"). Specifically, given a game state $G$, we first compute the appropriate category $C(G)$. This is done with a machine-learned multi-class classifier.

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# Level-of-Detail Stories as a Virtual Museum of a Movie

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## 1 Introduction

We propose a novel approach - employing of level-of-detail with stories. The key idea is to create a tree representation of a story, where the root represents a single annotated image, and the bottom a selection of several hundreds of annotated images. The time available for each percipient of the LOD story identifies the number of perceivable images from this story. In other words, the root offers the story's main picture and message (one-liner), while the leaf nodes mean the full-length comics strip. The LOD-story input is the time available to a virtual tourist. The output is given by the presentation itself - and its length.

We document the proof-of-the-concept with a feature film directed by Martin Tapak and produced by Peter Rufus. Matej Zeman art-photographed the movie creation and his hundreds of images are combined with movie script for the LOD-story. This LOD-story is intended for use in the first Slovak virtual museum on cratft and art of tinkering.

## 2 Previous Work

There is a vivid research of digital and interactive storytelling, including EU project Inscape or MIT Media Lab Center for Future Storytelling. Visionary books by Glassner [3] and Crawford [2] advocate immersive interactive storytelling. The final evaluation of a story can be easily measured by the feedback from e-tourists.

Virtual time, artificial intelligence (Facade), and perspectives of future storytelling are studied by [4,8,5,6]. Backtelling is the easiest way of storytelling in virtual museums [1], reading stories should be provided in any case, e.g. for disabled people or small children. Other types include visual novel, comics, even story use for visualization [11] etc. Our key observation is that there are multiple versions of any story, varying in length.

In our project Virtual Heart of Central Europe[1] we first used a triplet of story versions, the levels of detail - short, middle, and full length.

In the Virtual museum of tinkers' history[2] we faced another challenge. We created audio, video and timing data for presentations and for storing in memory.

[1] http://www.vhce.info

[2] http://www.sccg.sk/ projects/pav-pm3d/

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Virtual time is a specific resource for presentation and interaction. We dealt with its control in linear story case and static virtual museum, as well.

The primary datasets for the movie included the novel, movie script, 678 colour photos scanned in TIFF format (more than 7GB). For our purpose, the TIFF files were resized and stored in JPG with annotations. The material shot and the TV series (180 minutes) are not available for virtual museum. We had to reduce hundreds of script pages and hundreds of photos in terms of virtual time. Eduard Dlugoš, the computer specialist in the real museum, after reading the novel, composed a music composition. Its MP3 file has less than 8MB and its duration is 8 minutes and 16 seconds. So the first storytime reduction was a PowerPoint presentation using a selection of photos and the composition, converted to Flash. One can run it either interactively or with given timing with Slovak subtitles focused on story crucial actions. Besides the music, we used silence, when the protagonist died. The soundtrack is not related directly to the events. We added 6 documentary photos, some are repeated and in total there is 64 photos and 104 slides. The "compression ratio" is 1:20. The presentation is at the webpage.

## 3 Our Approach

We combined two ideas into a new approach: level-of-detail and timing. Our prototype offers an experimental presentation of the dataset described in the previous section. The approach can be used with any movie, but the authoring of meaning simplification pyramid (or story precision) can be a hard task in general. Up to now we have no authoring tool for this.

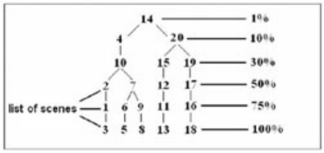
The names of photos helped us to assign images and scenes manually. Combining text and images we created single database items (scenes), Figure 1 illustrates the design. For each scene we identified the level, stored as scene index. For example, 20 indexed scenes are stored in 6 layers of a tree data structure, as shown in Scheme 1.

The biggest challenge in our project was the image-text assignment. We had scenes without photos and too many photos for a short scene. The second problem can be solved by representative selection. The first one we solved by creating an alternative photo stating S̈cene without an image:. The reason for this was to indicate, that the program runs well, just the data are missing.

Besides standard functions like Play or Rewind, the user can set intuitively the speed and percentage, as seen in Figure 1. The Percentage identifies the level in the tree and the Speed the speed of playing.

### 3.1 Implementation

We opted for multiplatform solution in JAVA. The level of detail indicator was added to each item (scene) and all items were stored in MySQL database. The database queries are communicated by a Java application. Visually and functionally we subdivide the screen into three parts for image data, text, and navigation. An e-tourist perceives the information shown in Figure 1.




Scheme 1: Manual assignment of 6 levels of details for 20 selected scenes and the resulting tree


**Fig. 1.** The witch doing some magic with a cock. In this case the Slovak text extends the imagination of a viewer, describing what happens around the fireplace before and after in terms of time - and in invisible surrounding, as well.

Our application reads from the database the list of selected scenes and the speed of automatic play. If no speed was selected, one can use the standard buttons like Rewind, Fast-Forward or jump to the story beginning or end. These functions can be used during the automatic presentation, as well. The speed can be changed during the replay and Stop and Finish are active all the time.

## 4 Results and Discussion

We have proposed and created a prototype of LOD-stories, suitable for a virtual museum presentation. For an English criticism of the original novel refer to [10]. As the film for movie theatres is not finished, it belongs to nonavailable cultural heritage nowadays. Virtualisation solves this problem, but the intellectual property limitations disable the full-length communication. LOD-story saves the time of an e-tourist and allows for sharing the message with certain uncertainty.

Our contribution generalizes the ideas, used in the projects' webpages. The tree representation is similar to [7], but we traverse the tree on a given level. Our representation serves for presentation, while Murtagh et al. analyze the script structure.

We guess that the everyday human experience with browsing and preview can be helpful at least to lock the conflict, approximate the story context and atmosphere. We prepare online publishing and evaluation of LOD-story approach, limited to Slovak language at the moment. The first feedback from another two target groups - amateur movie makers and filmmaking teachers - is highly positive. The early version of our idea was published in poster session at International Symposium on Computational Aesthetics in Graphics, Visualization, and Imaging, London 2010 [9].

## 5 Conclusions and Future Work

The future research work is motivated by an open problem - how to measure the quality of a LOD-story. Another promising application was proposed independently by two reviewers - LOD-stories for crossplatform, multiple accessing devices.

In general, our main contribution means extending the timing model of J.L.Borges by removing his hidden assumption – that the time speed is constant. It is not true for our user.

## Acknowledgement

This work has in part been funded by Slovak Ministry of Education VEGA No. 1/0763/09. The authors wish to thank for photographs to Matej Zeman and for valuable comments to all anonymous reviewers.

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# Establishing Communication Channels for Digital Storytelling Applications

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**Keywords:** Communication skills, computer-mediated communication, MPEG-V, ADML.

## 1 Introduction

Digital storytelling refers to use digital tools so that people can tell their stories. That is, it is a technological application that allows people to communicate a *message* to other people.

Due to that reason, from authors' point of view, the selection of the most adequate communication channel should be a crucial step in order to transmit correctly the story.

This work starts from the hypothesis that a correct selection of the communication channel provides these advantages to a digital storytelling application:

- An adequate communication channel can provide a better understanding of the story.
- Users could have different preferences about communication channels. An application that is able to adapt the communication channel to their preferences will be more satisfactory for users.
- Users could have disabilities that make hard to use some communication channels, for example the voice channels for deaf people. If an application has not that into account, the story cannot be transmitted.

However current digital storytelling applications have not a way for defining the user (consumer of stories) profile in a high level way. That is, there is not a way for providing to storytelling applications with the necessary knowledge for adapting the communication channels to each user.

Moreover, if it would exist and these profiles would be standard, all applications could be adapted to users based on an unique profile.

Then, in order to give a way for specifying these communication preferences or needs in a standard way, this work proposes the use of Avatar Definition Markup Language –ADML–. It is a XML-based high level language created by this article's authors and whose first stage results were published on [3]. This language is now part of the new MPEG-V standard.

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## 2 ADML Overview

ADML codifies the characteristics that define an avatar identity (appearance, personality and communication skills) following a similarity with the human being identity [3]. This codification is XML-compliant.

The fact of being XML-compliant, as standard for information representation, allows developers to quickly implement libraries and tools for integrating ADML in their applications.

ADML was initially designed for being adaptable to current virtual worlds. But some features as the communication skills can be clearly applied to other kind of applications, especially digital storytelling ones.

As it has been stated, ADML is composed by three main sections: appearance, personality and communication skills, following the structure of Fig. 1.

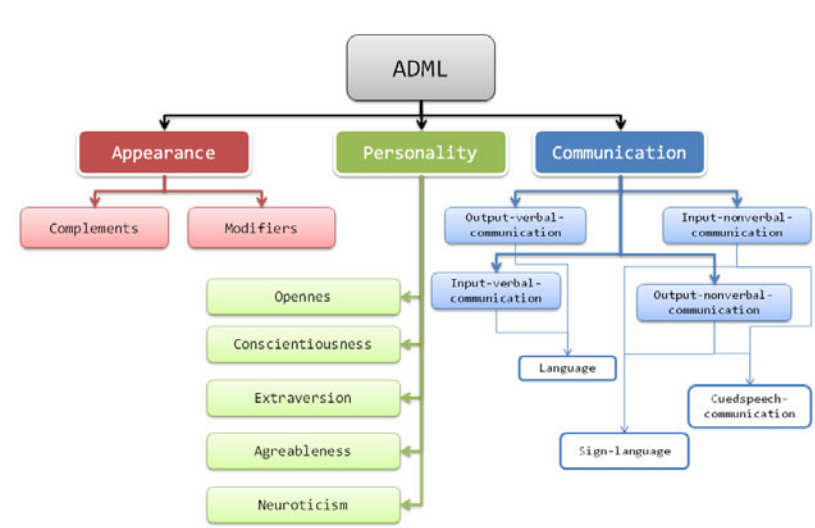


**Fig. 1.** ADML nodes structure

The root node is named by `adml` tag. There are three children nodes, one for each section, which can be used separately:

- In case of `appearance`, it can contain appearance modifiers or complements like clothes, jewelry, etc.
- In case of `personality`, it contains children nodes following the Five Factor model [1] in order to define a concrete personality.
- In case of `communication`, input and output channels can be specified and, for each of them, the language preferences.

## 3 Communication Channels

In order to obtain the features that define the communication among users, the features related with the Shanon-Weaver transmission/reception schema of a message will be specified [2]. The generation and interpretation of the message will happen in the intelligent elements (persons and storytelling components).

Features are referred as message codification and decodification options. That is, the objective is to configure a specification that allows transmitter and receiver to agree in a communication way that both of them are able to use.

Most usual communication possibilities between two (or more) persons are shown in Fig 2.

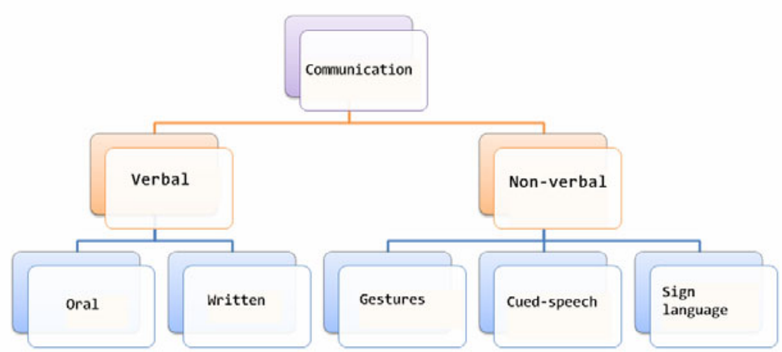


**Fig. 2.** Message transmission/reception possibilities

ADML defines the `communication` tag as a way that allow applications to know the communication preferences of users and to be able (or at least to be in position) of adapting their inputs and outputs to them. In this way, all the inputs and outputs would be individually adapted to each person.

Communication preferences are defined in ADML by means of two input and two output channels, guarantying multimodality. These channels are the voice and gestures recognition in case of inputs, and the verbal and gestural channels as outputs.

Basically, channels can be specified as enabled or disabled. If all the channels are active, it implies that the person is able to speak, gesticulate and recognize voice and gestures.

Moreover, in input and output verbal communication channels, text or voice preference can be specified.

Gesturing generation and recognition channels specifies three kinds of gestures: Gestures related with the speech-arising non-verbal language; sign language and cued-speech language.

All the language-dependent skills (speaking, both via text or voice, voice or text recognition, and generation and recognition of sign language and cued-speech language) include an attribute called `language` for specifying the concrete language skills.

## 4 Results

The ADML specification and its suitability for digital storytelling application have been tested by means of the prototype shown in Fig. 3.

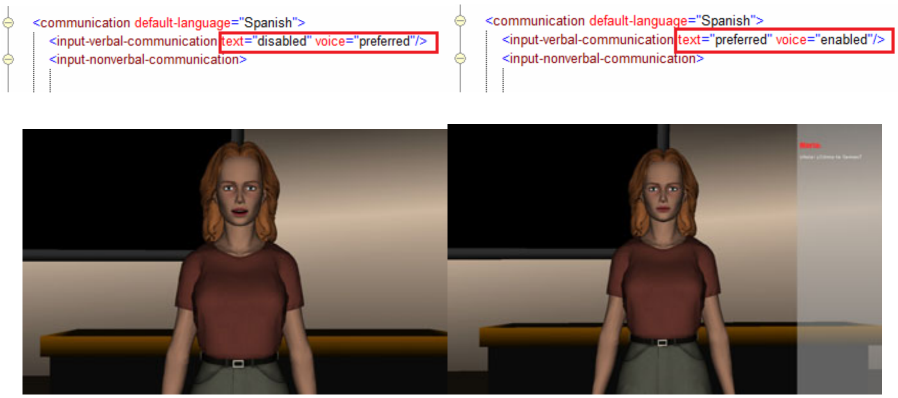


**Fig. 3.** Simple examples of communication preferences in ADML

The Fig. 3 shows a basic example where a character is telling a story. The story is the same but the way of transmitting it depends on the user communication preferences.

- In the first image, the user expresses through ADML his preference about verbal communication via voice. Then, the virtual character says the story speaking.
- In the second image the user has expressed his preference about verbal communication via text, although he is able to understand voice too. Then, the character says the same story via text.

This simple example is the base of the ADML applicability to digital storytelling: the same story could be individually adapted to audience communication skills.

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# Agency and the Art of Interactive Digital Storytelling

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**Abstract.** Taking seriously Andrew Stern's aspiration that IDS become a premier art form for the 21st century, this paper re-examines agency, understood as the ability to freely control the plot, as a key concept in IDS aesthetics. Tracing the origins of this notion in IDS theory, this paper suggests that "true" agency is a myth, and that even restricted agency is too constrained to serve as a desirable goal for IDS-as-art.

**Keywords:** agency, control, art theory, interactive art, IDS.

## 1 Introduction

In an inspirational keynote at the first international conference on Interactive Digital Storytelling (ICIDS), intended to equip the research community with a prescription for R&D, Andrew Stern expressed his belief that "digital interactive stories can become a premier art form of the 21st century"[1], but lamented the current condition of this nascent form, which is far from realising its potential. He then proceeded to list the "quintessential requirements of interactive story". The first such requirement is to acknowledge that "*agency* is the primary feature that must be offered players". Stern refers to the success of "high-agency videogames" as "empirical proof of this assertion". According to Stern, agency is "the first wish that most players, developers and researchers originally feel when first encountering and considering interactive story". Stern provides two descriptions of agency. He first links it to meaning, writing that "the most successful games offer true *agency* – the ability for players to have persistent, meaningful effects on the events of the experience" ([1], p. 2). He then premises it on intentional direction of the plot, writing that in the context of interactive stories it is "the implicit promise to the player to be able to directly affect the plot of the story, taking it in whatever direction they wish" ([1], p. 3). Stern bases his suggestion that agency become the primary design ideal for IDS on the assumption that this is what players want and expect, and he even goes as far as to say that if anyone believes otherwise then "it is only because they have been conditioned by play experiences (or research experiments) that fall short of this ideal" (Ibid). Consequently, Stern links agency to player control by suggesting that the term "storytelling" be replaced by "storymaking", since the verb "telling" implies a conceptual framework which is "antithetical to the notion of giving primary control to players to direct the interactive story", which is what the research community should aspire to "as we work towards building interactive stories with true agency".

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In an online response to Stern's article [2], improv-theatre maker Andreas Benkwitz wrote about control-agency that "if there is such a desire or ideal, it stems directly from our romantic ideal of authorship or being a creative artist…Stern wants to transfer the control ideal from the artist to the player and assumes that the ideal player wants to be like the romantic ideal of the free artist", and calls this ideal "control hell". In my opinion, the notion of control-agency seems more clearly to betray the cybernetic, control-engineering origins of the HCI heritage of IDS theory. However, a full discussion of the origins of this "control hell" must remain outside the scope of this short discussion, which will be limited to some of the theoretical issues that stem from Stern's keynote: the definition(s) of (true) agency, the relation between agency and authoriality, and the scope of control-agency's applicability.

## 2 Definitions of (True) Agency

Stern's two descriptions of *(true) agency* in the keynote are not identical. The first speaks of meaningful influence on events, yet lacks specificity about the mode of influence and lacks the component of intentionality - which the second description restores. Both, however, do not refer to some distinctions that were introduced to the discourse since Laurel broadly applied Aristotle's use of agency - originally related to a character's potential for action ([3], p. 60) - to user experience, as "the ability to *do* something" ([3], p. 116, italics in the original). Laurel's concept was not specific to IDS or interactive art of any sort. This was left to Janet Murray's influential definition: agency is "the satisfying power to take meaningful action and see the results of our decisions and choices"([4] p, 126). Murray's two innovations, which Stern upholds, are (1) to explicitly link agency to meaning and (2) to constrain the meaning of *doing* to the player's (intentional) *decisions and choices*.

Neo-Aristotelian theory, besides emphasising the primacy of agency (as Mateas does in [5]), contributes another important idea to the understanding of IDS experience: that of the temporality of meaning production. Mateas and Stern [6] distinguish between *local* and *global* agency. Local agency is the experience attendant to a specific user action or choice: "When the player's actions cause immediate, context specific, meaningful reactions from the system, we call this local agency." Global agency can be deferred: "[A]t the end of the experience the player can understand how her actions led to this storyline." This important distinction (which nevertheless seems not to revise Murray's emphasis on intentional actions), is missing from Stern's keynote. Is it local or global agency – or both - that players most wish to feel and which is responsible for the success of high-agency videogames?

A final distinction was introduced in Tanenbaum and Tanenbaum's ICIDS2008 paper [7] - the distinction between *true*, or *unrestricted* agency, and *limited* agency. They note correctly that it was the latter type which Murray initially suggested as a primary feature of interactive narrative (cf. [4], p. 152). However, it would seem that it is time to recognise that any distinction between true and restricted agency has no practical or theoretical value. Put simply, such true agency as Stern seems to call for just doesn't exist, at least not outside the realm of expectations and theoretical discussions. In fact, if there is an expectation of true agency, it may be (as Tanenbaum and

Tanenbaum also note) merely the product of the relatively recent culture of games, which conditions some players to expect to be able to control the plot ("taking it in whatever direction", as Stern suggests).

Agency in an IDS work (and in relation to any mediating technology in general) is always restricted. It is limited by the design of the system – as both Laurel (who devotes an important section to the importance of authorial constraints) and Murray have indeed emphasised. Rather than an ideal, true agency should be seen as a myth. Furthermore, restrictions on agency should not be viewed as a shortcoming. Dramatised agency – and this is what one might indeed experience in IDS – should be no different from any other emotion felt in a dramatic context. As with pity and fear, so does the feeling of agency in an artistic, dramatic context is experienced as free from any "threat of harm or pain in the real world" ([3] p. 114). Agency in IDS is not real world agency. It is always already restricted, first by virtue of being simulated and dramatised, and then specifically by any additional (authorial) constraints.

## 3 Agency and Authoriality

Stern's suggestion that the community should (a) be engaged in building interactive stories with true agency by offering players primary control to direct the interactive story, as well as (b) avoid "telling", appears to contrast agency with authoriality. If agency is primarily what IDS experience is about, but telling is not desirable, then it follows that interactive stories shouldn't be authorial. This may be an interesting avenue to explore but it can't be the only avenue. IDS, especially IDS-as-art, must also remain open to the possibility of authorial experiences that maintain, for example, a bi-directional communication between author and player (for a recent communicative model of IDS see [8]). In fact, players of authorial works are also always addressees of an authorial creation and may very well accept and welcome authorial restrictions on their agency.

Some evidence for this may be found in Knoller and Ben Arie [9], which analysed the self-reporting of a small sample of subjects who experienced Turbulence, a "low-agency" narrative hypervideo (agency is understood in this case not as a quality of meaningful involvement but rather as a quantity of the power to act). Subjects in that study had a mixed background in terms of their exposure to gaming and gaming culture, so their expectations varied. One point in the work was specifically designed to contradict assumed player intentions. If agency is indeed the freedom to control the story, this should clearly have resulted in a devastating loss of (global) agency, and that loss would be experienced as frustrating and certainly not pleasing. And yet, the subjects of the study seemed to indicate something else. Some (not all) of them noted that the low *local* agency impeded their engagement. But, on the other hand, some of those interviewed welcomed the apparent loss of *global* agency as part of the experience, highlighting the existence of different plot options. While a more careful study is required to validate and further nuance this conclusion (and especially to investigate how much prior immersion in gaming culture affects expectations), we can at least accept that for some players, global control-agency is not a requirement for pleasure as they expect and even enjoy authorial constraints and challenges.

## 4 The Limited Scope of Agency

Suggesting, as Stern does, that agency premised on intentional player control over the direction of the plot is an ideal that can't be questioned, over-constrains the artistic possibilities of the medium. It misses out on at least two important aspects of potentially meaningful interactive experience that fall outside the realm of intentional choices and decisions of players.

First, current sensing and affective computing technologies are able to react to implicit aspects of user behaviour and performance. Being implicit - and therefore unintentional - these aspects of interactivity can't be understood in terms of local control-agency, which is necessarily intentional, and yet they may produce meaning retrospectively, as the player's implicit causation of events becomes apparent.

Second, even if technology was able to respond only to choices and decisions, artists are within their rights to treat agency as subject matter by creating IDS experiences that play on, challenge and frustrate aspects of control-agency (both or either local and global) rather than simply offer it as-is (as we've seen in 3 above – and there are other examples such as [10] and [11]); and players may enjoy such experiences and find them meaningful.

In these respects, it seems that the assumption of the primacy of agency as intentional player control over the plot, at least for IDS-as-art, requires some revision.

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# Realism and Virtuality: Carmageddon as Contemporary Simulacrum Model

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**Abstract.** It is a popular idea that violence and addiction (long term immersion in virtual worlds) are negative outcomes of game's content and graphic. The paper explores weather those elements can serve as the starting point in research of the role of realistic representation of violence. By analysing basic structural elements of games (topography, narration and action), the paper will propose formal analyse as precondition for phenomenology of games. The game Carmageddon will serve as base for analyse of new type of simulacrum that is "action oriented".

**Keywords:** violence, addiction, formal analyse, representation, phenomenology, simulacrum.

## 1 Introduction

Games are at the same time to real and not real enough. Psychologists analysing games feared of "translating attitudes and actions from virtual in real" (Sommerseth, 2007), while at the same time co-opting "addiction rhetoric" (Cover, 2006) to describe narcotic qualities of imaginary worlds. The first problem relies on congruence between virtual and real in matter of "the final realization of André Breton's dream of the purest surrealist act: the desire to burst into the street with a pistol, 'the petty system of debasement and cretinization.'" (Galloway, 2006:104). The second problem is almost opposite one - what kind of fiction, narration, design creates such a great environment that forces player to denounce physical body and world?

## 2 Formal Analyze

Because of the "content barrier" critics of computer games fail to understand the value of economy of utilitarian acting in the non-utilitarian environment. Most of them claim that playing computer game is a "waste of time". All computer games are non-fruitful acting in order to receive (non-fruitful) reword. In that way running over pedestrians in Carmageddon is similarly unproductive act as collecting coins, balls, mushrooms, or diamonds in the platform games Super Mario Brothers (1985) or Giana Sisters (1987). Analyses of game content fail to decipher the "pleasure of the text" since affinity towards violence in Carmageddon (as in other violent games) is not only a matter of content, but also a matter of structure.

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Aiming, throwing bombs, kicking and other game actions are particularly popular game motives since they comprise all game variables (narration, action and topography). Formal film theory considered chase scene to be standard convention of film narrative because of its rhythm that defines film time (Peterlić, 2001). Carmageddon exploits tradition of this classic film motive by relying on classical "filmic experience" - chase scene as a motive that only sketches narrative situation (car, driver, pursuit). But more important, Carmageddon relays on rhetoric that can be defined as classical game rhetoric. Experience of playing games includes widely used and transformed motives that can be extrapolated from two basic forms - aiming and shooting. Popularity of specific motives emerges also from the fact that they force gamer to immerse into the virtual world (topography) by limiting perception (to the target).

## 3 An Unacceptable Passiveness: Games as a Symptom

In the days before digital storytelling, Jean Baudrillard considered Crash, a novel by J. Ballard (1973), to be an exemplar narration for understanding contemporary Western subjectivity (1985). According to Baudrillard, Crash is not a glorification of violence or perversion (novel represents a group of fanatics that find sexual excitement in car accidents), but analyze of Western society that is defined by technological mechanisms of crash, explosion or motor combustion. In the era of digital storytelling games offer one of the most precise diagnosis of "action culture". Gaming pleasure is a symptom, and not a cause of contemporary simulacrum society. Two dominant social fears regarding games (of acting and/or abandoning reality) offers important insight not into the ways in which games transform reality but into the ways in which games are symptom of it.

Liberal capitalism highly values active performance, while passiveness is unacceptable. Economy, politic and art are determined with acting metaphors as one of the most important source domain for contextualising contemporary "ultimate fight" experience. Today most common notice to politicians is «don't just talk, do something» (Žižek, 2008). Despite popular understanding of games as "wasting time", economy of non-fruitful accumulation (killing, collecting, organising, etc.) corresponds with economy of informational capitalism. The accumulation is not a matter of collecting real, material "things" but precisely a matter of understanding "codes" (an algorithms) what Gilles Deleuze predicted to be an dominant model of control societies (Deleuze, 1990). In the culture of proactive subjects every action is quantified with specific parameters that define whether the subject will be reworded or degraded. (The mechanism of management style control described by Deleuze.) In the game "every action is just a means to an and" , therefore constant insight into outcomes of gamer's decisions claims McKenzie Wark is a source of gamers pleasure (Wark 2007:9).

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# Emohawk: Learning Virtual Characters by Doing

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**Abstract.** Emohawk is a narrative-based serious game designed to be a supportive tool for teaching basics of virtual agents development at universities and high-schools. Emohawk is built utilizing a free version of Unreal Engine 2 and it features an interactive scenario with four virtual agents controlled by an appraisal-driven architecture playing out a story approximately 5-10 minutes long. Students are engaged in solving game-based tasks with increasing complexity and simple programming tasks related to various parts of the virtual agents curricula. The Emohawk distribution includes documentation, graphical debugging tools and tutorials. The project is in continuous development and we plan a large evaluation for the 2010/2011 academic year.

## 1 Introduction

Serious games are becoming increasingly important as educational aids. Despite some skepticism about integrating games within formal schooling environments, e.g. [4], the recent data suggest this approach as promising, e.g. [3].

The discipline of studying virtual characters (VC) matures; however educational issues in this field remain largely unaddressed [2]. To address the existing gap, we have been developing a serious game called Emohawk [5]. The game's goal is to provide support for the education in VC development. In particular, it should assist in teaching: a) basics of 3D VC control, e.g. steering and reactive planning, b) appraisal-driven architectures, c) coordination of multiple characters; i.e., unfolding "atomic bits" of a story, d) composing a story from these "atomic bits". The primary audience is university students and teachers of general computer sciences, social sciences, computer games and new media and art. However, our game should also serve as a tool for teaching high-school students, both girls and boys, basics of programming and graphics and promoting them to study technical disciplines at universities. Therefore, we have designed it to attract attention of this audience as well.

The Emohawk's scenario is situated within a 3D virtual town with modern architecture (Fig. 1a-c) featuring six different virtual characters (two boys, three girls and an alien creature called emohawk) with hundreds of animations. Students proceed in the game through several game levels corresponding to various parts of a typical university VC course, e.g. [2] (presently, two levels are finished). Each level represents an interactive task, in which the student is expected to build in his or her mind mental models related to particular aspects of VCs. This should happen while the student actively explores the underlying mechanisms producing the overall narrative.

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For instance, in one game level, students can switch on/off individual steering rules, investigating the impact on the resulting walking behavior. Another level provides students with control over individual appraisal rules. A third level gives the opportunity to add objects, which may distract the characters to the environment and investigate agent's attention mechanisms. In general, the game-play comprises constrained interaction with the environment from the observer's perspective.

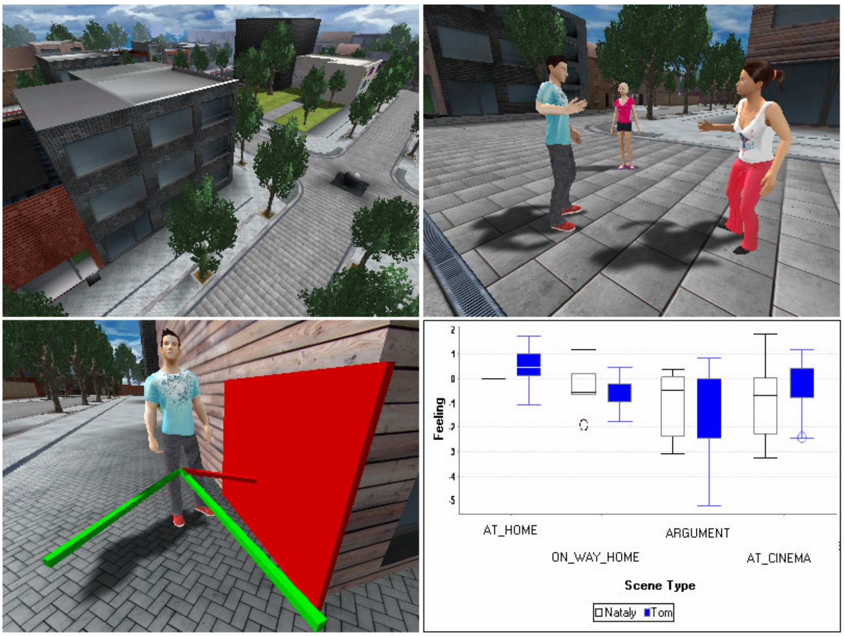


**Fig. 1.** Emohawk content in Unreal Engine 2: a) a virtual city, b) three characters arguing, c) a character with ray-tracing visualization, and d) one of output graphs

## 2 Technical Information

Emohawk is built upon the Pogamut platform [7] and uses the Unreal Engine 2 Runtime (UE2) [6] to represent the 3D world. Pogamut is our own toolkit allowing for rapid VC development in Unreal Tournament 2004 and UE2. UE2 offers a free licensed 3D environment with limited environment content. We extended the content (Fig. 1) by creating a 3D virtual city, new objects, and new character models with animations. These extensions are distributed with Emohawk.

Emohawk's game-play is organized around a narrative featuring four main virtual characters controlled by an appraisal-driven architecture. Its setting is as follows:

*At the edge of a small city, there is an emohawk farm. An emohawk is a kind of pet that has the ability to suck emotions from people and spit them on other people. Sometimes, an emohawk manages to escape from the farm.*

*Thomas, age 16-19, lives in the town. He has a girlfriend Barbara and, well, yet another girlfriend Natalie. The girls, of course, do not know about each other.*

*Thomas and Barbara had a lovely date at the cinema. Now, Thomas has to walk Barbara home and he has to make haste, since Natalie is waiting for him to be taken to the very next movie. Besides all this, there is an escaped emohawk roaming around.*

The story is branching and emerges from a centralized story director and appraisal-driven architecture controlling individual characters that combines reactive behavior and a fixed pre-set plan. The fixed pre-set plan defines goals and times when the goals should be activated (e.g. driving Thomas to pick up a girl in the middle of the story). Reactive behavior allows for dynamic addition of goals handling various situations such as “a girl meets the emohawk creature”. The centralized story director handles synchronization of characters – it controls the agents during multiple agent interaction, e.g. the boy and the two girls meet and start arguing.

There is no natural language communication between characters in Emohawk. Conversations are mediated via gestures and emoticons.

Debugging is an essential part of development. Emohawk toolkit features debugging windows allowing for inspection of internal states of characters during the story run and presents a set of graphs and text outputs automatically generated at the end of the story, saving the story runs for further analysis (Fig. 1d).

## 3 Usage

The usage of the Emohawk serious game and its content is threefold. Firstly, users may simply play the game as outlined above. Secondly, Emohawk allows for scripting simple stories. Users may script movement and animations of VC by means of a graphical editor. Users can save the final story and share it with others. Thirdly, Emohawk’s content may be used for tutorials or as an environment where students can solve various programming tasks (e.g., building an obstacle avoidance code for characters). While the first two possibilities are aimed at high-school students, the first and the third are suited for university students and researchers.

The second Emohawk usage presents an overlap with the Storytelling ALICE (SA), which was already used with positive results when educating middle school students [8]. SA is more complex than Emohawk’s GUI in regard to scripting stories; however, Emohawk presents content suitable for older audiences: e.g high-school students.

## 4 Conclusion

This paper presented our freeware serious game Emohawk designed to be a supportive tool for teaching basics of virtual agents development and programming. The target audiences are university and high-school students. Emohawk features a 3D virtual environment, an interactive scenario with virtual characters, tutorials, and graphical debugging tools. On the one hand, Emohawk is a tool designed for teaching. On the other hand, it will present a working example of a storytelling system, complementing few other storytelling systems, such as Façade [9] or FearNot! [1].

Our work on Emohawk still continues, most notably, we improve characters’ behavior during interactions and create game levels. Emohawk’s graphical content (but not the game as such) was already used on an AAMAS10 tutorial. We conducted a small-scale evaluation of the application's graphical content by high school students during 2009: the results suggested that the graphics was accepted by this otherwise very critical target group. We plan a larger evaluation in the academic year 2010/11.

**Acknowledgments.** This work was partially supported by the project CZ.2.17/3.1.00/31162 that is financed by the European Social Fund and the Budget of the Municipality of Prague. The research related to this application was also supported by the Ministry of Education of the Czech Republic (Res. Project MSM0021620838), by a project P103/10/1287 (GACR) and by a student grant GA UK No. 0449/2010/A-INF/MFF. The name "Emohawk" is inspired by Emohawk: Polymorph II, an episode of Red Dward VI (BBC). Emohawk graphical content was created by Zbynek Krulich using Mayang's Free Textures library: http://mayang.com/textures/.

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# Crowd-Sourced AI Authoring with ENIGMA

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**Abstract.** ENIGMA is an experimental platform for collaborative authoring of the behaviour of autonomous virtual characters in interactive narrative applications. The main objective of this system is to overcome the bottleneck of knowledge acquisition that exists in generative storytelling systems through a combination of crowd-sourcing and machine learning. While the authoring front-end of the application is used to create short example stories set in a specific story domain, the server side of the application collects many of those stories and derives behaviour models for autonomous virtual characters such as formal planning operator descriptions from them. A mixed initiative mode increases coherence by feeding already learnt character behaviour back into the client.

## 1 Introduction

Authoring has been recognized as a serious bottleneck in achieving more complex and compelling interactive digital storytelling applications. As a result, work on a number of authoring tools has been reported in recent years (e.g. [1], [2] or [3]). While these tools generally speed up and simplify the authoring process for their respective storytelling engine compared to hand-coding, none of them has yet led to the creation of significantly larger scale playable interactive stories and thus solved the original problem. Here we describe yet another authoring tool called ENIGMA, which was previously introduced (although at that time yet untitled) in [4]. Behind the tool however lies also a different authoring methodology, which might be able to address some of the common problems of current authoring approaches that were identified and summarized by Spierling and Szilas in [5].

## 2 System Overview

The ENIGMA system is intended as an authoring tool for FAtiMA [6], an agent architecture that can be used to create character-driven emergent narratives. Authoring story worlds in FAtiMA-based storytelling systems boils mostly down to defining character behaviour in the form of goal and action descriptions including pre- and post-conditions, emotional reaction rules that define how a character reacts emotionally to certain events, action tendencies for reactive behaviour and personality parameters for individual agents. ENIGMA automatically constructs

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this data, which we have hand-coded (XML format) in previous projects using FAtiMA agents (e.g. FearNot! [7]). Figure 1 gives an overview of the ENIGMA system architecture. A client application which can be run directly from the browser allows contributors, who are invited by a principal author (PA) to create a story within given boundaries, which are set by the PA. Those boundaries include a fixed cast of characters, set of props and scenes and authoring instructions regarding the theme of the story world, back stories of characters, etc. Every story that gets created within this client application will be submitted to a server where many of these stories are collected and processed by machine learning algorithms to generate FAtiMA agents that can be used as virtual actors within an interactive drama.

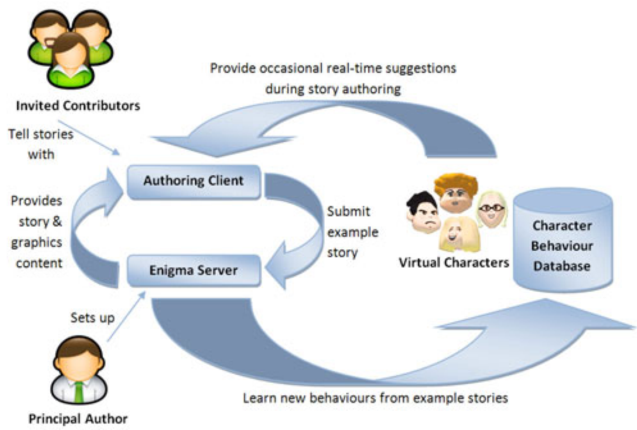


**Fig. 1.** ENIGMA system architecture and work flow

A similar project that also incorporates crowd-sourcing and machine learning aspects for the purpose of AI authoring is *The Restaurant* [8]. A distinguishing feature of ENIGMA is it's mixed-initiative mode, with which the virtual characters can run in the background while a story is created in the client. This allows the characters to make suggestions for the next event to the author during an authoring session, the author's acceptance of which helps to reinforce the learned behaviour. One of our central hypotheses is that this mixed initiative feature improves the coherence of the learned character behaviours through the iterative collaborative debugging it provides.

## 3 User Interface

In order to be processable by learning algorithms, stories created with ENIGMA necessarily have to be represented as semantic data structures with limited expressivity compared to for example natural language. Hence contributing authors tell stories by creating and arranging events through a context sensitive

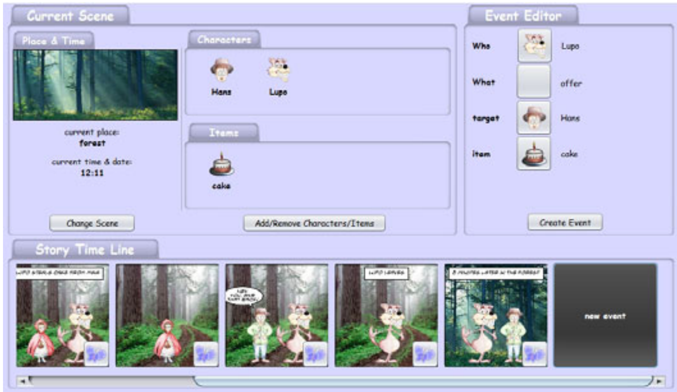


**Fig. 2.** screenshot of Enigma's main window

GUI (Figure 2). An event contains a subject, an action and action dependent typed parameters. For example, if the author selects the action *steal*, they will also be prompted to select an item to steal and a person to steal from. Every created event is also visualised through a dynamically generated comic strip frame. While the PA will provide an initial set of actions, authors can also create new actions through a wizard. Since the graphics library of the comics generator will not contain any content for newly created actions, the contributing author can provide a narration text that will be used as a place holder for visualizing the action. The PA or an additional *artist in the loop* could later add graphics for this action. In the case of dialogue, contributors can reuse existing speech acts (units of dialogue) or create new ones. In the latter case they may not just enter a new line of dialogue; they also have to provide a speech act name to assign semantics to the dialogue line. Authors can also control the narrative time and place and cause scene changes, character entries and exits, etc.

The user interface of the authoring tool will also ask contributors to annotate the stories they create in order to collect additional semantic context information for the processing of the stories by the ENIGMA server. After creating a new event, authors can specify how characters' emotions changed due to this event and which properties change. For example a character can have a property with the name *awake* and the data type boolean that is changed from true to false through the action *go to sleep*. A contributor specifies this by choosing properties and their values from lists. If a property that is needed to describe an event is not yet part of the domain model, the contributor can also define new properties at this stage (this might also involve defining new data types). After completing a story, authors will also be asked to explain it by specifying which goals characters had during the story, at which point in the story they started, succeeded or failed and which events contributed to these goals. We will have to determine through user trials of the tool, whether most authors are willing to perform this annotation and whether the concepts involved in the annotation (properties, types, goals) etc are understandable for non-experts; if they are not, the PA might have to perform the annotation himself (using common sense or author's feedback). In any case, the additional information that is provided by the annotations is an important and necessary input for the learning performed in the server. For example the information helps associating several event sequences with a certain goal, which in turn allows the server to generalise the pre, success and failure conditions for this goal.

## 4 Conclusion

In this paper we have discussed the ENIGMA authoring platform for collaborative authoring of emergent narratives. We have completed and are currently preparing the evaluation of a first version of the system, which consists of the authoring interface and the story collection server. This is also the version that will be demonstrated at ICIDS 2010. The usage data collected during this evaluation will help us completing the full system by adding the mixed initiative feature. We will then run another evaluation study of this second version and analyse differences between the two versions of the system.

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# Using Highly Interactive Drama to Help Young People Cope with Traumatic Situations

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**Abstract.** Traumatic brain injury (TBI) is a leading cause of disability and has a devastating impact on all family members. The goal of our project is to design, develop, and evaluate a pedagogical interactive drama to support uninjured youths aged 12 to 19 years who have a parent or sibling with a TBI. We used IDtension, a highly interactive drama engine, to develop a text-based interactive game, in which young users play the role of Frank, who has to prepare a dinner with Paul, his father, who suffers from a TBI.

**Keywords:** Interactive drama, Traumatic Brain Injury, e-learning, e-training, Narrative Simulation, Educational Games.

## 1 The Context: Traumatic Brain Injury in the Family

Traumatic brain injury (TBI) is a leading cause of disability and death worldwide. Moderate or severe TBI often has a devastating impact on all family members, in particular children or adolescents whose parent or sibling has been injured. Families can turn to different resources to help them cope but most resources target adult caregivers, rather than uninjured children or adolescents. The overall goal of this project is to design, develop, and evaluate narrative learning simulations that integrate educational materials for uninjured youths aged 12 to 19 years who have a parent or sibling with a TBI. This project will last 3 years and establish the feasibility and scientific, pedagogical, and technical merit of creating these narrative simulations designed to help uninjured youths understand and adapt to the reality of parental or sibling TBI, bolster their positive coping strategies, and prevent behavioral/emotional problems. The research has four main aims:

Aim 1 is to assess the psychological needs of uninjured youths faced with a parent or sibling's TBI. Informed by an existing theory of coping competence in children and adolescents [1], this assessment will rely on focus groups and on individual interviews with uninjured youths and parents.

Aim 2 is to deliver the educational materials created in Aim 1 by relying on a narrative interactive learning environment, in which youths play the role of virtual characters in short pedagogical stories, and to integrate these simulations on a web-based platform.

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Aim 3 is to collect qualitative and quantitative data to assess the suitability of the platform's contents and presentation, and to make adjustments in light of the data.

Aim 4 is to conduct an experimental study of the platform's efficacy.

This paper presents the first component of the platform, a text-based interactive drama based on an original short scenario developed from data collected in focus groups.

## 2 The Interactive Drama Engine: IDtension

To enable youths to role-play various situations related to their everyday life, we are using IDtension, a highly interactive drama engine (Szilas 2007). Fully developed in Java, IDtension's narrative management is characterized by the following distinctive features [2]:

- Atemporal structure: A story is not described as more or less pre-authored "chunks," such as events or scenes, but as an atemporal structure of goals, tasks, obstacles, and values.
- Second order actions: in order to obtain a large number of possible actions without increasing the authoring effort, actions are described according to a second order formalism. For example: inform(x,y,goal(z,g,u) means that a character informs another character that a third character has a given goal, with a fourth character as a parameter. It could produce the following dialog line: Olivia to Frank: "Did you know that Paul wants to cook with Sophie?" In the formula above, "inform", and "goal" are hardcoded, while x, y, z, u and g are variables that can take any authored-defined values. Hardcoded elements correspond to narratology-inspired fundamental actions and states.
- Model of the player: The action selection mechanism for Non Playing Characters (NPC) is based on a general model of the player's perception. Each action is evaluated according to a set of narrative criteria which ensure the global coherence of behaviors, the timely delivering of actions, the appropriate complexity of the story, and the maximization of dramatic conflict.

The IDtension user interface used in this demonstration is based on a previously developed history-based interface [3], which was redesigned specifically for this project.

## 3 The Scenario: The Simula Family

The scenario has been inspired by focus groups conducted with people who live with a family member suffering from TBI. It can be literary described as follows:

"Frank, 17 years old, is at home with his father Paul, his grandmother Olivia and his little sister Sophie. His mother Martina is still at work and has asked him to prepare the dinner. Frank is initially given three choices: prepare the dinner on hisown, prepare it with his father Paul or let Paul prepare it. Sophie and Olivia intervene from time to time to give their opinion on Frank's actions, and influence him. Sophie favors independence while Olivia favors collaboration. Paul often reacts abruptly and sometimes aggressively to Frank's actions. From time to time, the phone rings, which disturbs Frank. Frank, played by the user, is faced with situations in which he can collaborate or not with Paul. Collaborating creates some problems, but it is the only solution to the end of the scenario."

The scenario includes a structure of characters, goals, tasks and obstacles. An overview of this structure is represented in Figure 1.

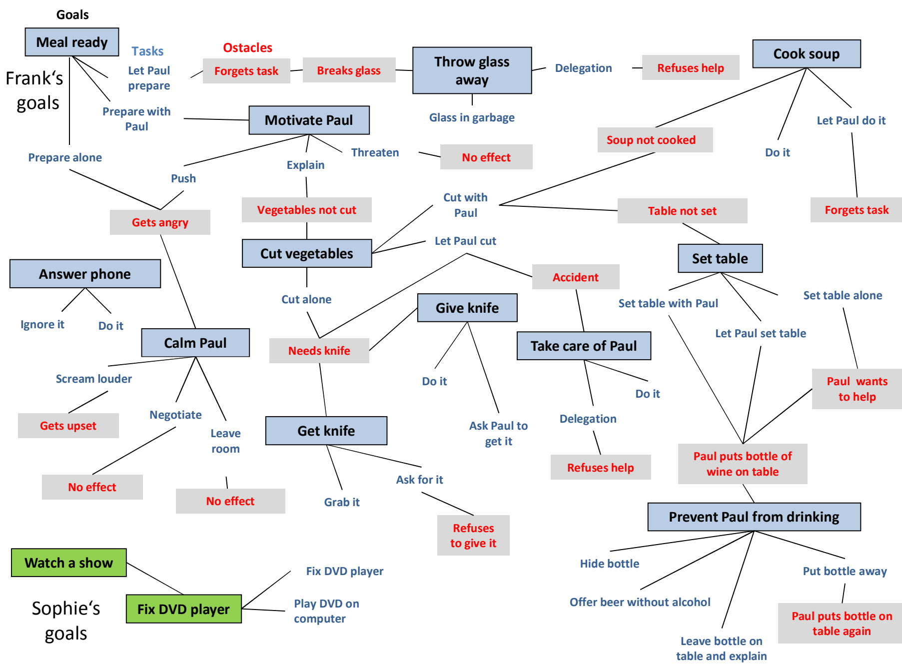


**Fig. 1.** Overall view of the scenario. Rectangles with borders are goals, texts are tasks, and grey rectangles without borders are obstacles.

The scenario was initially developed in French and later translated into English.

## 4 The User Experience

After a few introductory screens, the user is in the situation where his character has decided to prepare dinner. He has three ways to prepare dinner. He can either choose one of them, or interact with other characters to discuss these choices.

The user interface is reproduced on Figure 2. Colored text represents story actions from which other actions are proposed by the engine.


**Fig. 2.** IDtension user interface. Sophie has asked for help to fix the DVD player. Frank, the user, can accept or refuse to help his sister.

This scenario is designed to be complex, so that the user is overwhelmed by all that needs to be done to make dinner. It is not expected that the user will always finish the scenario. In its current implementation, the scenario will be monitored by a trained member of staff, who will stop the simulation after a while, and interact with the youth to find out about his/her experience (debriefing).

## Acknowledgements

This research is supported by a grant from the Swiss National Science Foundation (J. Dumas and N. Szilas, principal investigators).

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# Stories on a Sphere: Hyperglobes as Narrative Platforms for Global Geodata

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**Abstract.** The hyperglobe (HG) will be introduced both as a technological and a semiotic-communicative model. We will argue why and how concepts from the domain of digital storytelling can be used for developing authoring software for a HG (i.e. for a spherical display) and outline the HG's future potential as a narrative platform for multidisciplinary research.

**Keywords:** cartography, hyperglobe, spherical display, storytelling.

## 1 Introduction

Representing reality by means of maps defines the subject matter of cartography [1]. Why are cartographic representations necessary? Because they allow the user to experience his/her environment not just directly but also indirectly. Such indirect experience is, sometimes, the only experience possible, e.g.: if you want to know, how the Earth looks like (e.g. from outer space) you just can look at a map or a globe. The method of choice to represent cartographically has been the same for decades: the map. And although the concept *map* has been extended by digital and multimedia approaches [2], today's majority of digital or paper printed maps corresponds to the traditional idea of a map as an orthogonal (looking straight down) projection onto a plane [3]. This quite conservative practice may be due to shortcomings of cartographic theory, whose core concepts still root in the pre-digital era. From there, it is not surprising that cartographers picked up interactive digital storytelling (IDS) approaches just sporadically (e.g.: [4]). IDS, nevertheless, seems to be useful for cartographic concerns, based on a general fact: storytelling is about communicating experience and knowledge, and communicating (geospatial) knowledge is what cartography wants to do. That IDS is a relatively new area of research may explain why cartography and IDS didn't take much notice of each other so far. However, mutual acknowledgment can be of use to both sides, as the following discussion shall reveal. We will focus on a specific representation concept that seems to be well suited to emphasize the aforementioned two-way benefit, as it regards a scale level that is spatially and temporally accessible to humans only via indirect experience. This scale level is the global one and the chosen visualization concept is the hyperglobe (HG).

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## 2 From Globe to Hyperglobe

In cartographic textbooks, globes are hardly taken into consideration due to “many practical disadvantages. They are expensive to make, difficult to reproduce, cumbersome to handle, awkward to store, and difficult to measure and draw on” [3]. Such arguments could be countered by analogue globes just by one feature, namely their exclusive ability to represent global spatial relations (e.g. relative distances, areas and angles) without considerable distortions. Since the afore-mentioned disadvantages originate from the analogue nature of traditional globes, the rise of digital technologies has spurred new approaches to investigate implementation possibilities of non-analogue globes. Common attribute of these approaches is the digital character of the image that is being projected on a sphere. As such digital image allows to link global data on a reduced scale in terms of hyperlinks, Riedl [5] suggested the prefixoid *hyper-* to create a superordinate terminological concept for all forms of non-analogue globes. Thus, a hyperglobe (HG) can become a global information system for hypermedia. According to table 1, three types of non-analogue globes are available, namely *virtual hyperglobes*, *tactile hyperglobes* and *hologlobes*. Of these three types, only the two former are brought to the market so far.

**Table 1.** Typology of globes

| | **analogue globe** | **virtual hyperglobe** | **tactile hyperglobe** | **hologlobe** |
|---|---|---|---|---|
| globe body | *material* | *immaterial* | *material* | *immaterial* |
| image | *analogue* | *digital* | *digital* | *digital* |
| space | *real* | *virtual* | *real* | *real* |

Currently, nearly all existing examples of non-analogue globes are virtual hyperglobes (VHG). Applications like Google Earth are cited in the hundreds and downloaded in the hundreds of millions. Interestingly enough, the main reason for the dominance of VHGs is, at the same time, their main shortcoming: viewable on all common computer screens, they cut down on the original three-dimensionality of analogue globes. Therefore, the advantages of analogue globes compared with analogue maps are being diminished significantly, when a spherical 3D-model is projected onto a 2D-display: “The notion that virtual globes avoid the distortions of map projections is somewhat fallacious, of course, since images must still be projected onto the flat screen of the digital display“ [6]. THG systems [7] overcome this shortcoming, as shall be demonstrated subsequently by example of  a specific THG-system being (co-) developed by the HRG. Technically spoken, this THG is a mirror based, internal-projecting system, where digital images are projected onto an acrylic sphere in two steps. Step 1 comprises the projection from one or two video projector/s (labelled with (1) in fig.1) on a convex mirror inside of the sphere ((2) in fig.1). In step 2, this data is being reflected by the mirror and passes through the sphere's translucid surface ((3) in fig.1). As a result, the user faces a real 3D-representation of a 3D-object. Compared with other THG-systems, this approach offers a good compromise between high resolution and low space requirements.

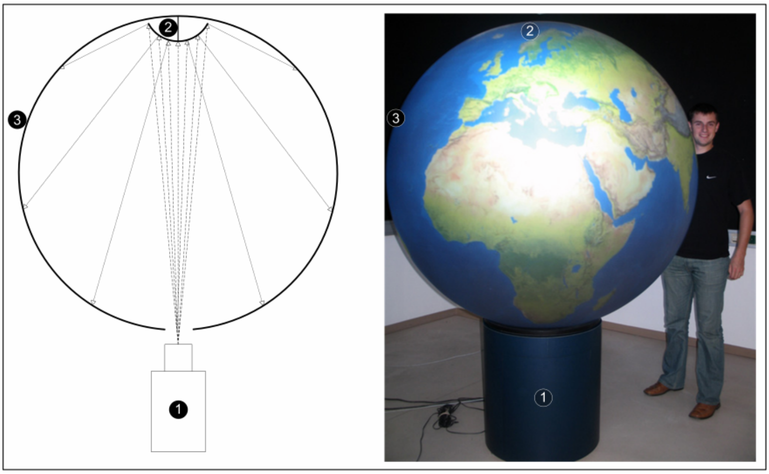


**Fig. 1.** THG with its main components: video-projector (1), mirror-system (2) and display (3)

## 3 Basic Elements of Global Stories – Stage and Cast

Against the background of chapter 2, we now address how storytelling can be implemented on a THG, starting our considerations by asking: "What is the narrative setting of a global story?" or, in other words: "Why is it necessary to translate between direct and indirect experience?" One answer is: *scale* – concretely, spatial and/or temporal scale. While temporal scale relates to past or future events, spatial scale refers to phenomena that evolve on a micro or macro scale beyond direct human perception. Globes imply spatial scale by definition while temporal scale is being added in dependence of the topic. Scale is, therefore, a narrative constant of visualizations on a THG. To further elaborate these constants via storytelling-strategies, some common structuring parameters of each narration apply, i.e. stage and cast (of characters). *Stage* of each THG-story is the spherical display itself, representing the signified object – in contrast to a map – in an iconic way, scaling down global dimensions on a level of human perceptual dimensions. Furthermore, the globe's spherical form determines a first parameter of interaction, namely *rotation*, which is necessary to perceive surface information of a 3D object. *Cast* of each THG-story are the themes that can be visualized and developed dramaturgically. As much as the stage, the cast members again are based upon sign characters – global phenomena can be learnt only via appropriate representations. To integrate stage and cast into a global story, the HRG is developing two software tools: Material Editor (ME) and Story Editor (SE). The ME's task is to elaborate the story's cast members. Technically, these cast members, i.e. the themes to be visualized, are textures being projected onto the sphere. All textures have to be parameterized with basic attributes, e.g. whether a cast member will act statically or dynamically. Furthermore, the ME allows setting the characters' mutual relationship and hierarchy (e.g. blending). Once the materials (i.e. the story's characters) have been prepared in the ME, stage directions are given in the SE, e.g. temporal instructions to indicate when a material or its attributes are to be changed.

By setting bookmarks, narrative structures can be developed both linearly and non-linearly, which enhances the story's interactivity level. Further characteristics (e.g. rotational speed and axis) can be modified for each moment of the story. Finally, if the stories are to be told in a rather multi-modal way, audio commentaries and video presentations on external (2D) displays can be added.

## 4 Conclusion and Outlook

The software outlined above features plenty of tools to realize IDS on spherical displays. Best practise examples can be found in museums and science centres. However, severe shortcomings of the status quo cannot be overlooked. Main problem is the limited interactivity on all levels of the aforenamed storytelling process, which is, on the one hand, due to hard- and software performance restrictions. On the other hand, theoretic and methodic deficits have to be mentioned: We don't just have to know, how we *can* bring IDS on a spherical display but also, if and how we *shall* combine IDS and THG-systems. Open questions are, e.g.: Do different visualizations cause different mental representations (e.g. 2D-maps vs. 3D-globes)? Do direct and indirect sources of (mental) representations require different narrative strategies? How to extend the scope of THGs from scientific visualization to stories of edutaining or even entertaining character, e.g. as global stories in the form of strategy games? Since these questions concern the whole IDS-research area, answering them with a comprehensive theory should be in the interest of all disciplines participating in the IDS-agenda. Although the IDS-community is traditionally a *multi*-disciplinary one, more *inter*-disciplinary crosslinks may be useful as well. That such crosslinks also can lead to cartography and produce interesting IDS-applications is what we have tried to foreshadow in this paper.

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# Users and Evaluation of Interactive Storytelling

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**Abstract.** The manuscript includes information about the objectives, methods, participation requirements and references for the Users and Evaluation of Interactive Storytelling at the 3rd International Conference on Interactive Digital Storytelling – Edinburgh 2010.

**Keywords:** User engagement, Interactive Storytelling, Evaluation.

## 1 Introduction

Interactive Storytelling (IS) is a multi-disciplinary research domain, which has attracted a lot of interest amongst scholars in recent years. However, despite a very strong activity towards specific aspects of IS (e.g. development of tools, applications and systems); the field is still to publish seminal work on connecting the notions and concepts of IS to users' experiences. We are yet to investigate the cognitive, emotional and behavioral aspects of IS and establish the relationship between users and interactive narratives, their constituent parts, and consumption. This knowledge gap is a sensitive issue and hinders the field's potential to move forward and produce further meaningful advances on interactive narratives' design. It is difficult to see how the IS medium can be popularized and spread across genres and media without a clear understanding and assessment of the way in which audiences react to it. The main purpose of this workshop is to bring the study of users' experiences of interactive stories to the forefront of the IS research agenda. Our approach is to investigate IS from a user's perspective and work towards the identification of the variables, dynamics and methods contributing to understand the user/medium relationships.

## 2 Objectives

The main purpose of the workshop is to advance in the definition of a useful model for measuring user's reaction to interactive narratives. In order to do so, a number of

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significant variables need to be identified so as to quantify and explain the user experience in consuming IS productions. The workshop will investigate a wide range of discipline so as to identify specific and appropriate techniques, procedures and methods for properly measuring the experience and its effects on receivers. We outlined three factors towards a model of users' narrative: narrative (a), formal (b), and decisions (c). These aspects will form the basis for discussions at the workshop. Factor (a) (narrative) concerns the variables that reception studies have largely considered to be meaningful in describing the user experience's of audiovisual narratives: engagement [1], presence [2], perceived realism [3], and identification with characters [4]. Also, we take into account the contributions of narratology researchers, whom relate the structure of the stories with its perception [5, 6]. Factor (b) (formal) focuses on elements derived from the audiovisual and interactive representation of stories, like visual communication [7] and reception [8], audiovisual cues [9], formal structures [10], production pace [11] or physical interfaces [12]. Finally, factor (c) (decisions) is variables used in different domains (as psychology, sociology or artificial intelligence) to explain decision-making.

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# Workshop: Education in Interactive Digital Storytelling

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## Workshop Abstract

The last 10 years of research in the domain of Interactive Digital Storytelling have led to several advanced systems [1], often based on Artificial Intelligence, which have been demonstrated on stories usually created by the systems' inventors themselves. To leverage the potential of these systems and to create more and particularly more compelling interactive narratives, it is essential to involve experienced story creators as authors. These authors often have an intermediate level of creative experience in some storytelling discipline, as well as certain knowledge of information technology. However, they may lack the technical and conceptual knowledge that is necessary to grasp the complexity of the systems produced by research groups. This explains why few of them have dared to write stories for the above mentioned systems. On the other hand, current storyworld creation by engineers lacks the conceptual knowledge of creative principles for narrative and drama.

One of the responses to this issue is to improve the access of existing systems to authors; another one consists in educating authors in Interactive Digital Storytelling, both at the general level of principles and at the specific level of a given engine. The latter approach is targeted by a tutorial [2] at the same conference. Further experiences and other approaches of education for story- and/or engine creators shall be shared in this workshop. Within advanced University courses, video game schools, interactive writing curricula, art schools, digital storytelling training sessions etc., students are currently taught in narrative writing and future interactive story technologies for games and digital media. However, while interesting and innovative approaches exist, there is limited opportunity of sharing experiences and also of reusing educational material across disciplines.

This workshop [3] aims at sharing knowledge, approaches and experiences in teaching Interactive Digital Storytelling. It brings together fellow colleagues and members of the Interactive Storytelling community with a commitment in IS- / Games education or in interdisciplinary projects. It is the starting point of building a community for knowledge sharing between different disciplines (arts and computer science), as well as for exchanging and creating educational material. The workshop consists of participant contributions and open discussions. Its outcome contributes to the building of a repository of educational material, managed by the IRIS Network of Excellence [4].

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## Acknowledgements

This work has been funded (in part) by the European Commission under grant agreement IRIS (FP7-ICT-231824). [4]

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# Interactive Stories for Health Interventions

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## 1 Motivation

In recent years, there has been an increasing interest in exploring virtual environments and computer aided interactive stories as tools in developing health promotion and disease prevention interventions. Applications have been developed to address a range of health related conditions, including stress [1], risky behaviors [2] and post-traumatic stress disorder(PTSD) [3].

Compared to conventional intervention techniques, which usually require face-to-face interactions with clinicians, computer aided interactive stories have several advantages. They are less expensive to the user. The user can access the materials at any time and from his/her convenient locations. The privacy provided by computer aided interventions can help engage the user more efficiently. People who are suffering from mental health conditions often do not actively seek treatment because of the perceived stigma. Interacting with a computer program can make them feel less embarrassed and more in control.

Moreover, story itself is a powerful tool to teach and change people's behaviors. The support of interactivity makes interactive stories even more powerful by allowing the user to experience and learn in context. Further, the story, and intervention messages, can be tailored based on user profiles and the user's patterns of interaction within the intervention.

## 2 Workshop Aims and Objectives

The main purpose of this workshop is to promote interdisciplinary research and collaborations on using interactive stories for health intervention.

Research in this field comes from a diverse community, e.g. games, digital art, AI, communication, and health practitioner. This workshop will provide an opportunity for discussions and exchange of ideas, experience and research results. We hope to bring together researchers with different backgrounds, present the state-of-the-art work in the field, discuss the challenges they face, and recommend approaches that might most effectively enable them to address those challenges.

The format of the workshop includes a combination of presentations and interactive discussions. The topics are grouped into three major areas as listed below.

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- The state of the art
  - Existing or proposed interventions
  - Effectiveness of the interventions
  - Challenges faced
  - Possibility of transferring existing techniques to a new domain
- Technological challenges
  - Hardware and software requirements
  - Integration of AI, art and technology
  - Steps in creating interventions using interactive storytelling
- Combine interactive stories with conventional methodologies
  - The role of interactive stories in the patient's treatment process
  - Risks associated with computer aided interventions

We hope the presentations and discussions will help further explore the potential of interactive stories for health interventions and enable a better understanding of the challenges faced in designing such interactive stories.

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# Towards a Shared Vocabulary for Interactive Digital Storytelling

## A Workshop at ICIDS 2010

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**Abstract.** As a new research domain matures, it becomes increasingly important for researchers to agree on a shared vocabulary. For researchers in Interactive Digital Storytelling, this is a particular challenge, because researchers come from many different domains and bring their own terminology with them. This workshop exposes and explores the differences in meaning and terminology of key terms such as "story" in different academic disciplines related to Interactive Digital Storytelling. In order to minimize confusion and misunderstandings in the academic discussion within the field and with outside disciplines, the workshop explores ways towards a shared vocabulary for Interactive Digital Storytelling.

**Keywords:** Interactive Digital Storytelling Theory and Practice, Shared Vocabulary, Key Terms, Story, Narratology, Digital Media.

## 1 Overview

A pressing issue in Interactive Digital Storytelling is the diversity of theoretical concepts and associated critical terminology, which are used to describe and think about digitally mediated forms of interactive narrative. Scholars and practitioners in the interdisciplinary area of Interactive Digital Storytelling come from many different academic backgrounds, each of which has developed its own critical vocabulary with specific definitions. Researchers originally trained in a specific field often continue to use the terminology they are familiar with, sometimes unaware of the potential misunderstandings that may arise. As a consequence, both the internal discussion amongst scholars and practitioners in the field of Interactive Storytelling Design and

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the external one with researchers from more traditional fields within the humanities and computer sciences have become difficult and prone to terminological misunderstandings. Some terms – such as "story" – seem especially ambiguous and tend to change their specialized meanings according to the disciplinary context: literary scholars, semioticians, game designers and researchers in interactive narrative and in artificial intelligence all understand them in quite different ways. A few more examples of controversial notions to be examined by this workshop are narration, narrativity, game, play, meaning-making, embodiment, point of view, competition and cooperation.

The workshop is a follow-up to the workshop "Do we need a new narratology for interactive digital storytelling?" held at ICIDS 2009. That workshop presented different theoretical perspectives on interactive digital storytelling based in semiotics, meta narrative, games studies, and an independent theory of digitally mediated interactive narrative. In their concluding remarks, participants expressed their appreciation of the workshop, but lamented the lack of a shared vocabulary, which would have made discussions more productive. The current workshop picks up at this point to explore and discuss ways towards such a vocabulary.

## 2 Workshop Format

The workshop will be a full-day workshop in order to allow ample time for discussion of these complex topics in terms of theory as well as practice.

The workshop will start by reviewing some particularly ambiguous terms – such as story – and the specialized meaning of such terms according to the disciplinary context: literature, semiotics, game design and research in interactive narrative and artificial intelligence. Other examples of terms to be put before this workshop are: plot, narration, game, process, media, embodiment and point of view. To start the concrete discussion, the organizers will apply the terms to three key works of interactive digital storytelling that will serve as a mini-corpus of works by which to judge design terminology throughout the workshop.

As a next step the workshop will create a mind map of concepts and disciplines connected to interactive digital narrative and identify areas of overlap and especially contended concepts. After the lunch break, the workshop will split up in groups led by the organizers and discuss possible avenues for establishing a shared vocabulary. This session will revisit the examples presented earlier and attempt to find common ground amongst the different approaches or argue for a new terminology. All participants will gather again after a coffee break and the results of the groups' discussions will be presented to all. Next, a panel of invited experts will react to the results and present their take on the problem. Finally the organizers will wrap up the workshop.

# Storytelling within an Internet of Things

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**Abstract.** The movement from a screen based experience of the internet to one in which everything is connected in the actual world is slowly becoming a reality. The advent of smart phones and data free contracts has provided a cultural context in Europe in which society will begin reading and writing stories to objects of their own. Digital Storytelling methodologies are required to understand how narratives between objects can be constructed as individual objects become connected with others. This workshop proposes research methods to carryout case studies and methods to understand the relationship between the objects and the participants. The implications for the knowledge to support this cultural / technical revolution are widespread – in particular of industry, but also leisure and the arts. We hope that storytellers, academics who are interested in social computing, and programmers will be interested in the workshop.

**Keywords:** Internet of things, Culture, stories and memories, object and artifacts, methods.

## 1 Description of the Workshop

This workshop is concerned with exploring the implications for digital storytelling methodologies as society moves toward an 'internet of things'. The term, 'internet of things', refers to the technical and cultural shift that is anticipated as society moves to a ubiquitous form of computing in which every device is 'on', and every device is connected in some way to the internet. The specific reference to 'things' refers to the concept that every new object manufactured will be a part of this extended Internet, because they will have been tagged and indexed by the manufacturer during production. It is also envisaged that consumers will have the ability to 'read' the tags through the use of mobile 'readers' and use the information connected to the object, to inform their purchase, use and disposal of an object. Digital Storytelling methodologies are required to understand how narratives between objects can be constructed as individual objects become connected with others. The implications for the knowledge to support this cultural / technical revolution are widespread – in particular of industry, but also leisure and the arts.

As well as facilitating logistical procedures in the manufacturing and production/consumption industries such as attaching tracking data to objects, the same

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echnology offers the opportunity for the public to attach stories to objects. This workshop will provide a critical context in which participants will be asked to explore the theoretical and practical implications for the retention, recall and construction of stories when they become associated with physical artifacts.

The workshop is offered by academic partners involved in a large EPSRC funded project that has been researching the potential of the technology to conserve social history. Whilst the technology at present is effective at recalling individual stories the team are interested in how discrete instances of stories can be associated with other stories to construct larger narratives. As more and more objects in daily life become tagged and connected to the internet, the potential for linking the data behind each object to other artifacts increases. This linkage offers a rich space and new space for digital storytelling.

Delegates are asked to bring something along with them that become part of a series of props in a story.

The object will be tagged with a QR paper tag and the story retrieved by an iPhone / Android app.

**Chairs:**

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## PROGRAM COMMITTEE

The workshop is delivered by Dr. Chris Speed and Arthi Kanchana Manohar, however it is convened by the Co-Investigators on the TOTeM research project: Maria Burke, The University of Salford, Andrew Hudson-Smith, University College London, Angelina Karpovich, Brunel University, Simone O'Callaghan, The University of Dundee, Jon Rogers, The University of Dundee, Chris Speed, (PI) Edinburgh College of Art.

# Just Another Tool for Interactive Digital Storytelling?

## A 1-Day Workshop on Korsakow

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**Abstract.** Korsakow is an open source program that can be used to create nonlinear films following a structure whose foundation is heavily keyword-oriented. An intuitive interface design and a compelling story are key in creating interactive digital stories. We believe that Korsakow offers opportunities for the creation of intuitive interfaces. We also believe that the type of treatment of discrete (linear) stories offers opportunities for compelling interactive narratives.

With this in mind, we designed a workshop in which the participants create an interactive story, based on discrete movies that they will shoot on site and on keyword-based systems that they will design in creative ways. More than simply offering a context in which to explore the tool, we wanted to draw on the knowledge capital offered by the participants concerning other tools in this area.

**Keywords:** interactive digital storytelling, IDS, Korsakow, interactive fiction, interactive narrative.

## 1 Context

Interactive narratives can be grossly labeled as fictional narrative, experimental, documentary or archival [1]. On the other hand, while the foci of the industry have been fictional narrative (in the form of games) and to a less extent archival and documentary titles, all four genre have been pursued by the academia.

We are at a crucial point in the IDS field where many will argue that we have yet to create the first compelling interactive story (for a timely and insightful discussion of the subject, see [2]) . On the other hand, those in the game industry have realized that they are close to the top of the production curve in what concerns technological sophistication (e.g. augmented reality) or characters' realism and that if the narrative is no good, no special effect will save the (interactive) story.

## 2 Description / Program

**Workshop website**: http://www.mediashots.org/wk_edinburgh2010

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- 1. Introduction: Screening of several Korsakow movies on the web — Readability of the pieces seen: opportunities and challenges offered by the software (discussion of design, aesthetic, and info architecture strategies).
- 2. The software: the interface — parts of a Korsakow movie — snoo-ifying.
- 3. The Project: Installing the software; discussion of the documents that were posted on the workshop website prior to ICIDS 2010 — group assignment (field work) — screening the pool of SNUs created; creating the movie: Snoo-ifying — finalizing the interactive movie, following an iterative process.
- 4. Group discussion: the value of Korsakow and similar tools for interactive storytelling — creating an ICIDS SIG on Korsakow (interest, feasibility, coordination with the software creators) — what can the ICIDs community do for and / with the Korsakow community?

## 3 Final Considerations

We believe that Korsakow offers opportunities for the creation of intuitive interfaces. The movies created by the creator of the program Florian Thalhofer, as well as other movies on the official site illustrate this well [3] [4]. In this workshop, more than teaching how to use the tool, we wanted to hear the participants' thoughts on the relevance of such a tool in the current - somewhat grim - panorama of interactive storytelling that we described at the beginning of this paper. We geared the discussion towards (1) identifying strategies for increasing the depth and clarity of each 'reading' of the final piece and (2) assessing how well the process of creation of an interactive movie from discrete movies maps to the final story from a visual and conceptual point of view.

## Acknowledgements and Disclaimer

The authors wish to thank Florian Thalhofer and Matt Soar for the feedback, the support and for their participation in the webcast during the workshop. The authors have not participated in the creation of the tool in any way. All credits go to Thalhofer and Soar, as well as to programmers David Reisch, Stuart Thiel, and Gabriel Gosselin.

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# Tutorial: Introduction to Interactive Story Creation

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## Tutorial Abstract

In the IRIS network of excellence [1], one work package ("Authoring Tools and Creation Methods") has been tackling accessibility issues of highly-interactive and generative Interactive Storytelling (IS) systems for story creators. While one problem is a current lack of well-designed tools, which needs improvement, the other side of the medal is that nevertheless, prospective interactive storyworld creators need basic knowledge in the currently available approaches. With the vision in mind that in the future, complex IS projects will be accomplished by an interdisciplinary team, future authors do not need to program a story engine, but they would indeed need to know about the characteristics of content conceptualization, knowledge modeling and forms of abstraction, which then are used in a collaborative production process with engineers.

The tutorial covers basics of conception and processing of interactive stories. That way, it can also serve as a general introduction to Interactive Digital Storytelling. It focuses on creative principles that are different from traditional ways of storytelling, and further briefly explains specific approaches of selected story engines with short insights into practical examples. This material has been compiled during the year 2010 by the IRIS project, in an attempt to produce educational material for authors of Interactive Storytelling, in particular in genres using highly-interactive and generative story engines. It also draws from experiences of authoring workshops at previous conferences [2, 3]. The practical showcases include story engines with previously created example storyworlds from the IRIS project.

The tutorial presents a subset of the material developed, offering information sharing and evaluation of its scope, presentation quality and understandability. In the limited time given, it zooms in on the discussion of two creative principles:

- Story abstraction and modeling of an interactive storyworld
- Conditional acting situations and making use of planning

Further creative principles for IS are outlined as an overview. Information on the complete material is made available on the IRIS website [4]. Further links are given on the Tutorial website [5].

R. Aylett et al. (Eds.): ICIDS 2010, LNCS 6432, pp. 299–300, 2010.

## Acknowledgements

This work has been funded (in part) by the European Commission under grant agreement IRIS (FP7-ICT-231824). [1]

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